1 Which quantity is **not** a base quantity?

A temperature
B electric charge
C electric current
D amount of substance

2 The base units of Planck's constant are

A $kgms^{-2}$.
B $kgm^{-1}s^{-2}$.
C $kgm^{2}s^{-1}$.
D $kgsm^{-1}$.

3 Which statement is correct about the resultant force acting on a mass undergoing uniform acceleration?

A It increases uniformly with respect to time.
B It is constant but not zero.
C It is proportional to the displacement from a fixed point.
D It is proportional to the velocity.

4 Which quantity remains constant for an orange falling from a tree?

A velocity
B displacement
C acceleration
D speed

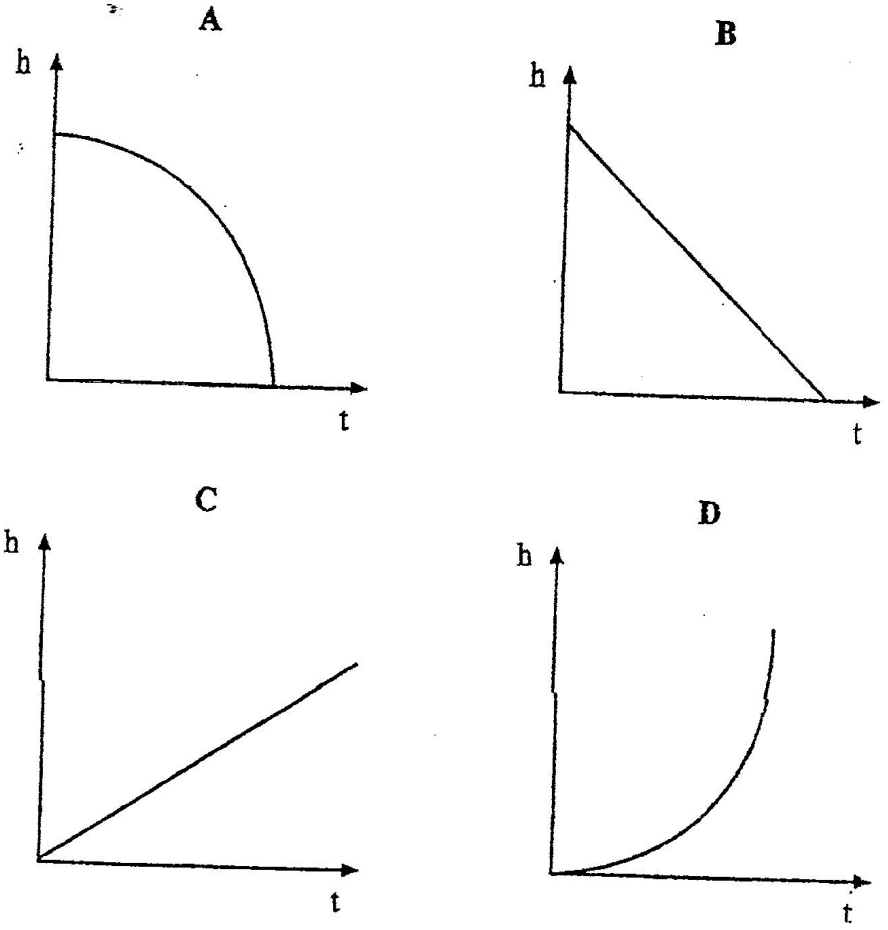
5 Which one is **not** a condition for static equilibrium?

A Forces form a closed system.
B Algebraic sum of moments is zero.
C Resultant force is the hypotenuse of a right angled triangle.
D Algebraic sum of the resolved components of force is zero.

6 Which quantity increases when a satellite moves to a higher orbit?

A angular velocity
B centripetal acceleration
C gravitational potential energy
D linear speed

7 Which graph shows variation of height h with time t for a dislodged brick falling from a tall building?



8 A 1 tonne car travelling at 30 ms^{-1} East, collides with a 2 tonne truck travelling and 20 ms^{-1} West.

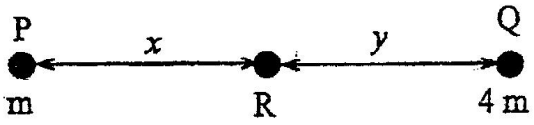
What is their speed after collision if they move off together?

A 23.8 ms^{-1}
B 23.3 ms^{-1}
C 10 ms^{-1}
D 3.3 ms^{-1}

9 When a 320 Hz key of a piano is struck the 640 Hz and 960 Hz will also vibrate. This is because they

A are in phase.
B resonate.
C are parallel.
D need damping.

10 The diagram shows two particles P and Q of mass m and 4m respectively in a gravitational field.



What ratio of $\frac{x}{y}$ would make the gravitational field strength at R due to the two masses equal?

A $\frac{1}{4}$

B $\frac{1}{2}$

C 2

D 4

11 Which process is **not** associated with sound waves?

A Polarisation.
B Diffraction.
C Interference.
D Reflection.

12 An example of a longitudinal wave is

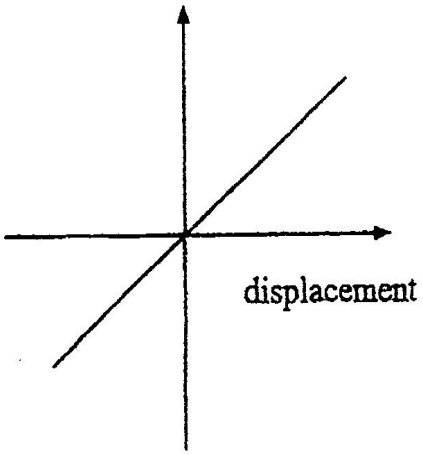
A a light wave travelling through air.
B a radio wave from a broadcasting station.
C a ripple on the surface of water.
D a sound wave travelling through air.

13 In a progressive wave

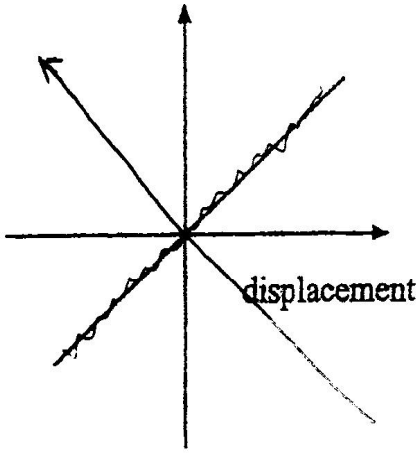
A neighbouring points are in phase.
B neighbouring points have different amplitudes.
C energy is not transferred along the direction of propagation.
D the wave profile moves in the direction of propagation.

14 Which graph shows how acceleration of a body executing simple harmonic motion varies with displacement from the centre of path?

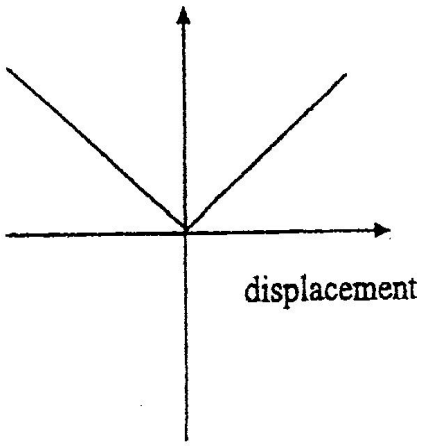
A



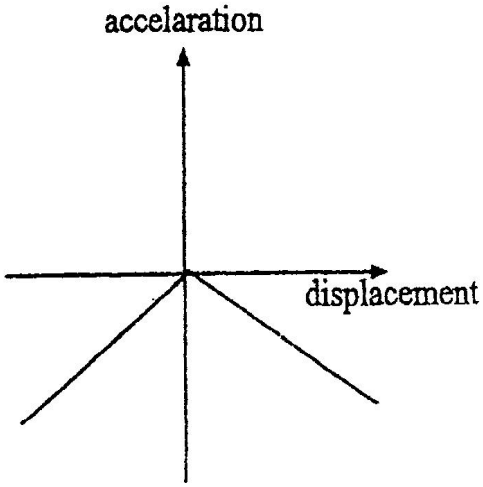
B



C



D



15 Which list of waves is in order of decreasing frequency?

A gamma trays, visible light, infrared radiation
B radio waves, X rays, gamma rays
C infrared radiation, radio waves, gamma rays
D gamma rays, visible light, ultra violet radiation.

16 Fringes of separation y are observed on a screen 1.20 m from a Young's slit arrangement that is illuminated by yellow light of wavelength 600 nm.

At what distance from the slits would fringes of the same separation y be observed when using blue light of wavelength 400 nm.

A 0.56 m
B 0.80 m
C 1.25 m
D 1.80 m

17 Which statement is true for two coherent monochromatic light waves incident at a point on a screen?

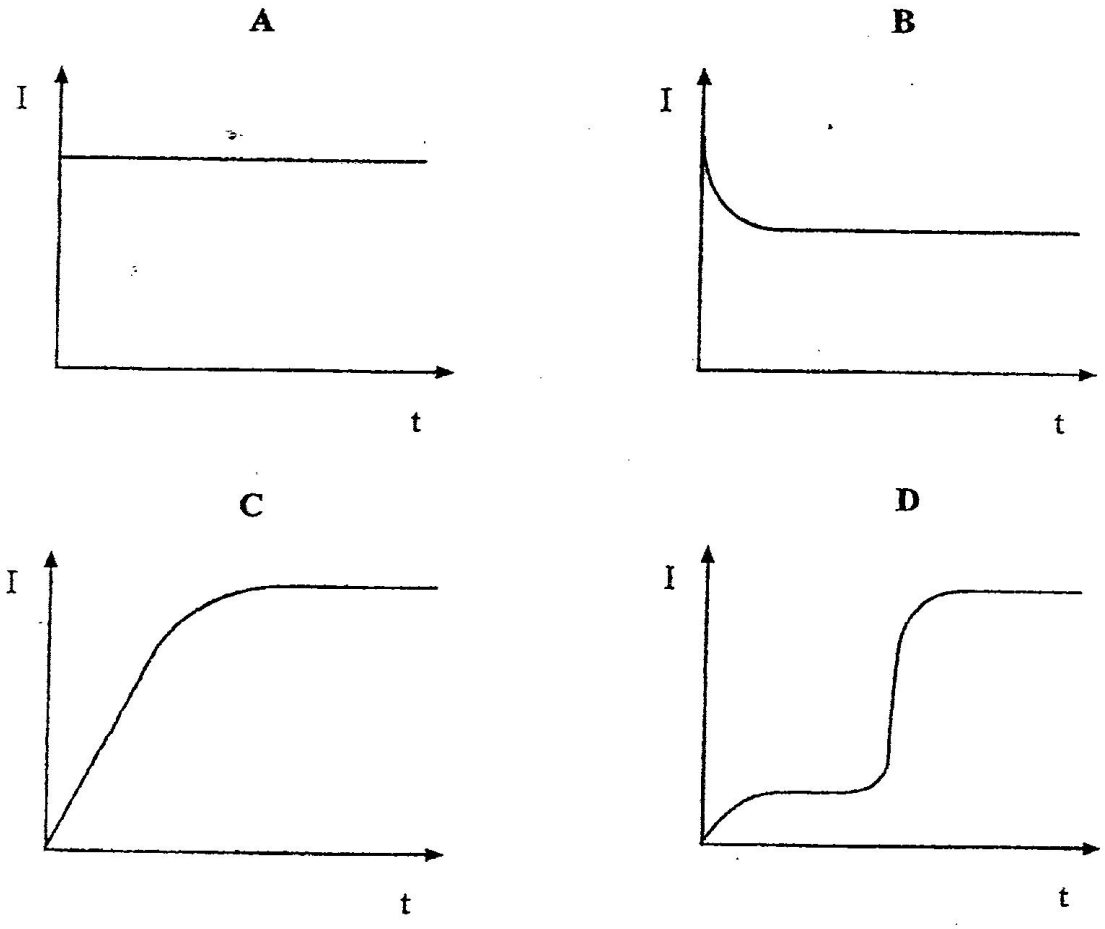
A They have a constant phase difference.
B They have the same optical path.
C They have almost the same amplitude.
D They produce constructive interference.

18 A generator produces 100 kW of power at a potential difference of 10 kV. The power is transmitted through cables of total resistance 5 Ω.

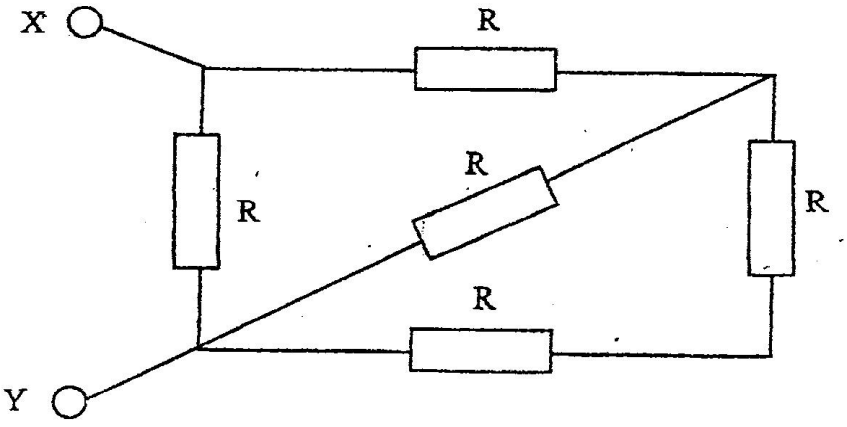
What is the power loss in the cable?

A 0.05 W.
B 20 W.
C 500 W.
D 2×10^7 W.

19 Which graph best shows the variation with time t, of current, I, in a tungsten filament lam



20 The diagram shows a network of identical resistors.



What is the effective resistance between the points X and Y.

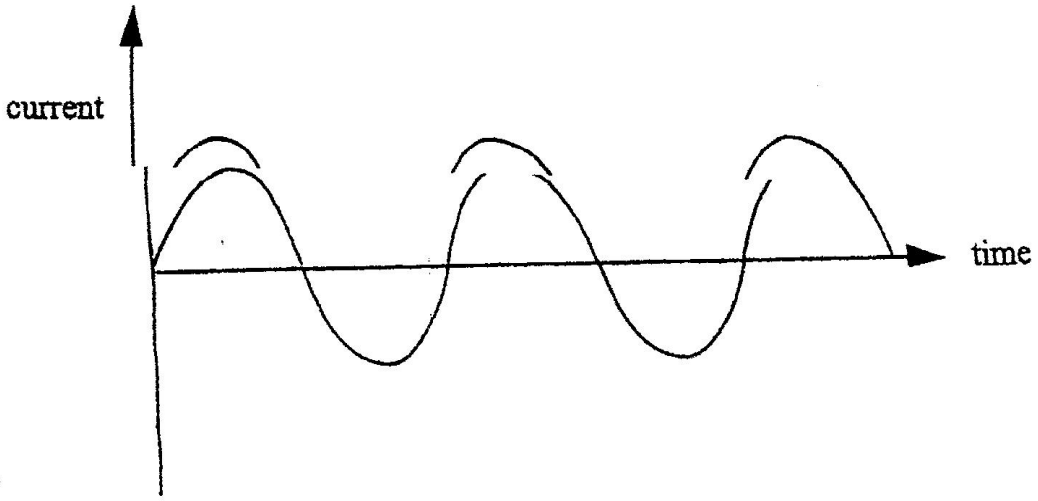
A $\frac{2}{7}$ R

B $\frac{1}{5}$ R

C $\frac{5}{8}$ R

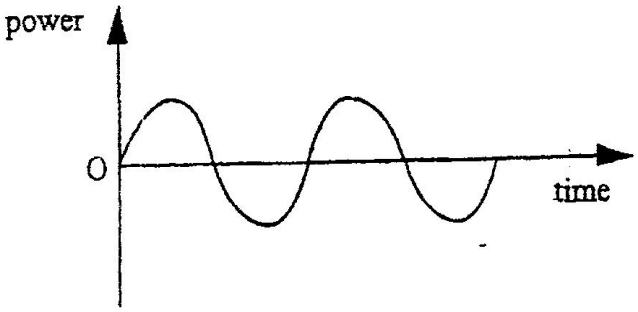
D R

26 The graph shows the variation with time of a.c through a resistor.

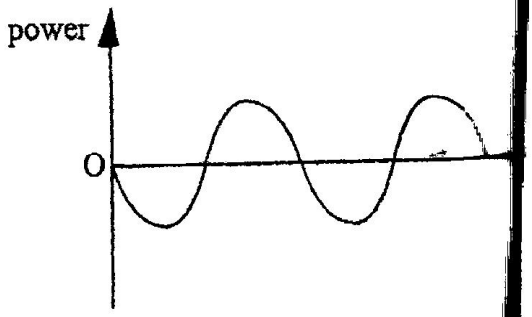


Which graph shows the approximate variation with time of power dissipated in the with time?

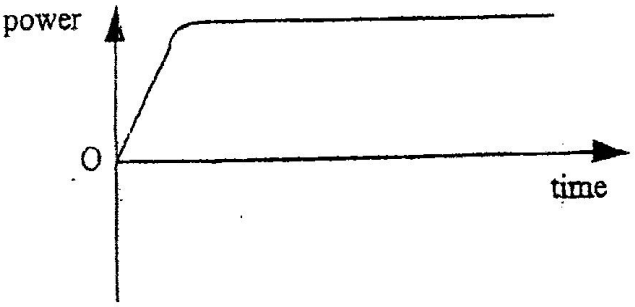
A



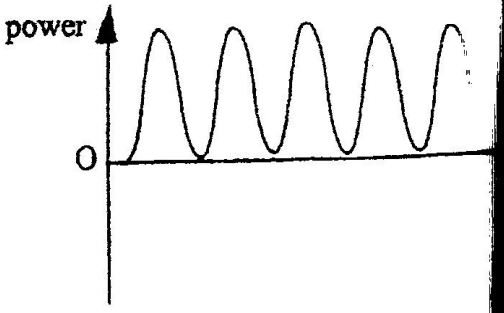
B



C



D



27 An ideal operational amplifier does **not** have

A high output impedance.
B high gain.
C infinite bandwidth.
D high slew rate.

39 An isotope is said to have a half-life of 6 years. This means that

A after 1 year $\frac{1}{6}$ of the isotope has decayed.
B after 1 year $\frac{1}{6}$ of the isotope remains undecayed.
C after 12 years $\frac{1}{4}$ of the isotope as decayed.
D after 12 years $\frac{1}{4}$ of the isotope remains undecayed.

40 Which statement is not correct about α-particles?

A They are deflected by electric and magnetic fields.
B They are stopped only by a few mm of aluminium.
C They have the highest ionizing power.
D They are helium nuclei.

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

MARKING SCHEME

JUNE 2009

PHYSICS 9188/1

1	B	21	C
2	C	22	A
3	B	23	D
4	C	24	C
5	C	25	D
6	C	26	D
7	A	27	A
8	D	28	B
9	B	29	A
10	B	30	C
11	A	31	C
12	D	32	A
13	D	33	D
14	B	34	A
15	A	35	B
16	D	36	B
17	A	37	A
18	C	38	B
19	B	39	D
20	C	40	B

Candidate Name	Centre Number	Candidate Number

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS 9188/2

PAPER 2

JUNE 2009 SESSION 1 hour 15 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
For numerical answers, **all** working should be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	

This question paper consists of 12 printed pages.

[Turn over

Data

speed of light in free space,	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7}\ \mathrm{H\,m^{-1}}$
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12}\ \mathrm{F\,m^{-1}}$
elementary charge,	$e = 1.60 \times 10^{-19}\ \mathrm{C}$
the Planck constant,	$h = 6.63 \times 10^{-34}\ \mathrm{J\,s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27}\ \mathrm{kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27}\ \mathrm{kg}$
molar gas constant,	$R = 8.31\ \mathrm{J\,K^{-1}\,mol^{-1}}$
the Avogadro constant,	$N_A = 6.02 \times 10^{23}\ \mathrm{mol^{-1}}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23}\ \mathrm{J\,K^{-1}}$
gravitational constant,	$G = 6.67 \times 10^{-11}\ \mathrm{N\,m^2\,kg^{-2}}$
acceleration of free fall,	$g = 9.81\ \mathrm{m\,s^{-2}}$

Formulae

uniformly accelerated motion, $s = ut + \frac{1}{2}at^2$
$v^2 = u^2 + 2as$

work done on/by a gas, $W = p\Delta V$

gravitational potential, $\phi = -\frac{Gm}{r}$

refractive index, $n = \frac{1}{\sin C}$

resistors in series, $R = R_1 + R_2 + \ldots$

resistors in parallel, $1/R = 1/R_1 + 1/R_2 + \ldots$

electric potential, $V = \frac{Q}{4\pi\epsilon_0 r}$

capacitors in series, $1/C = 1/C_1 + 1/C_2 + \ldots$

capacitors in parallel, $C = C_1 + C_2 + \ldots$

energy of charged capacitor, $W = \frac{1}{2}QV$

alternating current/voltage, $x = x_0 \sin \omega t$

hydrostatic pressure, $p = \rho gh$

pressure of an ideal gas, $p = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$

radioactive decay, $x = x_0 \exp(-\lambda t)$

decay constant, $\lambda = \frac{0.693}{t_{\frac{1}{2}}}$

critical density of matter in the Universe, $\rho_0 = \frac{3H_0^2}{8\pi G}$

equation of continuity, $Av = \text{constant}$

Bernoulli equation (simplified), $p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$

Stokes' law, $F = Ar\eta v$

Reynolds' number, $R_e = \frac{\rho v r}{\eta}$

drag force in turbulent flow, $F = Br^2\rho v^2$

Answer all questions.

1 (i) Define the term

1. *systematic error,*

_____

_____

2. *random error.*

_____

_____

(ii) Give **one** example of each.

1. systematic error _____

2. random error _____

[4]

2 (a) Define the term *momentum.*

_____

_____ [1]

(b) (i) State Newton's law concerned with momentum.

_____

_____

(ii) Use the above stated law to derive the defining equation F = ma.

[5]

For Examiner's Use

(c) A snooker ball of mass m_1 and velocity u_1 collides with another ball of mass m_2 and velocity u_2 as shown in **Fig. 2.1.**

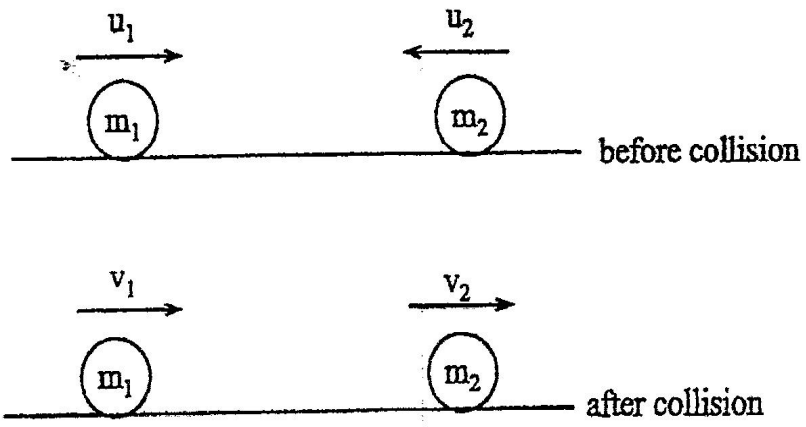


Fig. 2.1

(i) If the velocities after collision are v_1 and v_2 respectively, give an expression for the conservation of momentum for the snooker balls.

_____

_____

(ii) State the condition under which the principle of conservation of linear momentum holds

_____

_____ [2]

3 (a) Define *gravitational field strength* and state its units.

_____

_____

_____ [2]

For Examiner's Use

(b) Fig. 3.1 shows a planet of radius 5.6×10^6 m with gravitational field strength of 15 Nkg^{-1} at the surface.

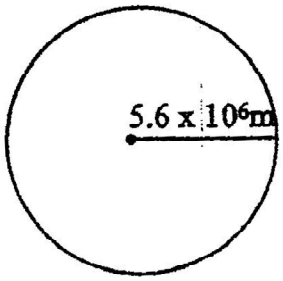


Fig. 3.1

(i) Add on **Fig. 3.1** a set of

1. solid lines to represent the gravitational field of the planet,
2. dotted lines to represent points of equal potential.

(ii) Calculate the mass of the planet.

[4]

4 (a) Distinguish between transverse waves and longitudinal waves.

[2]

(b) State **three** conditions required for two progressive waves to form a stationary wave.

1. _____

2. _____

3. _____ [3]

5 **Fig. 5.1** is a network of resistors connected to a 6.0 V battery of negligible internal resistance.

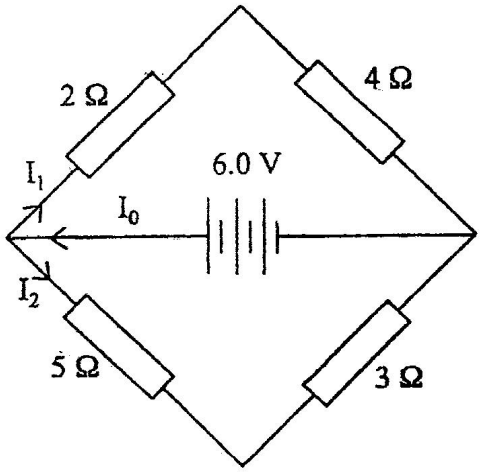


Fig. 5.1

Determine

(i) the effective resistance for the circuit,

Effective resistance = _____

(ii) current

1. I_o,

2. I_2.

[6]

For Examiner's Use

6 (a) Define the root-mean-square value of an alternating current.

[1]

(b) A bulb is marked "100 W, 240 V_{rms}", determine the

(i) mean power,

(ii) the maximum power for the bulb.

[2]

(c) Electric power is transmitted as alternating current and at high voltages.

Explain the advantage of using

(i) alternating current,

(ii) high voltages.

[3]

7 (a) State **four** properties of an ideal opamp.

1. _____

2. _____

3. _____

4. _____ [4]

(b) Give **two** advantages and **one** disadvantage of negative feedback.

advantages

1. _____

2. _____

disadvantage

_____

_____ [3]

(c) Draw an EX-OR gate constructed using NAND gates only.

[1]

8 (a) Explain the term

(i) *lamina flow,*

_____

_____

(ii) *incompressible flow.*

_____

_____ [2]

For Examiner's Use

(b) Fig. 8.1 shows a diagram used to investigate the flow of a liquid.

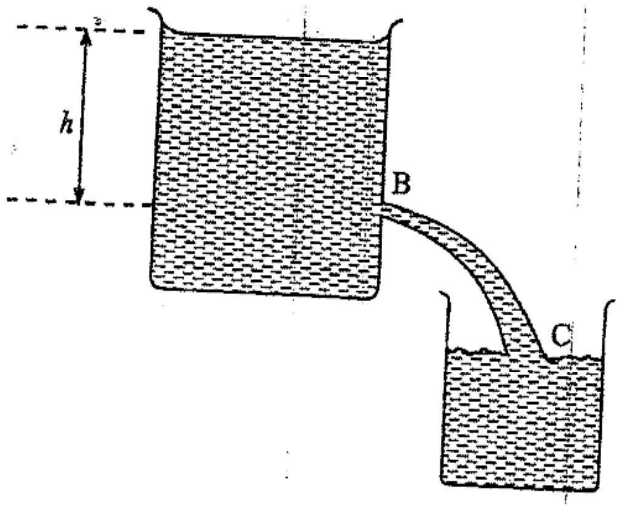


Fig. 8.1

The height, h of the liquid is kept constant.

Show how the student reached the following deductions:

(i) The mass per second, m, is related to volume per second q and density ρ by $m = \rho q$

(ii) $q = Av$, where A is the cross-sectional area and v is velocity at B.

(iii) $v = \sqrt{2gh}$

[3]

For Examiner's Use

9 (a) Electromagnetic waves have a wave-particle duality.

(i) Explain the term *wave-particle duality*.

_____

_____ [1]

(ii) Complete the table stating physical phenomena that show how electromagnetic radiation and electrons behave as particles and as waves.

	Wave behaviour	Particle behaviour
Electromagnetic radiation		
Electron		

[3]

(b) Calculate the wavelength of a beam of electrons which is accelerated through a p.d. of 1200 V.

Wavelength = _____ [3]

10 Fig. 10.1 shows decay curves for radioactive elements A and B.

For Examiner's Use

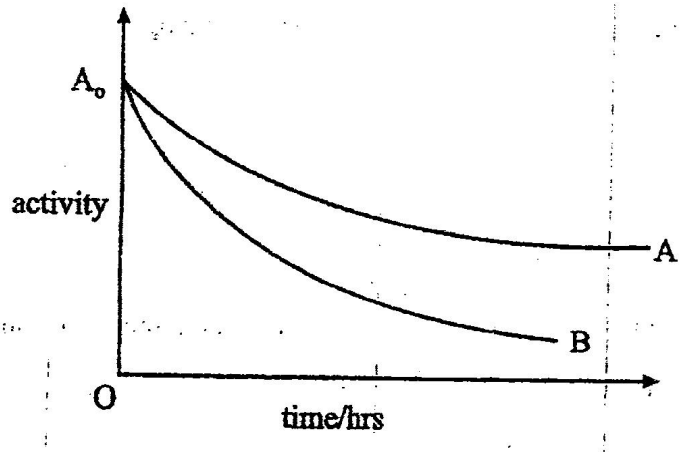


Fig. 10.1

(a) Mark on the graph, the times for activity to be $0,5A_0$ for A and B. [1]

(b) Suggest with a reason, which one of the elements would

(i) cause more environmental hazard,

element

_____

reason

_____

_____

(ii) be useful and preferred as a tracer in medicine.

element

_____

reason

_____

_____ [4]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

POSSIBLE ANSWERS

JUNE 2009

PHYSICS

9188/2

1 (i) 1. A systematic error is one which results in all readings being faulty in one direction/ an error due to the instrument. 1

2. A random error result in a scatter of readings about a mean value caused by the observer. 1

(ii) Systematic error – zero error 1

Random error – fluctuations in temperature 1

2 (a) Momentum = product of mass(m) and velocity(v)

(b) (i) The rate of momentum is directly proportional to the force F causing the change, and occurs in the direction of the force 1

(ii) $F \alpha \frac{mv-mu}{t}$ 1

$F = km\left(\frac{v-u}{t}\right)$ but from definition of 1N, k = 1. 2

$F = m\left(\frac{v-u}{t}\right)$ but $\frac{v-u}{t} = a$ (form definition of a).

$F = ma$ 1

(c) (i) $m_1u_1 - m_2u_2 = m_1v_1 + m_2v_2$ 1

(ii) No external forces/system is isolated 1

3 (a) force per unit mass 1

Nkg^{-1} 1

(b) (i) 1 and 2 1

(ii) $M = \frac{gR^2}{g} = \frac{15 \times (5.6 \times 10^6)2}{6.67 \times 10-11} = 7.05 \times 10^{24}$ kg 2

4 (a) In transverse waves the disturbances are right angles to the direction of travel (of the wave) 1

While in longitudinal waves disturbances are parallel to the direction of travel (of wave) 1

(b) same frequency 1
same amplitude 1
same speed 1
moving in opposite directions 1
Max 3

5 (i) $Re_{ff} = \frac{1}{\frac{1}{6}+\frac{1}{8}} = \frac{6 \times 8}{6 \times 8}$ 1

$= 3.4\ \Omega$ 1

(ii) 1. $I_0 = \frac{V}{R_{eff}} = \frac{6}{3.4}$ 1

2. $I_{\frac{1}{2}} = \frac{6}{8}$ 1

$= 0.75$ A 1

6 (a) A value which produces the same heating effect in a resistor as a steady current of the same value. 1

(b) (i) 100 W 1

(ii) 200 W 1

(c) (i) A.C. can be ~~stopped~~ stepped up or down 1

(ii) High voltages reduce power losses due to joule heating since since current is low 1 1

7 (a) infinite open loop gain 1
infinite bandwidth 1
infinite input impendence 1
infinite slew rate 1
zero output impendence 1
Max 4

(b) *Advantage*

less distortion 1
bandwidth increased 1
greater operating stability 1
Max 2

Disadvantage

Gain reduced 1

(c)

See text book

1

8 (a) (i) In lamina flow each fluid particle follows a smooth path (streamline) 1

(ii) In incompressible flow a change in pressure produce no change in density 1

(b) (i) mass = density x volume
∴ mass per second = density x volume per second

$m = pq$ 1

(ii) volume per second = cross sectional area x distance per second

$q = Av$ 1

(iii) loss in p.e. = gain in k.e.

$mgh = \frac{1}{2} mv^2$

$v = \sqrt{2gh}$ 1

9 (a) (i) waves show particle behaviour while particles show wave behaviour 1

(ii)

	wave behaviour	particle behaviour
e.m. radiation		– photoelectric effect; – γ rays are detected as individuals pulses by the GM tube;
electron	diffraction;	

(b) $eV = 1/2\ mv2$

$v = \sqrt{\frac{2ev}{m}}$ 1

From de Broglie, wavelength of a beam of electrons $\lambda = \frac{h}{mv}$

$= \frac{h}{\sqrt{2mev}} = \frac{6.63 \times 10^{-34}}{(2 \times 9.1 \times 10^{-31} \times 1.6 \times 10^{-19} \times 200)^{\frac{1}{2}}}$ 1

$= 3.6 \times 10^{-11}$m 1

10 (a) $t_{½}$ for A and B marked on graph's time axis 1

(b) (i) A; remains active for longer periods (has larger $t_{½}$); 2

(ii) B; activity quickly decays to safe levels (shorter $t_{½}$); 2

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS

PAPER 3

9188/3

JUNE 2009 SESSION

50 minutes

Additional materials:
- Answer paper
- Electronic Calculator and / or Mathematical tables
- Ruler (mm)

TIME 50 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer paper/answer booklet.

Answer **three** questions.

Question 1 is compulsory.
Answer any other **two** from the remaining questions.

Write your answers on the separate answer paper provided.
If you use more than one sheet of paper, fasten the sheets together.
All working for numerical answers must be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
You are reminded of the need for good English and clear presentation in your answers.

Candidates are advised to spend 25 minutes on **question 1**.

This question paper consists of 7 printed pages and 1 blank page.

[Turn over

Data

Speed of light in free space,	$c = 3.00 \times 10^{8}\ m\ s^{-1}$
Permeability of free space,	$\mu_0 = 4\pi \times 10^{-7}\ Hm^{-1}$
Permittivity of free space	$\epsilon_0 = 8.85 \times 10^{-12}\ Fm^{-1}$
Elementary charge,	$e = 1.60 \times 10^{-19}\ C$
The Planck constant,	$h = 6.63 \times 10^{-34}\ J\ s$
Unified atomic mass constent,	$u = 1.66 \times 10^{-27}\ kg$
Rest mass of electron,	$m_e = 9.11 \times 10^{-31}\ kg$
Rest mass of proton,	$m_p = 1.67 \times 10^{-27}\ kg$
Molar gas constant,	$R = 8.31\ JK^{-1}mol^{-1}$
The Avogadro constant,	$N_A = 6.02 \times 10^{-23}\ mol^{-1}$
The Boltzmann constant,	$k = 1.38 \times 10^{-23}\ JK^{-1}$
Gravitational constant,	$G = 6.67 \times 10^{-11}\ N\ m^2\ kg^{-2}$
Acceleration of free fall,	$g = 9.81\ m\ s^{-2}$

Formulae

uniformly accelerated motion, $s = ut + \frac{1}{2}at^2$
$v^2 = u^2 + 2as$

work done on/by a gas, $W = p\Delta V$

gravitational potential, $\phi = -\frac{Gm}{r}$

refractive index, $n = \frac{1}{\sin C}$

resistors in series, $R = R_1 + R_2 + \ldots$

resistors in parallel, $1/R = 1/R_1 + 1/R_2 + \ldots$

electric potential, $V = \frac{Q}{4\pi\epsilon_0 r}$

capacitors in series, $1/C = 1/C_1 + 1/C_2 + \ldots$

capacitors in parallel, $C = C_1 + C_2 + \ldots$

energy of charged capacitor, $W = \frac{1}{2}QV$

alternating current/voltage, $x = x_0 \sin \omega t$

hydrostatic pressure, $p = \rho g h$

pressure of an ideal gas, $p = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$

radioactive decay, $x = x_0 \exp(-\lambda t)$

decay constant, $\lambda = \frac{0.693}{t_{\frac{1}{2}}}$

critical density of matter in the Universe, $\rho_0 = \frac{3H_0^2}{8\pi G}$

equation of continuity, $Av = \text{constant}$

Bernoulli equation (simplified), $p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$

Stokes' law, $F = Ar\eta v$

Reynolds' number, $R_e = \frac{\rho v r}{\eta}$

drag force in turbulent flow, $F = Br^2\rho v^2$

*Answer **question 1** and **any other 2** from the remaining questions.*

1 (a) (i) Define simple harmonic motion.

(ii) Describe an experiment which shows simple harmonic motion.

(iii) The displacement of an oscillating bob is given by the equation

$$x = 0.53\sin 4.14t.$$

Deduce the maximum acceleration of the bob.

(iv) Sketch a graph of acceleration against time for the bob in (iii). [8]

(b) (i) State Newton's law of gravitation.

(ii) Show that the gravitational field strength on the earth's surface is $\frac{GM_E}{R_E^2}$, where the symbols have their usual meanings.

(iii) Distinguish between the gravitational constant G and the acceleration due to gravity g. [6]

(c) (i) Show that $v^2 = u^2 + gs$ is homogeneous, where symbols have their usual meaning.

(ii) State the limitation in the use of base units to check the equations in (c)(i).

(iii) Outline how this limitation can be overcome. [6]

2 The internal diameter of a glass cylinder was measured using a travelling microscope focused at two opposite points on the circumference. The readings of the two points were 2.35 ± 0.01 cm and 3.54 ± 0.01 cm.

(i) Determine the diameter of the cylinder and its associated uncertainity.

(ii) The volume of the glass cylinder when completely filled with water is 50.0 ± 0.2 cm^3.

Calculate the length of the cylinder with its associated uncertainity.

(iii) State **one** assumption you have made in making the calculation in (ii).

(iv) Suggest **three** ways of improving the accuracy of the readings taken. [10]

3 (a) Define torque of a couple and state its base units. [3]

(b) Fig. 3.1 shows a uniform wooden board of mass 3.0 kg and length 40.0 cm used as a book shelf. The board is supported by a light string from end A to the wall at an angle of 36°. Two books of mass 1.5 kg each are placed such that their centre of mass is 25.0 cm from the hinge.

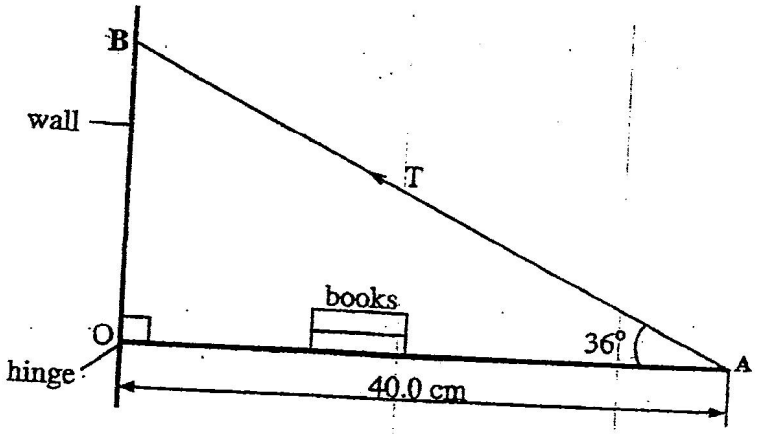


Fig. 3.1

Calculate

(i) the tension in the string,

(ii) the force exerted by the hinge. [7]

4 (a) State **four** different types of electromagnetic waves other than visible light and infra-red radiation.

Give **one** similarity and **one** difference between them. [4]

(b) (i) Describe and explain what is observed on a screen when white light passes through a diffraction grating. [3]

(ii) Monochromatic light of wavelength 400 nm is incident on a diffraction grating. The third order maxima is observed at an angle of 30°.

Calculate the number of lines per millimetre of the grating. [3]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

POSSIBLE ANSWERS

JUNE 2009

PHYSICS

9188/3

Section A

1 (a) (i) motion where acceleration is proportional to displacement from a fixed point and is directed towards that point 1

(ii) any motion that oscillates about a fixed pint
idea of fixed point (particle speeds up towards, fixed point/particle slows down after passing fixed point)

motion repetitive with constant amplitude 3

(iii) $a = w^2r = 4.14^2 \times 0.53$
$= 9.08\ m/s^2$ 2

(iv)

displacement (y) and acceleration (a) are always in anti-phase 2

(b) (i) every particle in the universe attracts every other particle with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

OR

If formula is used it must be explained correctly. 1

(ii) $g = F/m$

$F = \frac{GM_Em}{R_E^2}$ 2

$g = \frac{GM_Em}{R_E^2}/m$

$g = GM_E/R_E^2$ AO

(iii) G - has same value everywhere for all matter

g - varies from one position to another in the same field

G-scalar g-vector 3

(c) (i) $J^2 \equiv as/$
$(ms^{-1})^2 \equiv (ms^{-2})m$
$m^2s^{-2} \equiv m^2s^{-2}$ 2

(ii) Constants cannot be checked from method
Missing terms and extra terms cannot be checked 1

(iii) By performing an experiment to
Determine g
Compare the experimental value of g with 9.81 m/s^2 3

2 (i) 3.54 – 2.35
1.19 cm
$\Delta d = \pm 0.02$ cm 2

(ii) $h = \frac{50.0 \times 2^2}{\pi \times (1.19)^2}$

$= 44.98$ cm

$$\frac{\Delta h}{h} = \frac{\Delta v}{v} + 2\frac{\Delta D}{D}$$

$= \frac{0.2}{50} + \frac{2 \times 0.02}{1.19}$

$\Delta h = 1.69$ cm

$h = 45 \pm 2$ cm 4

(iii) Assumed uniform diameter 1

(iv) - use a more sensitive microscope
- repeating and averaging
- avoiding parallax error 3

3 (a) Product of one force and perpendicular distance between forces
Nm
Kgm^2s^{-2} 3

(b) (i) clockwise moments = anticlockwise moments

$0.2 \times 3 \times 9.81 + 0.25 \times 3 \times 9.81 = T\sin 36$

$T = 56.3$ N 3

(ii) $T\sin 36° + R\sin\theta = 6g$

$R\sin\theta = 25.77$
$R\cos\theta = T\cos 36$
$= 45.55$ N

$R = 52.33$ N
$29.49°$ 4

(a) gamma, X-rays, uv, microwaves, radio (any four)

difference - frequency/wavelength
similarity - same speed in vacuum/
- all are transverse waves 4

(b) (i) Central band is white because it's mixture of all wavelengths.

Maxima are coloured on either side of central band

Violent/blue closet to central band
Red furthest because greatest λ. 3

(ii) $d\sin\theta = m\lambda$

$$d = \frac{3 \times 400 \times 10^{-9}}{\sin 30} = 2.4 \times 10^{-6} m$$

$$= 2.4 \times 10^{-3} \text{ mm}$$

$$\text{No. Of lines per mm} = \frac{1}{2.4 \times 10^{-3}}$$

$$= 417$$ 3

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

9188/5

PHYSICS

PAPER 5

JUNE 2009 SESSION 1 hour 15minutes

Additional materials:
Answer paper
Electronic Calculator and / or Mathematical tables
Ruler (mm)

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer paper/answer booklet.

Answer **four** questions.

Question 1 is compulsory.
Answer any other **three** from the remaining questions.

Write your answers on the separate answer paper provided.
If you use more than one sheet of paper, fasten the sheets together.
All working for numerical answers must be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
You are reminded of the need for good English and clear presentation in your answers.

Candidates are advised to spend 30 minutes on **question 1**.

This question paper consists of 8 printed pages.

[Turn over

Data

speed of light in free space,	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7}\ \mathrm{H\,m^{-1}}$
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12}\ \mathrm{F\,m^{-1}}$
elementary charge,	$e = 1.60 \times 10^{-19}\ \mathrm{C}$
the Planck constant,	$h = 6.63 \times 10^{-34}\ \mathrm{J\,s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27}\ \mathrm{kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$
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the Avogadro constant,	$N_A = 6.02 \times 10^{23}\ \mathrm{mol^{-1}}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23}\ \mathrm{J\,K^{-1}}$
gravitational constant,	$G = 6.67 \times 10^{-11}\ \mathrm{N\,m^2\,kg^{-2}}$
acceleration of free fall,	$g = 9.81\ \mathrm{m\,s^{-2}}$

Formulae

uniformly accelerated motion, $s = ut + \frac{1}{2}at^2$

$v^2 = u^2 + 2as$

work done on/by a gas, $W = p\Delta V$

gravitational potential, $\phi = -\frac{Gm}{r}$

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Stokes' law, $F = Ar\eta v$

Reynolds' number, $R_e = \frac{\rho v r}{\eta}$

drag force in turbulent flow, $F = Br^2\rho v^2$

*Answer **question** 1 and any other 3 from the remaining questions.*

1 (a) (i) State Faraday's law.

(ii) Two coils X and Y are placed close to each other as shown in **Fig. 1.1.**

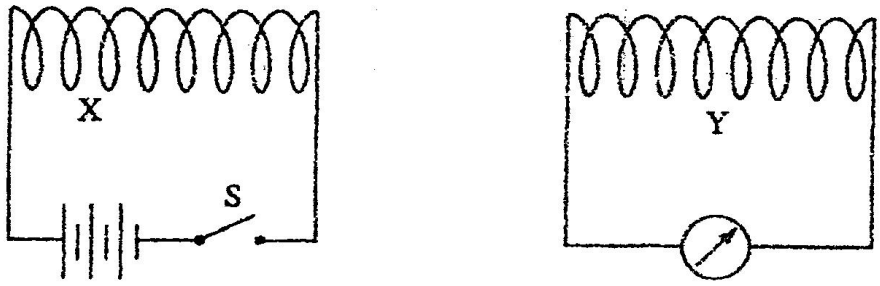

Fig. 1.1

Describe and explain the obser

1. on closing the switch S,

2. when S is kept closed,

3. when S is opened.

(iii) Explain how the observations verify Lenz's law. [8]

(b) (i) Define the term *Young modulus*.

(ii) A steel wire of length L = 2.00 m and cross-sectional area A = 0.012 cm^2 is subjected to a force F = 50 N and produces an extension *e*. The young modulus of steel is 2.1×10^{11}Pa.

1. Show that the elastic energy stored in the wire can be expressed as

$W = 63\,000e^2$.

2. State **two** assumptions made in **(b)(ii)**1.

3. Calculate the energy stored in the wire. [8]

(c) (i) 'A beta emitting radioactive source has a half-life of 13 hours.'

1. Explain this statement.

2. Determine the percentage loss of activity which occurs in the source over a period of 2.0 hours.

(ii) Describe how a radioactive source can be used in the manufacture of thin uniform sheets of aluminium. [8]

2 (a) State Kirchoff's laws and give the principle from which each is derived. [4]

(b) Fig. 2.1 shows a circuit in which the voltmeter is used to measure p.d.

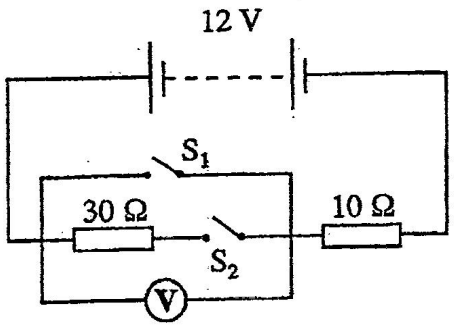

Fig. 2.1

State, giving reasons, the voltmeter reading when

(i) only S1 is closed,

(ii) only S2 is closed,

(iii) both S1 and S2 are open,

(iv) both S1 and S2 are closed. [4]

(c) (i) Give one condition that will enable a transformer to behave ideally.

(ii) Alternating voltage of peak value 10.5 V is the input of an ideal transformer. The mean power output from the transformer is supplied to a consumer at 0.440 kW. The peak current in the secondary coil is 10.0 A and the number of turns in the primary coil is 260.

Determine the number of turns in the secondary coil. [4]

3 (a) Oxygen atoms are ionised by the removal of electrons. The ions are accelerated in a vacuum and injected into a region where there is uniform magnetic and electric fields as shown in **Fig. 3.1**.

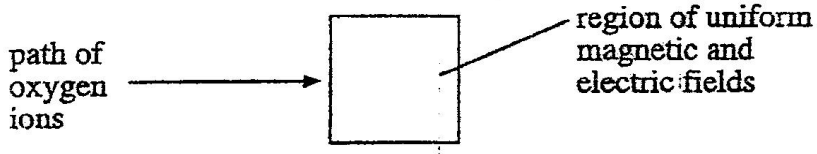

Fig. 3.1

(i) Describe the conditions necessary for the ions to pass through the fields undeflected.

(ii) If the speed of the ions as they reach the fields is 2.1×10^7 m/s and the magnetic flux density is 2.5×10^{-4} T, calculate the magnitude of the electric field strength so that the ions are not deflected in the region of the fields.

(iii) State the change, if any, in the path of the ions in the two fields if the ionisation of oxygen resulted in the removal of one electron.

[6]

(b) **Fig. 3.2** shows some energy levels of a hydrogen atom (not to scale).

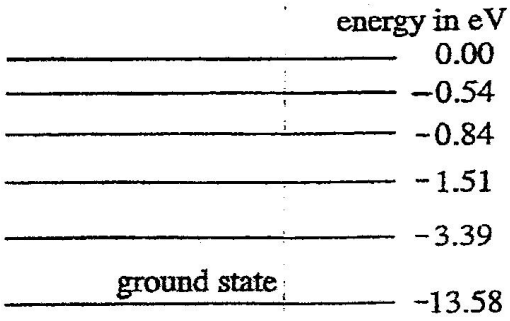

Fig. 3.2

(i) Explain why the energy levels are

1. labelled with negative energies.

2. the energy levels are not uniformly spaced.

(ii) State the transition that will result in the emission of radiation of wavelength 436 nm. Justify your answer with a suitable calculation.

(iii) Determine the frequency of electromagnetic radiation that can cause a transition from ground state to 0.00 eV [6]

4 (a) Give any **one** assumption of the kinetic theory of gases. [1]

(b) A cubical box contains a carbon dioxide gas molecule. Show that the force the molecule exerts on the wall is proportional to the square of its speed. [3]

(c) Fig. 4.1 shows a graph of pressure against density of a gas at 25°C.

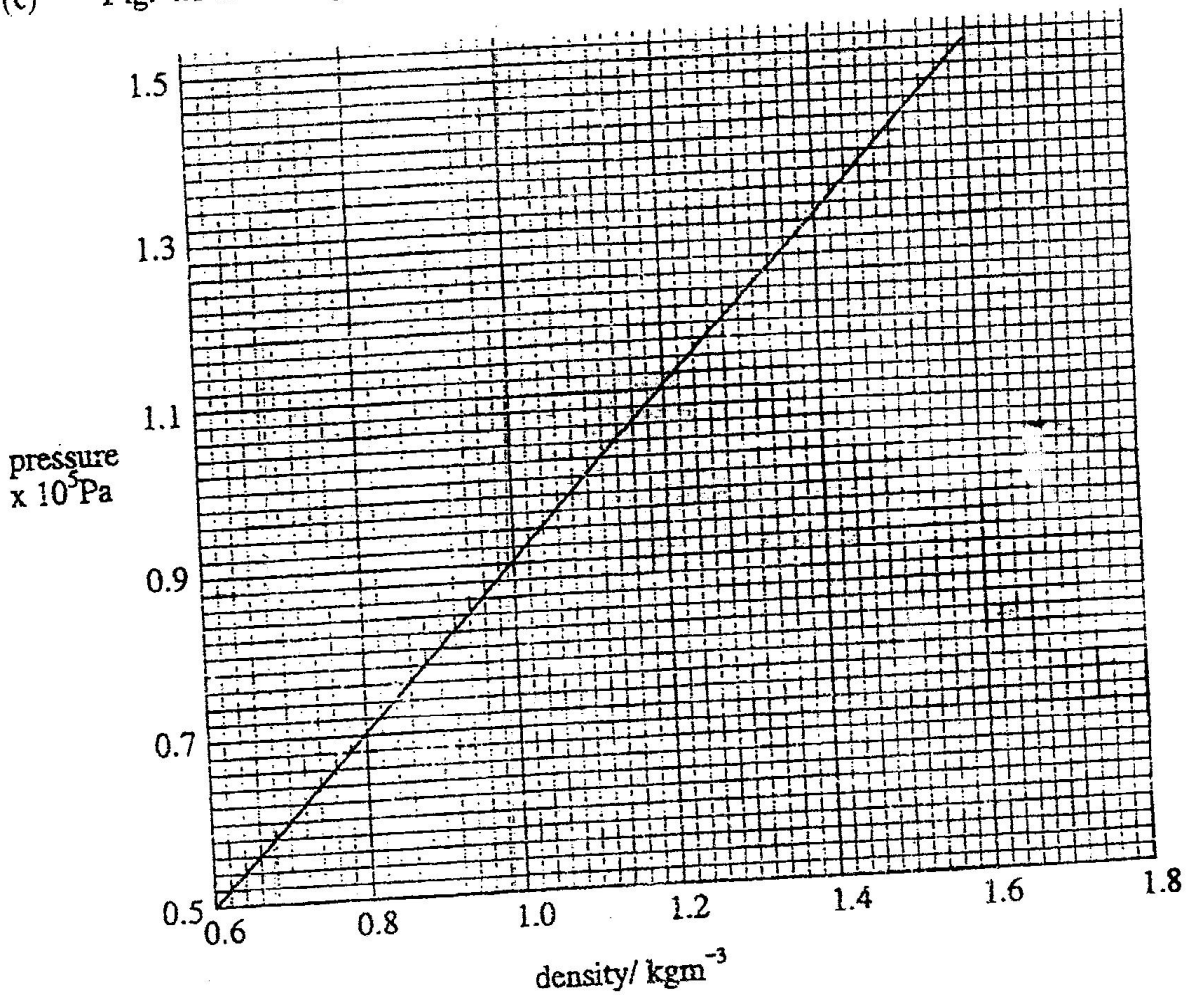

Fig. 4.1

(i) State and explain whether or not the gas behaves as an ideal gas at this temperature.

(ii) Use the graph to calculate the root mean square speed.

(iii) The temperature of the gas is raised to 55°C calculate the pressure when the density is 1.02 kgm^{-3}. [8]

5 (a) Explain the terms *mass defect* and *binding energy*. [2]

(b) (i) Sketch a graph to show how the binding energy per nucleon varies with mass number.

(ii) Explain the significance of the shape of the graph. [5]

(c) Calculate the

(i) energy released,

(ii) the fraction of energy taken by the Beta particle,

when strontium-90 disintergrates by Beta emission to produce yitrium 90.

Note: mass of strontium nucleus is 89.90730 u
mass of yitrium nucleus is 89.90670 u
mass of Beta particle is 0.00055 u [4]

(d) The mass of a cold body is measured on a sensitive balance. After heating the body strongly, its mass increased.

Explain this observation. [1]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

MARKING SCHEME

JUNE 2009

PHYSICS **9188/5**

1 (a) (i) The magnitude of induced emf is directly proportional to the rate of change of magnetic flux [1]

(ii) 1. A momentary deflection on meter
due to change in magnetic field linking Y [2]

2. no change in magnetic flux in Y
no deflection [2]

3. momentary deflection is seen in opposite direction.
magnetic flux decreases or changes on switch off. [2]

(iii) Deflection of pointer in two different directions [1]

(b) (i) $E = \frac{\text{stress}}{\text{strain}}$ [1]

(ii) 1. Work done by the force is stored as energy

$W = \frac{1}{2}Fe$

$\left(E = \frac{F/A}{e/L} = \frac{FL}{Ae}\right)$

$F = \frac{EAe}{L}$

$W = \frac{1}{2}\frac{EAe^2}{L}$

Substitutes values get

$63\,000e^2$ [3]

2. - Elastic limit not exceeded/obey hooke's law

- no energy lost as heat [2]

3. $W = 63\,000e^2$

$e = \frac{FL}{EA} = 3.97 \times 10^{-4} m$

$W = 63\,000 \times (3.97 \times 10^{-4})^2$

$= 9.92 \times 10^{-3} J$ [2]

(c) (i) 1. It takes 13 hours for the number of active nuclei present in the radioactive source at a given time to fall to half its value [1]

Reject definition of $T_{½}$

2. $N = Noe^{-\lambda t}$

$\frac{N}{No} = e^{\frac{-0.693x2}{13}} = 0.899$

% loss = 10.1% [3]

(ii) Radioactive source on one side and detector on another side of sheet
Record back ground reading
Set detector value to wanted reading
Adjust rollers if reading is different from set value
OR
Accept a labelled diagram showing the above details [4]

2 (a) $\sum E = \sum IR$
from conservation of energy
at junction $\sum I = 0$
conservation of charge [4]

(b) (i) Voltmeter records zero because its p.d. across zero resistance [1]

(ii) 9V, p.d. across the 30Ω resister [1]

(iii) 12V, p.d. on open circuit = e.m.f. source [1]

(iv) 0V, current by passes 30Ω for zero resistance [1]

(c) (i) 100% efficiency [1]

(ii) $\frac{N_s}{N_p} = \frac{Vs}{Vp}$

$Vs = \frac{440 \times 2}{10}$

$N_s = \frac{260 \times 440 \times 2}{10 \times 10.5}$

2179 turns [3]

3 (a) (i) 2 fields ⊥ to one another
magnetic force and electric force in opposite directions
magnitudes of forces equal [3]

(ii) $Ee = Bev$

$E = B \times v$

$= 2.5 \times 10^{-4} \times 2.1 \times 10^{7}$

$= 5.25 \times 10^{3}$ V/m [2]

(iii) no change [1]

(b) (i) 1. Ionisation state referred to as zero/forces are Attractive [1]

2. energy levels quantised [1]

(ii) $\Delta E = hf = \frac{6.63 \times 10^{-34} \times 3.0 \times 10^{8}}{436 \times 10^{-9}}$

$= 456 \times 10^{-19}$ J = 2.85 eV

Transition from -0.54 to -3.39
(not vice versa) [3]

(iii) $\Delta E = hf$ $f = 3.28 \times 10^{15}$ Hz [1]

4 (a) Any one assumption of the kinetic theory of gases [1]

(b) Change of momentum = mu-(-mu)=2mu

time = $\frac{2l}{u}$

Force = rate of change of momentum

$= \frac{2mu}{2\left(\frac{l}{u}\right)} = \frac{mu^2}{l}$ [3]

(c) (i) pressure directly proportional to density so behaves ideally [2]

(ii) $P = \frac{1}{3}\rho\langle c^2\rangle$

gradient = 1×10^5

$\frac{1}{3}\langle c^2\rangle = 1 \times 10^5$

$\Rightarrow \sqrt{\langle c^2\rangle} = \sqrt{3 \times 10^5} = 548 m/s$ [3]

(iii) $\langle C^2\rangle \propto T$

$\Rightarrow \langle C_{55}^2\rangle = \frac{328}{298}\langle C_{55}^2\rangle$

$\langle C_{55}^2\rangle = 3.30 \times 10^5$

$\Rightarrow P = \frac{1}{3} \times 1.02 \times 3.30 \times 10^5$

$= \quad 1.12 \times 10^5$ Pa [3]

Reject use of Charle's Law

5 (a) Mass defect – difference between the total mass of separated nucleons and the mass of the nucleus

Binding Energy - work done on the nucleus to separate it into its constituent neutrons and protons [2]

(b) (i)

See Extra Sheet.

Shape
Axes + mass number at peak [2]

(ii) Low binding energy – less stable
Lighter nuclei fused to be more stable
Heavy nuclei (can) split to become more stable [3]

(c) (i) Mass defect 89.90730
-89.90725
0.0005

energy = 0.00005 x 931MeV
= 0.0466 MeV [2]

(ii) $\frac{E\beta}{E_T} = \frac{My}{My+M\beta} = \frac{89.90670}{89.90725}$

= 99.99% [2]

(d) energy converted into mass [1]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS 9188/1

PAPER 1 Multiple Choice

NOVEMBER 2009 SESSION 1 hour

Additional materials:
- Electronic calculator and/or Mathematical tables
- Multiple Choice answer sheet
- Soft clean eraser
- Soft pencil (Type B or HB is recommended)

TIME 1 hour

INSTRUCTIONS TO CANDIDATES

Do not open this booklet until you are told to do so.

Write your name, Centre number and candidate number on the answer sheet in the spaces provided unless this has already been done for you.

There are **forty** questions in this paper. Answer **all** questions. For each question there are four possible answers, **A, B, C** and **D**. Choose the **one** you consider correct and record your choice in **soft pencil** on the separate answer sheet.

Read very carefully the instructions on the answer sheet.

INFORMATION FOR CANDIDATES

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

This question paper consists of 16 printed pages.

Data

speed of light in free space,	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$
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Reynolds' number, $R_e = \frac{\rho v r}{\eta}$

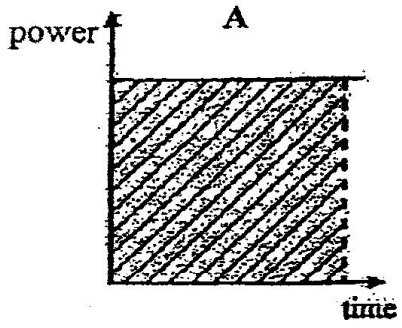
drag force in turbulent flow, $F = Br^2\rho v^2$

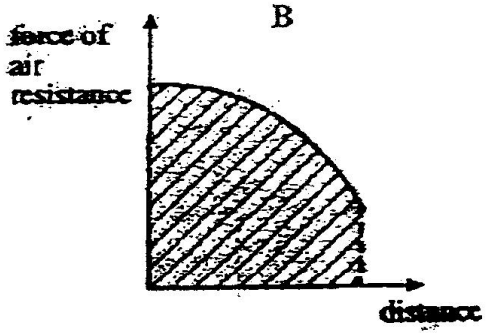
1 Which is **not** a base unit?

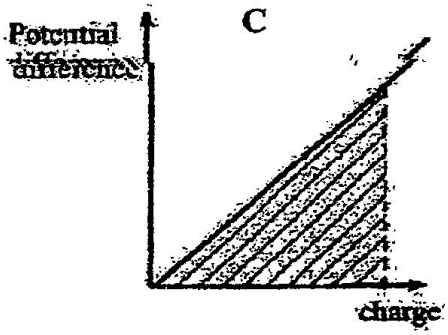
A joule
B mole
C ampere
D kelvin

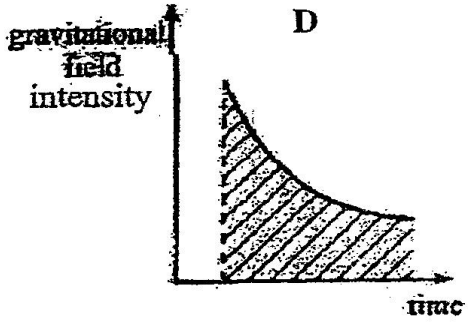
2 Graphs below were obtained from four different experiments.

Which shaded area does **not** have units of energy?









3 Which definition is **not** correct?

A Acceleration is the rate of change of displacement with time.
B Force is the rate of change of momentum.
C Impulse is the change in momentum.
D Linear momentum is the product of mass and velocity.

4 A car uniformly decelerates from 30 ms^{-1} to 15 ms^{-1} over a distance of 75 m.

What total distance is moved by the car before coming to rest?

A 25 m
B 75 m
C 100 m
D 175 m

5 What happens to momentum and kinetic energy when two objects coalesce after a head on collision?

	Momentum	Kinetic Energy
A	conserved	conserved
B	conserved	not conserved
C	not conserved	conserved
D	not conserved	not conserved

6 What is the rate of change of momentum when a force of 4 N acts on a mass of 2 kg for a time of 2 s?

A $1\ kgms^{-2}$
B $2\ kgms^{-2}$
C $4\ kgms^{-2}$
D $8\ kgms^{-2}$

7 The components of a particle's velocity in two directions at right angles are $3\ kms^{-1}$ and $4\ kms^{-1}$.

What is the actual velocity of the particle?

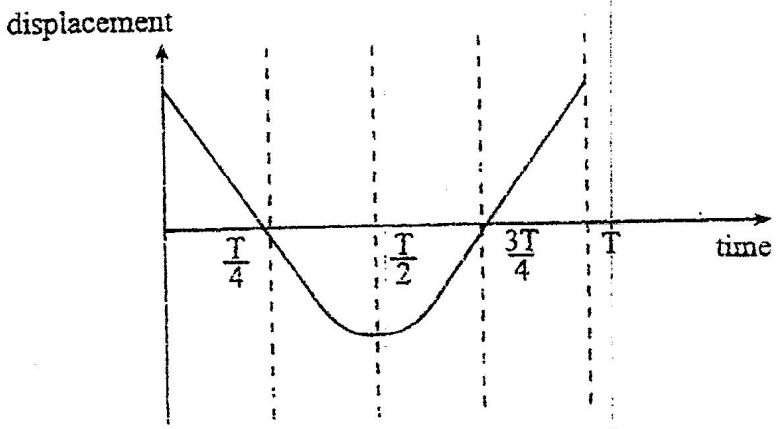
A $1\ kms^{-1}$
B $\sqrt{7}\ kms^{-1}$
C $5\ kms^{-1}$
D $7\ kms^{-1}$

8 A planet of mass M moves in a circular orbit of radius R round the Sun of mass S with period T.

Which relationship is correct?

A $T \propto M^2$
B $T \propto R^{\frac{3}{2}}$
C $T \propto S^{\frac{1}{2}}$
D $T \propto S^2$

9 The diagram shows how the displacement of a particle describing simple harmonic motion varies with time.



Which statement is **not** true?

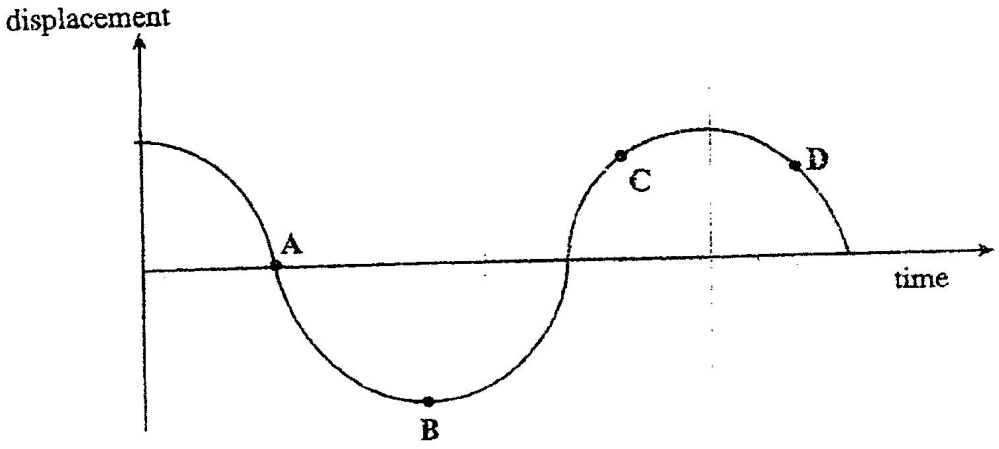
A Restoring force is zero at time $\frac{T}{4}$.

B Velocity is maximum at time $\frac{T}{2}$.

C Acceleration is maximum at time T.

D Kinetic energy is zero at time $\frac{T}{2}$.

10 The graph shows how displacement varies with time for a body performing simple harmonic motion.



At which point is the body travelling and accelerating in the same direction?

11 The equation of a transverse wave moving along a string is given by

$$y = 6.0\sin(0.20x + 4.0t).$$

The 4.0 in the equation represents

A amplitude.
B angular velocity.
C phase difference.
D frequency.

12 Which statement about the size of the image formed in a plane mirror is **not** correct?

A The image can be taller than the object.
B The height of the image depends on the object distance.
C The width of the image is the same as the width of the object.
D The image height depends on the object height.

13 Which property is evidence that light is transverse rather than longitudinal?

A diffraction by a narrow slit
B two coherent waves produce interference
C refraction by a glass prism
D polarisation

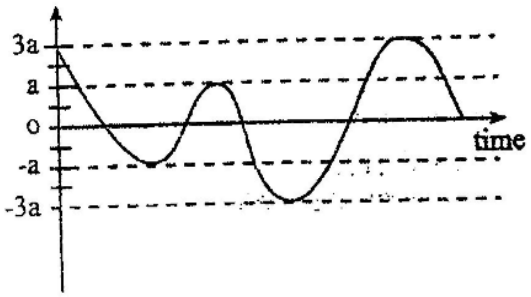
14 Which physical phenomenon cannot be fully described by the wave theory?

A diffraction
B interference
C photoelectricity
D polarisation

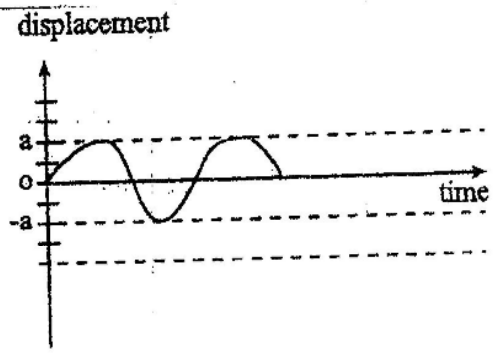
15 S_1 and S_2 are coherent water wave generators. At some point Q, the path difference $S_1Q - S_2Q = \frac{\lambda}{2}$. The amplitude of S_1 waves is 3a while for those from S_2 is 2a.

If both generators are switched on, which graph correctly represents the resultant wave at Q?

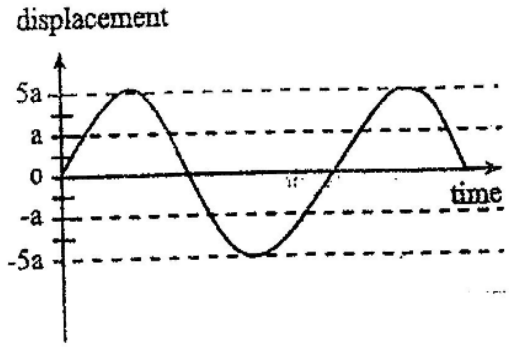
A



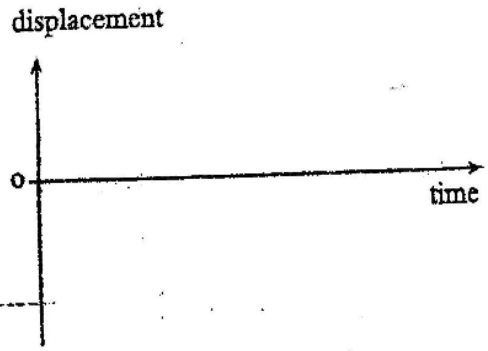
B



C



D



16 What take(s) place during Young's double slit experiment?

A interference only
B diffracion only
C refraction and intereference
D intereference and diffraction

17 The resistance of a wire is R, its length is L and its cross sectional area is A. If L is increased to 3L and its cross-sectional area to 2A, its resistance becomes

A $\frac{3R}{2}$.

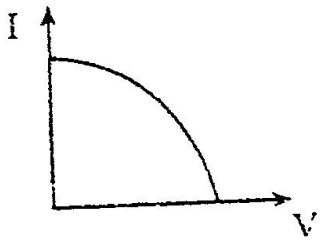
B $\frac{2R}{3}$.

C $\frac{R}{2}$.

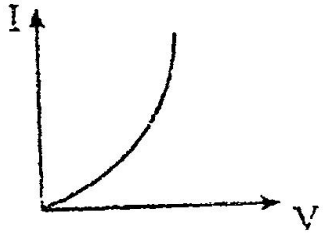
D $\frac{R}{3}$.

18 Which graph shows the I - V relationship of a thermistor?

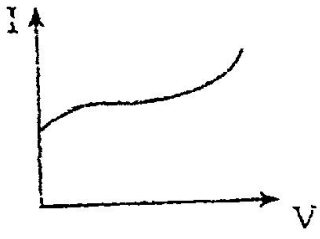
A



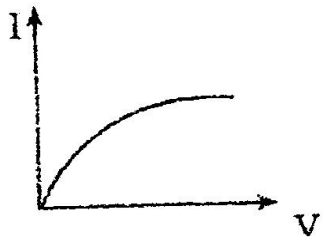
B



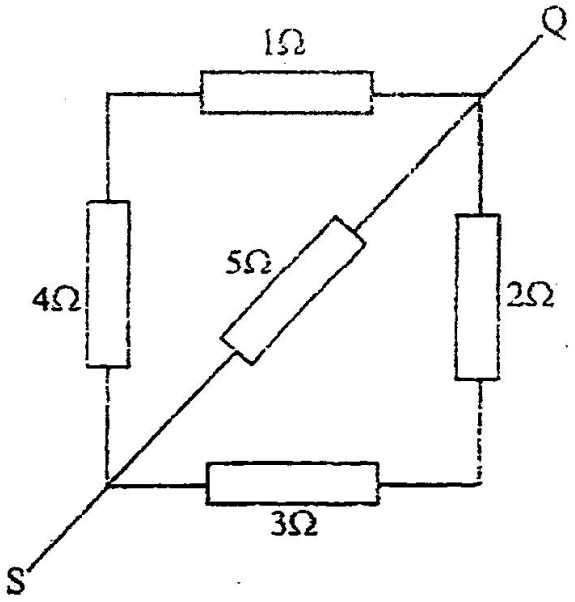
C



D



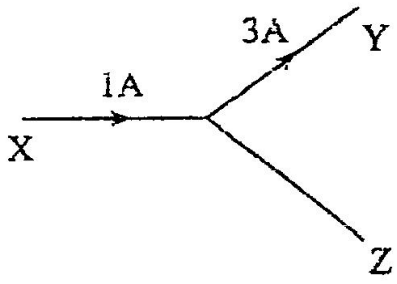
19 Five resistors are connected as shown below.



What is the resistance between S and Q?

A 0.43 Ω
B 0.6 Ω
C 1.67 Ω
D 15 Ω

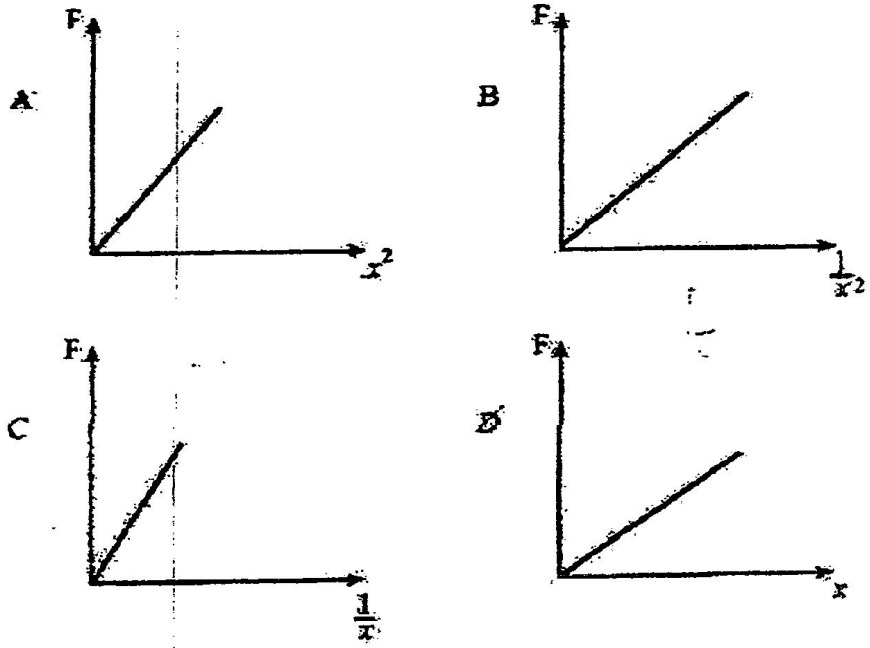
20 Three wires X, Y and Z meet at a junction as shown in the diagram below.



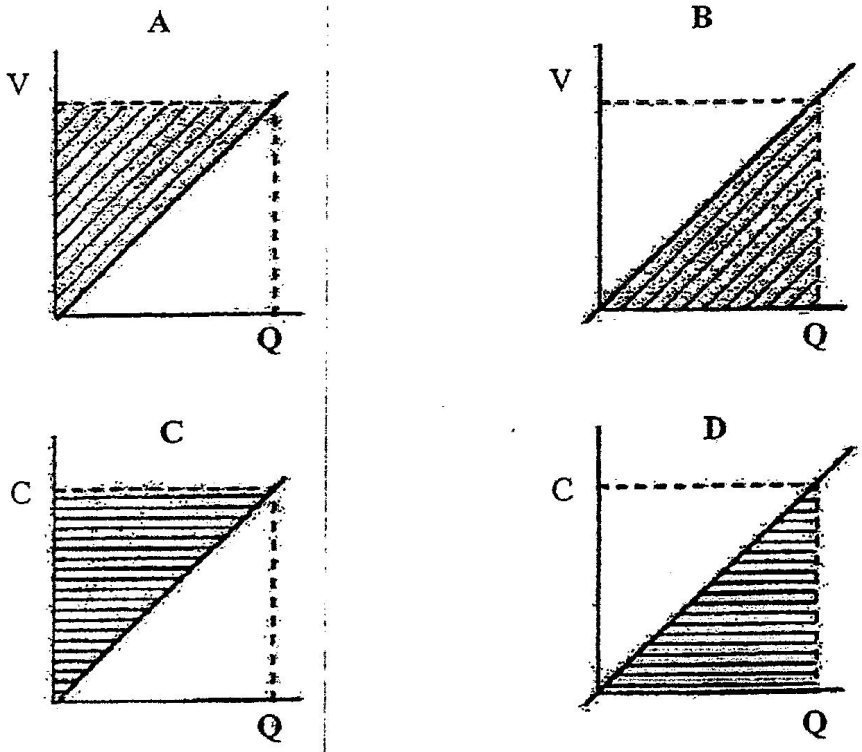
What charge passes a given point in wire Z in 5 seconds?

A 2 C
B 4 C
C 10 C
D 20 C

21 Which graph shows the variation of the force of repulsion, F, with separation, x, of two point charges?



22 Which shaded area represents energy stored in a capacitor?



23 A straight wire 2 m long lies at 30° to a uniform magnetic flux density 2×10^{-5} T and carries a current of 0.02 A.

The magnitude of the force experienced by the wire is

A 2×10^{-7} N.
B 4×10^{-7} N.
C 6.9×10^{-7} N.
D 8×10^{-7} N.

24 The path of an electron moving with uniform speed in a magnetic field in a direction perpendicular to the field is a

A straight line parallel to the field.
B parabola in the plane perpendicular to the field.
C circle in the plane parallel to the field.
D a straight line perpendicular to the field.

25 An alternating current can be represented by the equation

$$I = 4\sin 200\lambda t$$

The peak value of the current is

A $\frac{\sqrt{2}}{4}$ A.
B $2\sqrt{2}$ A.
C 4 A.
D $4\sqrt{2}$ A.

26 Which combination is correct for an ideal opamp?

	Property	Implication
A	infinitely large input impedence	draws in very large currents
B	infinitely small output impedence	delivers small currents
C	infinite bandwidth	amplifies all frequencies
D	infinite slew rate	too slow to respond

27 An opamp has

A an ability to accept positive, negative or alternating inputs.
B two identical inputs which give an output of the opposite sign.
C a low gain.
D a high output impedence.

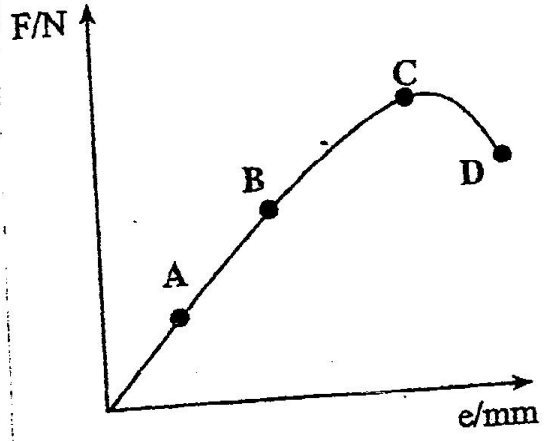
28 Which logic statement is correct for the truth table?

A	B	C
0	0	0
0	1	1
1	0	1
1	1	0

A Output is 1 if and only if both A and B are 1.
B Output is 1 if and only if $A \neq B$.
C Output is 0 if and only if $A \neq B$.
D Output is 0 if and only if A and B are 0.

29 The diagram shows a force-extension graph of a metal specimen.

Which is the fracture point of the metal?



30 A coil wire has resistance 2.0 Ω, 2.8 Ω and 3.0 Ω at the ice point, steam point and temperature t respectively.

The temperature t on the scale defined by the resistor is

A 25°C
B 35.7°C
C 80°C
D 125°C

31 Internal energy of a system is the

A maximum amount of work that can be extracted from the system.
B sum of the kinetic and potential energies of the particles in the system.
C total amount of work which has been done on the system.
D energy needed to raise the temperature of the system by one Kelvin.

32 A mixture of two gases at constant temperature contains molecules of two kinds, the first of mass m_1 and r.m.s. speed C_1, the second of mass m_2 and r.m.s speed C_2.

The ratio C_1/C_2 equals

A m_1/m_2.

B m_2/m_1.

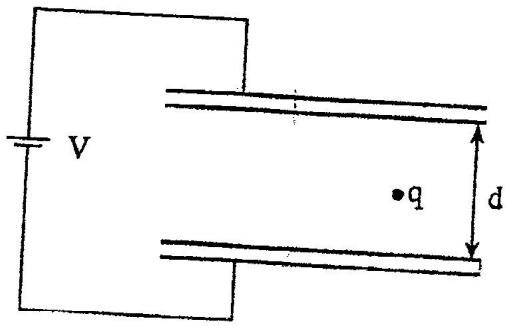
C $\left(m_2/m_1\right)^{\frac{1}{2}}$.

D 1.

33 In a non-viscous fluid flow both the equation of continuity and Bernoulli equation are forms of the principle of conservation of

A mass.
B momentum.
C pressure.
D energy.

34 The diagram shows a charged drop q held stationary between two metal plates.



What would eventually cause the charged drop to move downwards?

A Loss of negative charge from the drop.
B A decrease in the separation d, of the plates.
C An increase in the magnitude of the voltage V.
D Expansion of the drop due to temperature increase.

35 The threshold wavelength λ_0 of a metal surface

A is given by $\frac{hc}{W_0}$. (W_0 is work function).

B is given by $\frac{hW_0}{c}$. (W_0 is work function).

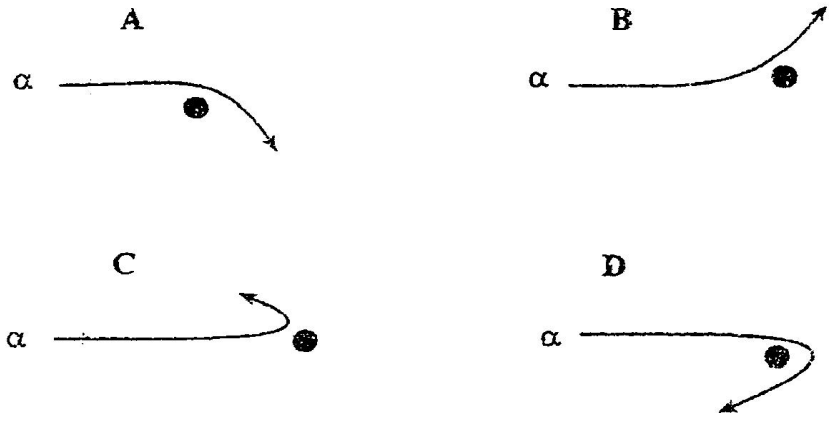
C decreases with the frequency of the light.

D increases with the frequency of the light.

36 Which property is true for both alpha-particles and gamma-rays?

A Both are stopped by few centimetres of paper.
B Both are deflected by magnetic fields.
C Both are deflected by electric fields.
D Both can ionise air molecules.

37 Which diagram shows the path of particles in the α-particle scattering experiment?



38 A helium - 3 nucleus is formed according to the equation.

$$^{2}_{1}H + ^{2}_{1}H \rightarrow ^{3}_{2}He + ^{1}_{0}n + \text{energy}.$$

The binding energies per nucleon are:

for $^{2}_{1}H$ 1.09 MeV
for $^{3}_{2}He$ 2.54 MeV

How much energy is released in this reaction?

A 0.36 MeV
B 1.45 MeV
C 3.63 MeV
D 5.44 MeV

39 What is the decay constant for a radioactive source for which average rate of decay for 96 nuclei is 16 s^{-1}?

A $0.043\ s^{-1}$
B $0.167\ s^{-1}$
C $6\ s^{-1}$
D $1\,536\ s^{-1}$

40 The units of electric field strength are

A Cm^{-1}
B Vm^{-2}
C Nm^{-1}
D NC^{-1}

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

MARKING SCHEME

NOVEMBER 2009

PHYSICS

9188/1

1	A
2	D
3	A
4	C
5	B
6	C
7	C
8	B
9	B
10	D
11	B
12	A
13	D
14	C
15	B
16	D
17	A
18	B
19	C
20	C
21	B
22	A
23	B
24	B
25	C
26	C
27	A
28	B
29	D
30	B
31	B
32	C
33	A
34	A
35	A
36	D
37	C
38	A
39	B
40	D

Candidate Name	Centre Number	Candidate Numbe

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

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PHYSICS

9188/2

PAPER 2

NOVEMBER 2009 SESSION

1 hour 15 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
For numerical answers, **all** working should be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	

This question paper consists of 12 printed pages.

[Turn over

*Answer **all** questions.*

1 Complete the table to distinguish between a *systematic error* and a *random error*.

	systematic	**random**
cause		
example		
effect		
treatment		

[8]

2 (a) Explain the difference between *elastic* and *inelastic* collision.

_____

_____

_____ [2]

(b) A car of mass 1 tonne travelling at 30 ms^{-1} due East collides head-on with a lorry of mass 3 tonnes travelling at 20 ms^{-1} due West. Find

(i) the velocity after collision if the car and the lorry move off together,

velocity = _____

(ii) the change in kinetic energy.

change in kinetic energy = _____

[4]

3 (a) A diver times his bounces on a springboard so as to build up a large amplitude but a comfortable car reduces the amplitude of oscillation in the shortest possible time.

(i) Identify the phenomenon described for

1. the diver,

_____

_____

2. the car.

_____

_____

[2]

(ii) Sketch well labelled graphs for each phenomenon.

[5]

4 (a) Explain the following terms:

(i) *critical angle*

(ii) *total internal reflection*

[2]

(b) Give **one** application of *total internal reflection.*

[1]

(c) Suggest why the sky is blue during daylight.

[2]

5 (a) A potentiometer is used to measure *e.m.f.* and *p.d.* to a high accuracy.

Distinguish between *e.m.f.* and *p.d.* in terms of energy considerations.

[2]

(b) **Fig. 5.1** shows a potentiometer circuit for measuring the e.m.f. of a test cell X.

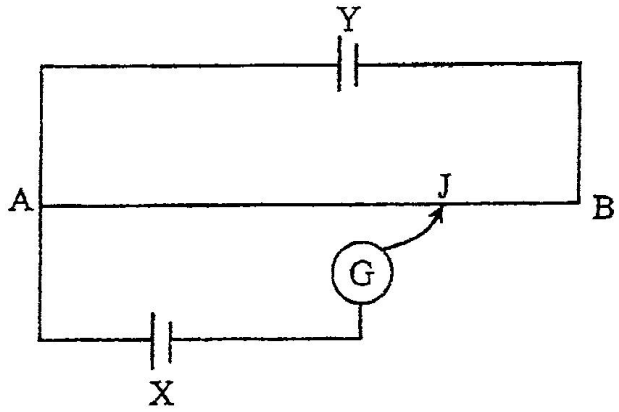

Fig. 5.1

(i) Identify cell Y and its function.

[2]

(ii) The slider J should not be moved continuously along the wire.

Explain why.

_____

_____ [1]

6 (a) Give a statement of the

(i) *Lenz's law,*

_____

_____

_____

(ii) *Faraday's law.*

_____

_____

_____ [2]

(b) State with a reason which of the two laws involves conservation of energy.

_____

_____

_____

_____

_____ [2]

(a) Define *Young modulus*.

_____

_____ [1]

(b) Fig. 7.1 shows the relationship between extension and load for three different materials A, B and C. The initial length of each material is 1.00 m and diameter is 1.00 mm.

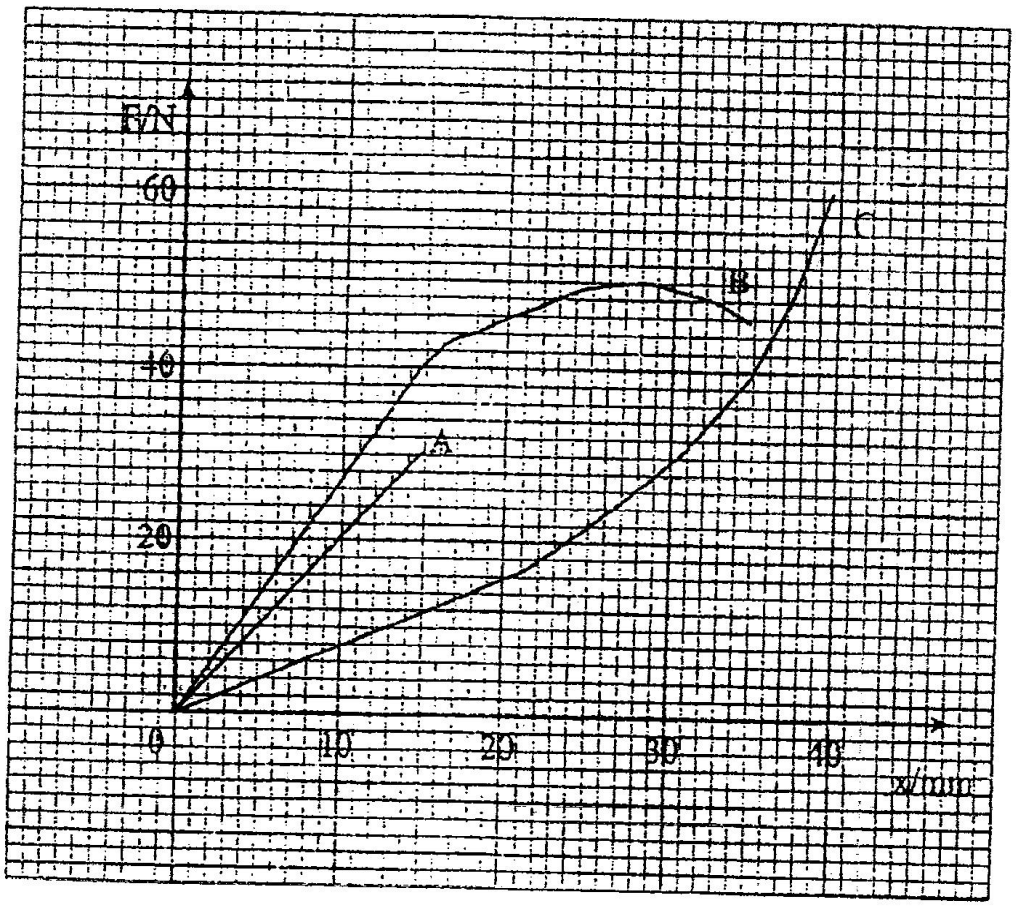

Fig. 7.1

(i) Identify the materials in terms of polymeric, brittle and ductile.

polymeric _____

brittle A _____

ductile B _____

(ii) Estimate the total energy needed to break material B.

energy = _____ [4]

(c) Deduce the Young Modulus for material A.

Young Modulus = _____ [2]

(d) Suggest with a reason the stronger material between A and C.

_____

_____ [1]

8 (a) The flow of a fluid can be represented by $R = Av$.

where A is cross-sectional area and v is the speed of flow of the liquid.

(i) Determine the base units of R.

base units = _____

(ii) Hence identify the quantity R.

_____

_____

[3]

(b) Bernoulli's equation $P + \rho gh + \frac{1}{2}\rho v^2 = \text{constant}$, suggests that the term $\frac{1}{2}\rho v^2$ has the same base units as P.

Confirm the assertion.

[2]

9 (a) Give **three** uses of radio isotopes.

1. _____

2. _____

3. _____ [3]

(b) A certain isotope decays to $\frac{1}{3}$ of its original value in 10 days.

Determine

(i) its decay constant,

decay constant = _____

(ii) its half life.

$T_{\frac{1}{2}}$ = _____ [4]

10 (a) The overall voltage gain of an amplifier with feedback is given by

$$\frac{V_{out}}{V_{in}} = \frac{A_0}{1 - A_0\beta}.$$

State the effect on the overall gain of making

(i) β negative,

_____

(ii) β positive.

_____ [2]

(b) State the **three** essential parts of an *electronic system*.

_____

_____

_____

_____

_____ [3]

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POSSIBLE ANSWER

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PHYSICS

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1

	systematic	random
causes	faulty instruments 1	human limitation 1
Example	zero error 1	parallax error 1
Effects	measurements either always greater or less than the actual 1	measurements centred around a mean value 1
Treatment	change instrument or observer or method 1	(Repeated readings) and averaging 1

2 (a) An elastic collision is one in which kinetic energy is conserved but in an inelastic collision kinetic energy is not conserved. 2

(b) (i) momentum beforce = momentum after collision

$$1 \times 10^3 \times 30 - 3 \times 10^3 \times 20 = V(4 \times 10^3)$$ 1

$$\frac{3\times10^4 - 6\times10^4}{4\times10^3} = V$$

$V = 7.5\ ms^{-1}$ West 1

answer with direction

(ii) $$\frac{1}{2}(m+M)v^2 - \left(\frac{1}{2}mu_1^2 + \frac{1}{2}Mu_1^2\right) = \Delta ke$$

$$\Delta ke = \frac{1}{2}4\times10^3 \times (7.5)^2 - \frac{1}{2}\times10^3 \times 30^2 + \frac{1}{2}\times3\times10^3 \times 20^2$$ 1

$= 937\ 500\ J$ 1

3 (i) 1. Resonance 1

2. Critical damping 1

(ii)

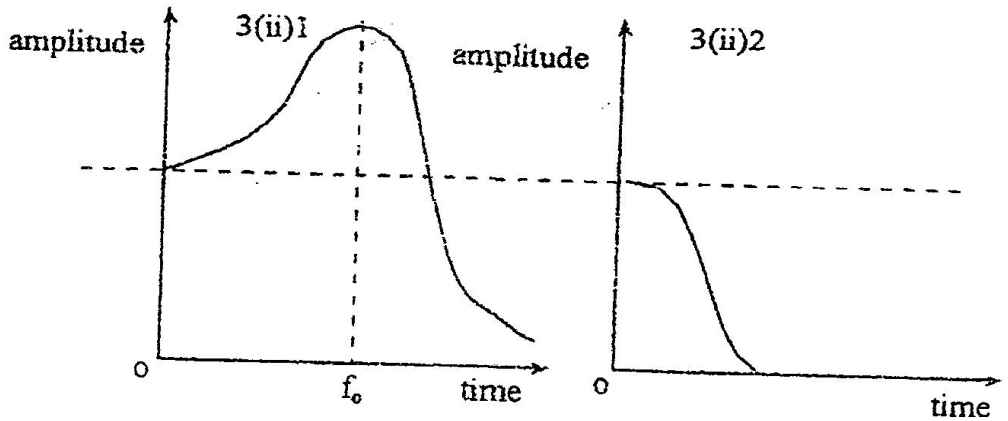


Diagram for 3(ii) 1.

Axes labelled 1
Correct shape 1
f_o marked 1

Diagram for 3(ii) 2.

axes labelled 1
correct shape 1

4 (a) (i) critical angle – angle of incidence for which angle of refraction is 90° (from dense medium to a less dense medium) 1

(ii) total internal reflection – nonerefracted ray for angle of incidence greater than critical angle. 1

(b) fibre optics 1

(c) blue is most scattered/diffracted (by dust in sky) 1

$\lambda_b \approx$ diameter of dust in the sky 1

5 (a) - e.m.f. electrical energy produced per unit change inside the source 1

- p.d. electrical energy converted into other formal when 1 Coulomb 1 passes from one point to another

(b) (i) Cell Y – driver cell 1
which is used to maintain a constant potential difference across the ends of the wire. 1

(ii) so that uniformity is maintained. 1

6 (a) (i) The induced emf is always in a direction that tends to oppose the change causing it 1

(ii) Induced emf is proportional to the rate of change of magnetic flux linking the coil 1

(b) Lenz's law — 1

mechanical energy to overcome the opposition to the motion produces electrical energy — 1

7 (a) $\frac{\text{stress}}{\text{strain}}$ — 1

(b) (i)

polymeric	C	*2 for all three correct*
brittle	A	*1 for 2 correct*
ductile	B	*0 for 1 correct*

2

(ii) Energy = $\frac{1}{2} \times 40 \times \left(1.5 \times 10^{-3}\right)^2 + \frac{1}{2}(40+45) \times 2 \times 10^{-3}$ — 1

$= \quad 0.085$ J — 1

(c) $E = \frac{FL}{Ax}$

$= \frac{350 \times 1}{\lambda\left(0.5 \times 10^{-3}\right) \times 1.5 \times 10^{-3}}$ — 1

$= \quad 2.55 \times 10^{10}$ Pa — 1

(d) C is stronger
larger area under the curve — 1

8 (a) (i) units of R = $ms^{-1}\ m^2$ — 1

$= \quad m^3 s^{-1}$ — 1

(ii) R = volume per second/rate of flow/volume flow rate — 1

(b) units of $\frac{1}{2}\rho v^2 = kgm^{-3}\left(ms^{-1}\right)^2 = kgm^{-1}s^{-2}$ — 1

units of $P = \frac{kgms^{-2}}{m^2} = kgm^{-1}s^{-2}$ — 1

$\therefore$ units of $\frac{1}{2}\rho v^2$ and P are the same — 0

9 (a) - tracing leaks in underground pipes — 1

- carbon dating — 1

- radiotherapy — 1

- sterilising medical equipment — 1

- thickness control of metal sheets — 1

Max 3

(b) (i) $N = No\ e^{-\lambda t}$

$\frac{1}{3} = e^{-10\lambda}$ 1

$\lambda = 0.11$ 1

(ii) $t_{\frac{1}{2}} = \frac{\ln 2}{\lambda} = \frac{\ln 2}{0.11}$ 1

$= 6.3$ days 1

10 (a) (i) the overall gain becomes less than the open loop gain 1

(ii) the overall gain becomes infinity/AW 1

(b) input device/sensor
electronic circuit
output device 3

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

9188/3

PHYSICS

PAPER 3

NOVEMBER 2009 SESSION

50 minutes

Additional materials:
- Answer paper
- Electronic Calculator and / or Mathematical tables
- Ruler (mm)

TIME 50 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer paper/answer booklet.

Answer **three** questions.

Question 1 is compulsory.
Answer any other **two** from the remaining questions.

Write your answers on the separate answer paper provided.
If you use more than one sheet of paper, fasten the sheets together.
All working for numerical answers must be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
You are reminded of the need for good English and clear presentation in your answers.

Candidates are advised to spend 25 minutes on **question 1.**

This question paper consists of 7 printed pages and 1 blank page.

Data

speed of light in free space,	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7}\ \mathrm{H\,m^{-1}}$
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12}\ \mathrm{F\,m^{-1}}$
elementary charge,	$e = 1.60 \times 10^{-19}\ \mathrm{C}$
the Planck constant,	$h = 6.63 \times 10^{-34}\ \mathrm{J\,s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27}\ \mathrm{kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27}\ \mathrm{kg}$
molar gas constant,	$R = 8.31\ \mathrm{J\,K^{-1}\,mol^{-1}}$
the Avogadro constant,	$N_A = 6.02 \times 10^{23}\ \mathrm{mol^{-1}}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23}\ \mathrm{J\,K^{-1}}$
gravitational constant,	$G = 6.67 \times 10^{-11}\ \mathrm{N\,m^2\,kg^{-2}}$
acceleration of free fall,	$g = 9.81\ \mathrm{m\,s^{-2}}$

Formulae

uniformly accelerated motion, $s = ut + \frac{1}{2}at^2$, $v^2 = u^2 + 2as$

work done on/by a gas, $W = p\Delta V$

gravitational potential, $\phi = -\frac{Gm}{r}$

refractive index, $n = \frac{1}{\sin C}$

resistors in series, $R = R_1 + R_2 + \cdots$

resistors in parallel, $1/R = 1/R_1 + 1/R_2 + \cdots$

electric potential, $V = \frac{Q}{4\pi\epsilon_0 r}$

capacitors in series, $1/C = 1/C_1 + 1/C_2 + \cdots$

capacitors in parallel, $C = C_1 + C_2 + \cdots$

energy of charged capacitor, $W = \frac{1}{2}QV$

alternating current/voltage, $x = x_0 \sin \omega t$

hydrostatic pressure, $p = \rho g h$

pressure of an ideal gas, $p = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$

radioactive decay, $x = x_0 \exp(-\lambda t)$

decay constant, $\lambda = \frac{0.693}{t_{\frac{1}{2}}}$

critical density of matter in the Universe, $\rho_0 = \frac{3H_0^2}{8\pi G}$

equation of continuity, $Av = \text{constant}$

Bernoulli equation (simplified), $p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$

Stokes' law, $F = Ar\eta v$

Reynolds' number, $R_e = \frac{\rho v r}{\eta}$

drag force in turbulent flow, $F = Br^2\rho v^2$

*Answer **question 1 and any other** 2 from the remaining questions.*

1 (a) (i) Define *work*.

(ii) Derive from the definition in (i), the equation for the change in potential energy near the earth's surface.

(iii) A cubic wooden block of mass 3.0 kg and side 0.75 m, lying horizontally on one of its faces is tilted through 30° as in fig. 1.1.

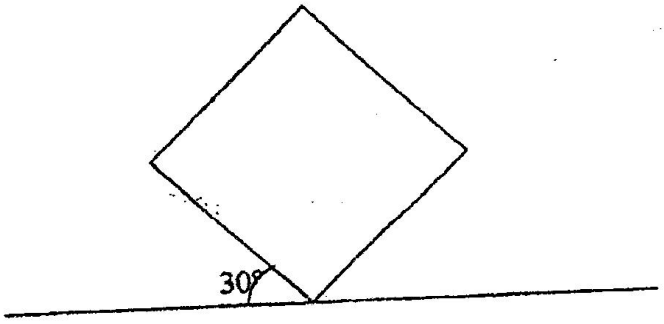


Fig. 1.1

Determine the change in potential energy. [7]

(b) (i) Distinguish between a transverse and a longitudinal wave.

(ii) Explain with the aid of a diagram, why in progressive transverse waves, crests and troughs move away from the source of disturbance. [7]

(c) (i) State **three** base quantities and their corresponding units.

(ii) Express **the volt** in its base units. [6]

2 (a) (i) State the universal law of gravitation.

(ii) Give **one** difference and **one** similarity between this law and Coulomb's law. [4]

(b) Calculate the work done in taking a 5.0 kg mass from the Earth's surface to a point where the earth's gravitational effect is negligible.

[Assume that the earth is a uniform sphere of radius 6 400 km and mass 6.0×10^{24} kg.] [3]

(c) A satellite of mass, m, is placed in an orbit such that it appears stationary above a given point on the Earth.

Show that the radius of the satellite's orbit is given by

$r = 574\sqrt[3]{GM_E}$, where M_E is the mass of the Earth and G the universal gravitational constant. [3]

3 (a) Explain the terms

(i) angular frequency, and

(ii) phase difference. [2]

(b) The graphs in **Fig. 3.1** are showing oscillations of carbon atoms.

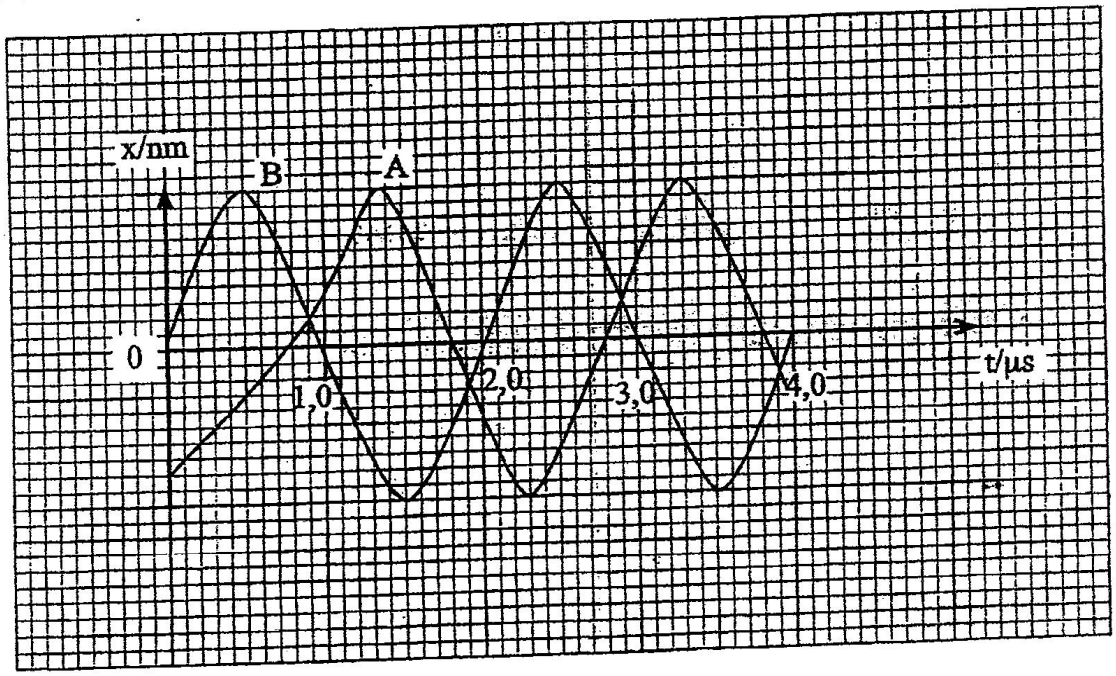


Fig. 3.1

(i) State with a reason the oscillation that is leading.

(ii) Calculate the phase difference in radians between the two oscillations. [5]

(c) Sketch a graph of velocity against displacement for one of the oscillating atoms. [3]

4 (a) Define *linear momentum* and *impulse*. [2]

(b) Use Newton's third law to derive the principle of conservation of momentum. [4]

(c) Two motor vehicles **A** and **B** are moving along a horizontal straight road in opposite directions. Vehicle **A** of mass 3 500 kg is moving with a speed of 14 m/s and vehicle **B**, mass 2 000 kg is moving with a speed 20 m/s. They collide and move together.

Calculate the change in kinetic energy. [4]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

POSSIBLE ANSWERS

NOVEMBER 2009

PHYSICS **9188/3**

1 (a) (i) Product of force and displacement in the direction of the force [1]

(ii) $F = mg$

$\therefore \Delta h = h_2 - h_1$

$\Delta p = mg\Delta h$ [2]

(iii) $h_1 = \frac{0.75}{2} = 0.375$

Length of diagonal $= \sqrt{0,75^2 + 0,75^2} = 1,061\,m$

length from edge $= \frac{1.061}{2}$

$= 0.530$ m

$h_2 = 0.53\sin 75°$

$= 0.512$ m

$\therefore \Delta = 0.512 - 0.375$

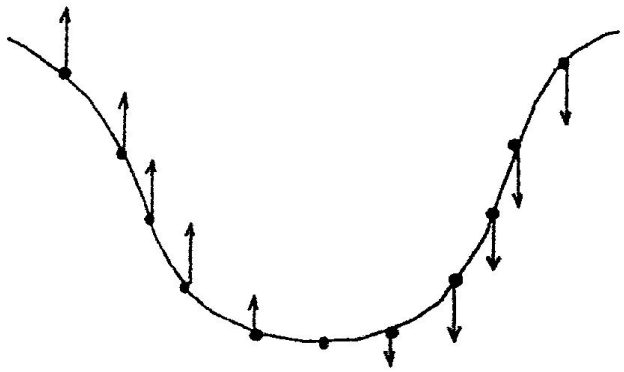
$= 0.137$ m

$\Delta mgh = 0.3 \times 0.137 \times 9.81$

$= 4.03$ J [4]

(b) (i) particles vibrate perpendicular to direction of travel in transverse
particles vibrate parallel to direction of travel in longitudinal.
Longitudinal waves have compression and rare functions.
transverse waves can be polarised. [3]

(ii)



as particles vibrate;
they pass on energy to next particles

Adjacent particles not in phase/adjacent particles not at same displacement [5]

(c) (i) first three correct pairs [3]

(ii) $v = \frac{J}{c}$

$= \frac{Nm}{AS} = \frac{kgms^{-2}}{As}$

$= kgm^2A^{-1}s^{-3}$ [3]

2 (a) (i) $F = \frac{GM_1M_2}{r^2}$

terms explained correctly [2]

(ii) <u>similarity</u>

inverse square law applies/($F \alpha \frac{1}{r^2}$)
involve particles/Newton's third law applies
involve force between particles

<u>difference</u>

deal with point masses for gravitational law/deals with point charges for Coulomb's law.
attractive forces only for gravitation either attractive or repulsive for Coulomb's law.
have different constants of proportionality [2]

(b) gravitational effect negligible at infinite

$W = GMm\left(\frac{1}{\infty} - \left(-\frac{1}{r_E}\right)\right)$ OR

$= +6.67 \times 10^{-11} \times 6 \times 10^{24} \times 5 \times \frac{1}{6.4 \times 10^6}$

$= 3.1 \times 10^8$ J [3]

(c) $mrw^2 = \frac{GM_Em}{r^2}$

$\frac{4\pi^2}{r^2} = \frac{GM_E}{r^3}$

$r = \sqrt[3]{\frac{GM_Er^2}{4\pi^2}}$

$T = 24 \times 3\,600$

Result is $r = 574\sqrt[3]{GM_E}$ [3]

3 (a) (i) Angular frequency is rate of change of angular displacement [1]

(ii) Phase difference is difference in angular displacement between particles oscillating

phase difference Φ $\frac{2\pi\Delta x}{\lambda}$ or $\frac{2\pi\Delta t}{T}$ [1]

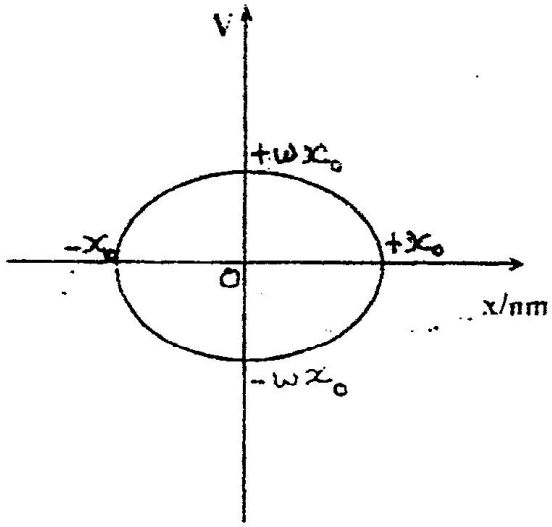
(b) (i) B is leading
because at t = 0 displacement of B is zero and that of A is negative. [2]

(ii) Phase difference $\phi = \frac{t}{T} \times 2\pi$

$= \frac{(1.3-0.5)}{2} \times 2\pi$

$= 2.5$ rad [3]

(c)



Shape
Amplitude labelled
Axes labelled [3]

4 (a) Momentum product of mass and velocity

impulse is product of force and time [2]

(b) Action and reaction are equal and opposite
Bodies in contact exert equal and opposite force in the same time of collusion
time of collision the same
∴ magnitude of impulse the same $m_1v_1 - m_1u_1 = m_2u_2 - m_2v_2$

Impulse is change in momentum

$\therefore m_1v_1 + m_2v_2 = m_2u_2 + m_1v_1$ [4]

(c) use conservation of momentum

$14 \times 3\,500 - 2\,000 \times 20 = 5\,500\ V$

$V = 1.64$ m/s

Ek before impact

$= \frac{1}{2} \times 3500 \times 14^2 + \frac{1}{2} \times 2000 \times 20^2$

$= 343\,000 + 400\,000$

$= 743\,000J$

Ek after $= \frac{1}{2} \times 5500 \times 1.64^2 = 7396J$

Change in Ek $= 743\,000 - 7\,396$

$= 7.36 \times 10^5$ J [4]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS 9188/5

PAPER 5

NOVEMBER 2009 SESSION 1 hour 15minutes

Additional materials:
Answer paper
Electronic Calculator and / or Mathematical tables
Ruler (mm)

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer paper/answer booklet.

Answer **four** questions.

Question 1 is compulsory.
Answer any other **three** from the remaining questions.

Write your answers on the separate answer paper provided.
If you use more than one sheet of paper, fasten the sheets together.
All working for numerical answers must be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
You are reminded of the need for good English and clear presentation in your answers.

Candidates are advised to spend 30 minutes on **question 1**.

This question paper consists of 8 printed pages.

[Turn over

Formulae

uniformly accelerated motion, $s = ut + \frac{1}{2}at^2$, $v^2 = u^2 + 2as$

work done on/by a gas, $W = p\Delta V$

gravitational potential, $\phi = -\frac{Gm}{r}$

refractive index, $n = \frac{1}{\sin C}$

resistors in series, $R = R_1 + R_2 + \ldots$

resistors in parallel, $1/R = 1/R_1 + 1/R_2 + \ldots$

electric potential, $V = \frac{Q}{4\pi\epsilon_0 r}$

capacitors in series, $1/C = 1/C_1 + 1/C_2 + \ldots$

capacitors in parallel, $C = C_1 + C_2 + \ldots$

energy of charged capacitor, $W = \frac{1}{2}QV$

alternating current/voltage, $x = x_0 \sin \omega t$

hydrostatic pressure, $p = \rho gh$

pressure of an ideal gas, $p = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$

radioactive decay, $x = x_0 \exp(-\lambda t)$

decay constant, $\lambda = \frac{0.693}{t_{\frac{1}{2}}}$

critical density of matter in the Universe, $\rho_0 = \frac{3H_0^2}{8\pi G}$

equation of continuity, $Av = \text{constant}$

Bernoulli equation (simplified), $p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$

Stokes' law, $F = Ar\eta v$

Reynolds' number, $R_e = \frac{\rho v r}{\eta}$

drag force in turbulent flow, $F = Br^2\rho v^2$

Answer question 1 and any other 3 from the remaining questions.

1 (a) (i) State *de Broglie's wave equation.*

(ii) A man of mass 50 kg runs through a door of dimensions 90 × 150 cm at a velocity of 7.9 ms^{-1}.

1. Calculate the wavelength associated with the man.

2. State and explain whether there is a diffraction pattern observed.

3. Explain briefly how the wave nature of particles can be demonstrated. [8]

(b) (i) A sealed container of volume 0.8×10^{-3} m^3 contains a gas at a temperature of 47 °C and a pressure of 1.5×10^6 Pa.

Calculate

1. the number of molecules of the gas,

2. the kinetic energy of the molecules when pressure is increased to 2.5×10^6 Pa.

(ii) Give any **two** assumptions made when coming out with the solutions above. [8]

(c) (i) Define *magnetic flux* and *magnetic flux density*.

(ii) When using a Hall probe, there is a Hall potential difference. Explain how this arises.

(iii) The Hall potential difference across a chip of width 5.0 mm is 10μV when placed between the poles of a U-shaped magnet. The average drift speed of the charge carriers in the chip is 6.0×10^{-1} mms^{-1}.

Determine the magnetic flux density between the poles of the magnet. [8]

2 (a) State *Kirchoff's laws*. [2]

(b) **Fig. 2.1** shows a circuit for the supply of energy to a load of 6.0 Ω.

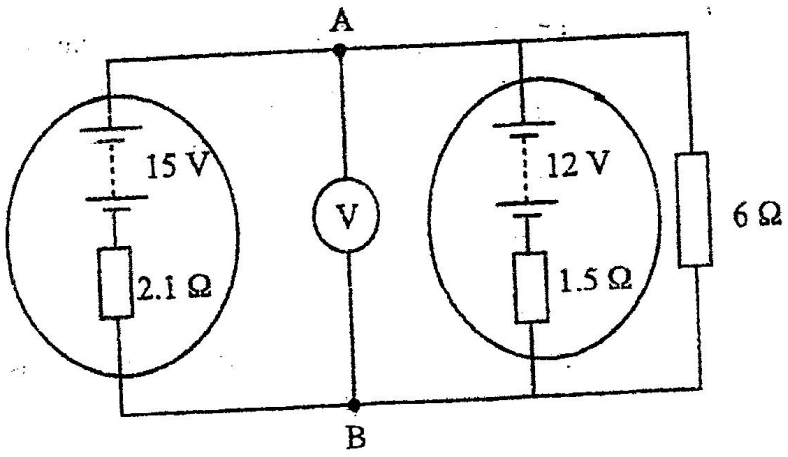


Fig. 2.1

A high resistance voltmeter is connected to the points A and B.

(i) Calculate the currents through the power supplies and the load.

(ii) Deduce the voltage recorded by the voltmeter.

(iii) Calculate the power dissipated in the load. [10]

3 (a) (i) Explain what is meant by the term *internal energy of a gas*.

(ii) Describe how internal energy of a gas can be changed.

[3]

(b) **Fig. 3.1** shows apparatus used to observe smoke particles at room temperature.

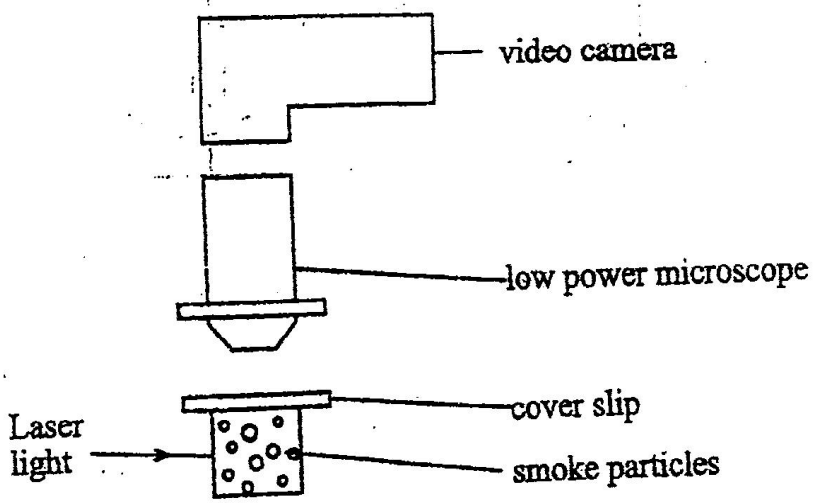


Fig. 3.1

(i) Describe and explain the observations on the television screen when the video taken is played.

(ii) Describe and explain the observations, if the experiment is repeated

[5]

(c) Explain why a pot handle made of copper heats up faster than that of wood. [4]

4 (a) Distinguish between *elastic* and *plastic deformation*. [2

(b) A brass wire 3.0 m long of cross-sectional area 1.0×10^{-3} cm^2 is stretched 1.0 mm by a load of 0.40 kg. The breaking load of the wire is 125 N.

(i) Calculate the Young Modulus, E, for brass.

(ii) Determine the percentage strain produced in the wire.

(iii) Use the value of E in (i) to calculate the force required to produce a 3.3% strain in the same wire.

(iv) State and comment on your assumptions in making calculations in (iii). [1

5 (a) Explain what is meant by an *output transducer*.

Give **one** example. [2]

(b) The circuit shown in **Fig. 5.1** is used to convert a voltmeter of low input resistance to an ideal one.

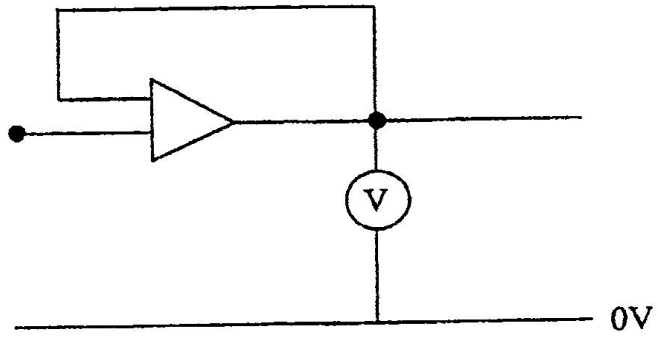


Fig. 5.1

(i) Suggest what is meant by an *ideal voltmeter*.

(ii) State the name given to the operational amplifier when used in this mode and its gain.

(iii) State with a reason the property of the operational amplifier being used in the circuit. [5]

(c) **Fig. 5.2** shows three logic gates connected together.

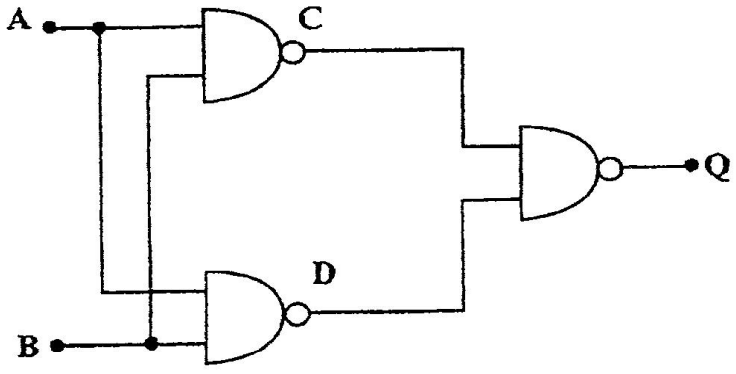


Fig. 5.2

(i) Give the name of the logic gates used.

(ii) Draw the truth-table for the circuit shown.

(iii) Write down the name of a single logic gate that performs the same function as the circuit in **Fig. 5.2**. [5]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

POSSIBLE ANSWERS

NOVEMBER 2009

PHYSICS 9188/5

1 (a) (i) $\lambda = \frac{h}{p}$ [1]

(ii) 1. $\lambda = \frac{h}{mv} = \frac{6.63\times10^{-34}55}{50\times7.9}$

$= 1.68 \times 10^{-36}$m [1]

2. No diffraction
Wavelength too small compared with the dimensions of aperture. [3]

For diffraction pattern to be observed wavelength and aperture must be of same order. [3]

3. Diffraction of electrons
through thin carbon or nickel in
an evacuated tube [3]

(b) (i) 1. $n = \frac{PV}{RT} = \frac{1.5\times10^{6}\times0.8\times10^{-3}}{8.31\times320}$ [3]

Number of molecules $= 0.451 \times 6.02 \times 10^{23}$ [3]

$= 2.72 \times 10^{23}$ [3]

2. $T = \frac{PV}{nR}$

$Ek = \frac{3}{2}NkT = \frac{3}{2}\frac{NkPV}{nR} = \frac{3}{2}\times PV$

$= \frac{3}{2}\times2.5\times10^{6}\times0.8\times10^{-3}$

$= 3\,000$ J [2]

(ii) Any two assumptions of the kinetic theory [2]

(c) (i) magnetic flux

- $\Phi = BA$ terms explained

magnetic flux density:

- Magnetic force acting <u>per</u> unit current length

(ii) Charge carriers moving in a magnetic field experience a force

The force deflects them to one side

Charge accumulates on one side leaving a deficit of the charge on the other side hence the potential difference. [3]

(iii) $B = \frac{V_H}{\upsilon d}$

$= \frac{10 \times 10^{-6}}{6 \times 10^{-4} \times 5 \times 10^{-3}}$

$= 3.33\ T$ [3]

2 (a) $\Sigma E = \Sigma Ir$

$\Sigma I = 0$, at a junction [2]

(b) (i) $15 - 12 = 2.1I + 1.5I_1$

$3 = 2.1I + 1.5I_1$ (1)

$15 = 2.1I + 6I_2$ (2)

$I = I_1 + I_2$ (3)

From equation (1), (2) and (3)
Solve simultaneous equations

$I_1 = 0.296A$

$I_2 = 1.94A$

$I = 1.64A$

(ii) $V = I_2 \times 6$

$V = 11.6\ V$ [1]

(iii) $P = I^2R = 22.6W$ [1]

3 (a) (i) Sum of its molecules' kinetic energy and potential energy [1]

(ii) Doing work (on or by gas); transferring o f heat (to or from gas) [2]

(b) (i) Random motion of smoke particles

Smoke particles being knocked by (invisible) air molecules

Air molecules are in random motion (have E_k) [3]

(ii) Speed of smoke particles reduced

Kinetic energy $\propto$ Temperature [2]

(c) Copper contains free electrons
free electrons diffuse
through a Temperature gradient
In both copper and wood, atoms
Vibrate through Temperature gradient [4]

4 (a) Elastic – material returns to its original length or size when stress is removed

plastic – material suffers permanent strain/does not regain its original size [2]

(b) (i) $E = \frac{6}{5} = \frac{FL}{ADL}$

$= \frac{0.4 \times 9.81 \times 3}{1 \times 10^{-7} \times 1 \times 10^{-3}}$

$= 1.17 \times 10^{11}\ Pa$ [3]

(ii) $\frac{\Delta L}{L} \times 100\% = \frac{1 \times 10^{-3}}{3} \times 100\%$

$= 0.033\%$ [2]

(iii) $E = \frac{F}{A \times 0.033}$

$F = 1.17 \times 10^{11} \times 1.0 \times 10^{-7} \times 0.033$

$= 386.1\ N$ [2]

(iv) Force greater than breaking load
Calculation of force using Hooke's law
Assumption not valid since elastic limit is exceeded [3]

5 (a) A device that converts electrical energy to an observable form of energy

LED, Buzzer, etc [2]

(b) (i) has infinite resistance [1]

(ii) Voltage follower
gain = 1 [2]

(iii) high input impedance/Infinite input impedance

Voltmeter must not draw current [2]

Candidate Name	Centre Number	Candidate Number

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS 9188/2

PAPER 2

JUNE 2010 SESSION 1 hour 15 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
For numerical answers, **all** working should be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

This question paper consists of 11 printed pages and 1 blank page.

Data

speed of light in free space,	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7}\ \mathrm{H\,m^{-1}}$
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12}\ \mathrm{F\,m^{-1}}$
elementary charge,	$e = 1.60 \times 10^{-19}\ \mathrm{C}$
the Planck constant,	$h = 6.63 \times 10^{-34}\ \mathrm{J\,s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27}\ \mathrm{kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27}\ \mathrm{kg}$
molar gas constant,	$R = 8.31\ \mathrm{J\,K^{-1}\,mol^{-1}}$
the Avogadro constant,	$N_A = 6.02 \times 10^{23}\ \mathrm{mol^{-1}}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23}\ \mathrm{J\,K^{-1}}$
gravitational constant,	$G = 6.67 \times 10^{-11}\ \mathrm{N\,m^2\,kg^{-2}}$
acceleration of free fall,	$g = 9.81\ \mathrm{m\,s^{-2}}$

Formulae

uniformly accelerated motion, $s = ut + \frac{1}{2}at^2$
$v^2 = u^2 + 2as$

work done on/by a gas, $W = p\Delta V$

gravitational potential, $\phi = -\frac{Gm}{r}$

refractive index, $n = \frac{1}{\sin C}$

resistors in series, $R = R_1 + R_2 + \ldots$

resistors in parallel, $1/R = 1/R_1 + 1/R_2 + \ldots$

electric potential, $V = \frac{Q}{4\pi\epsilon_0 r}$

capacitors in series, $1/C = 1/C_1 + 1/C_2 + \ldots$

capacitors in parallel, $C = C_1 + C_2 + \ldots$

energy of charged capacitor, $W = \frac{1}{2}QV$

alternating current/voltage, $x = x_0 \sin \omega t$

hydrostatic pressure, $p = \rho gh$

pressure of an ideal gas, $p = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$

radioactive decay, $x = x_0 \exp(-\lambda t)$

decay constant, $\lambda = \frac{0.693}{t_{\frac{1}{2}}}$

critical density of matter in the Universe, $\rho_0 = \frac{3H_0^2}{8\pi G}$

equation of continuity, $Av = \text{constant}$

Bernoulli equation (simplified), $p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$

Stokes' law, $F = Ar\eta v$

Reynolds' number, $R_e = \frac{\rho v r}{\eta}$

drag force in turbulent flow, $F = Br^2\rho v^2$

Answer all questions.

1 (a) A student measuring the diameter of a piece of wire mistakenly used a micrometer screw gauge which did not read zero when fully closed.

(i) State with a reason if her readings have a random error or a systematic error.

_____

_____

_____

_____

(ii) Explain how this error can be reduced.

_____

_____

(b) A test tube has the following diameters:

external diameter $d_1 = (17,9 \pm 0,5)$ mm

internal diameter $d_2 = (13,6 \pm 0,5)$ mm

Determine the percentage uncertainty in $d_2 - d_1$.

=_____

2 (a) Define

1. work,

_____

_____

2. *power.*

_____

_____

(b) By reference to equations of motion, derive an expression for the kinetic energy, E_k, of an object of mass, m, moving at speed, V, from rest.

[3]

3 (a) State two conditions that must be satisfied by a body executing simple harmonic motion.

1. _____

2. _____

[2]

(b) The displacement x in cm of the needle of an electric sewing machine is represented by the equation

$$x = 1.5 \cos 2.3 \pi t$$

Determine

(i) the amplified and period of oscillation,

amplitude = _____

period = _____

(ii) the acceleration when t = 0.1 seconds.

acceleration = _____

[5]

4 (a) State *the principle of superposition* of waves.

_____

_____

_____ [2]

(b) Superposition of light waves results in the production of a pattern of alternate bright and dull fringes.

State three conditions necessary for the production of the pattern of fringes.

1. _____

2. _____

3. _____

[3]

(c) In Young's double slit experiment, light of wavelength 7×10^{-7}m was used. Given that the slit separation and the slit-to-screen distance were 0.30 mm and 1.00 m respectively, determine the fringe separation.

separation = _____

[2]

For Examiner Use

5 (a) Define

1. *capacitance,*

_____

_____

2. *the farad.*

_____

_____ [2]

(b) A capacitor is marked "220 μF; 20 V".

(i) Explain the importance of the 20 V.

_____

_____

_____

_____

(ii) Calculate the

1. charge stored by the capacitor,

charge = _____

2. energy stored by the capacitor.

energy = _____

[5]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

POSSIBLE ANSWERS

JUNE 2010

PHYSICS

9188/2

1 (a) (i) Systematic error — 1
readings produce a consistent difference and are centred about a value other than the true value — 1

(ii) Using another instrument — 1
- adjust for the zero reading — 1 Max 1

(b) Percentage uncertainty in

$d_2 - d_1 = (17.9 - 13.6)$ mm

$= 4{,}3$ mm

$\Delta(d2 - d1) = (0{,}5 + 0{,}5)$ mm

$= 1$ mm — 1

Percentage uncertainty $= \frac{1}{4{,}3} \times 100\%$

$= 23{,}3\ \%$ — 1

2 (a) 1 Work is the energy (expended) used when a force is exerted over a distance/product of force and displacement of point of app. Of force. — 1

2 rate of doing work — 1

(b) E_k = work done

$= F \times s$ — 1

force F produces acceleration a

$F = Ma$

$v^2 = u^2 + 2as$

$v^2 = 2as$

$as = \frac{v^2}{2}$ — 1

$E_k = Fs$

$= Mas$

$= \frac{mv^2}{2}$ — 1

3 (a) acceleration must be proportional to displacement 1
acceleration must be directed towards a fixed point 1
(the equilibrium position)

(b) (i) amplitude = 1.5 cm (1.5×10^{-2}m) 1
period T obtained from $x = x_0 Sinwt \; w = \frac{2\lambda}{T}$ 1

$$T = \frac{2\pi}{w} = \frac{2\pi}{2.5\pi}$$

$$T = 0.80\text{sec}$$ 1

(ii) $a = -X_0 W^2 Coswt \qquad X_o = 1.5 \times 10^{-2} m$ 1

$$= = -1.5 \times 10^{-2} (2{,}5\pi)^2 Cos(2{,}5\pi \times 0{,}1)$$

$= 0{,}65 ms^{-2}$ ($65\ cms^{-2}$) 1

4 (a) The resultant displacement at a point is equal to the algebraic (vector) sum of the individual displacements due to each of the waves passing through the point 1

(b) Waves must come from coherent sources 1
amplitudes of waves must be equal (or almost equal) 1
sources must be close to each other 1

(c) $x = \frac{\lambda D}{a} = \frac{7 \times 10^{-7} \times 1}{0.3 \times 10^{-3}}$ 1

$= 2.33$ mm 1

5 (a) 1. The ratio of charge stored to potential difference
$C = \frac{Q}{V}$

2. Farad is the capacitance when charge of 1 C flows in when the p.d. is 1V/AW 1

(b) (i) Maximum p./d. which if exceeded breaks down the insulation between the plates and capacitor loses its charge-storing ability. 1

(ii) 1 $Q = CV$ 1
$= 220 \times 10^{-6} \times 20$
$= \underline{4.4 \times 10^{-3}\ C}$ 1

2 $E = \frac{1}{2} CV^2$

1 Which expression has the newton as its unit?

A pressure × volume
B pressure × area
C pressure ÷ area
D pressure ÷ volume

2 Which of the following pairs has one scalar and one vector quantity?

A displacement, acceleration
B kinetic energy, force
C velocity, momentum
D momentum, moment

3 The density ρ of a cube is give by

$$\rho = \frac{mass}{volume}.$$

If the mass m = (12.4 ± 0.1)g, and cube side l = (2.10 ± 0.05) *cm*, what is the maximum possible percentage error in density?

A 2.4 %
B 3.0 %
C 8.0 %
D 12.0 %

4 Which statement is correct for a ball kicked vertically upwards if air resistance is assumed to be negligible?

A The kinetic energy of the ball is greatest at the greatest height attained.
B The potential energy of the ball increases uniformly with time during the ascent.
C By the principle of conversation of energy, the total energy of the ball is constant throughout its motion.
D By the principle of conservation of momentum, the momentum of the ball is constant throughout its motion.

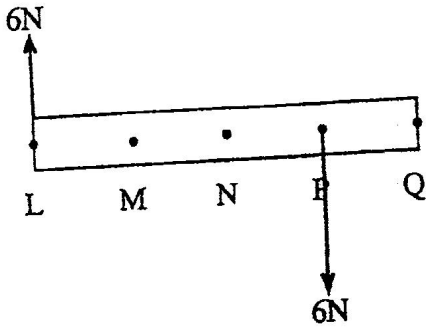
5 A car passes two points A and B, 100 *m* apart, with speeds 10 ms^{-1} and 30 ms^{-1} respectively. What is the acceleration of the car?

A 0.1 ms^{-2}
B 1.5 ms^{-2}
C 4.0 ms^{-2}
D 8.0 ms^{-2}

6 What does the area under a force time graph represent?

A momentum
B impulse
C work done
D power

7 A uniform wooden bar LQ of weight 8 *N* is held horizontally by vertical forces. Two of the forces of 6 *N* each act at L and P. The points L, M, N, P and Q are at equal intervals along the bar.



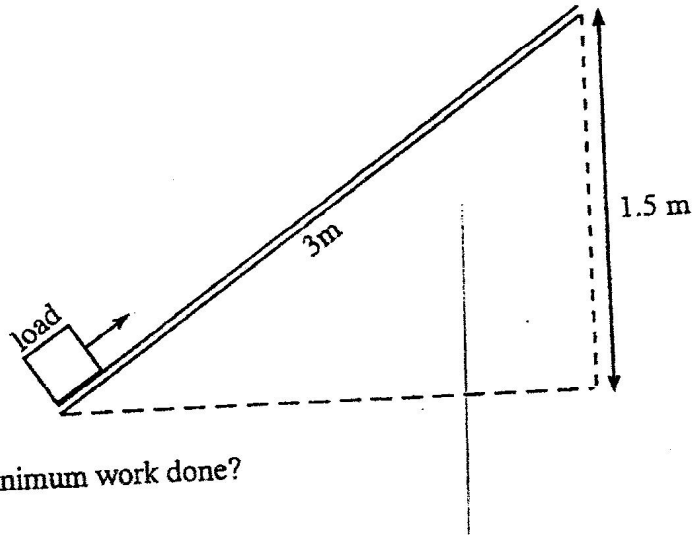
At which point must a vertical force of 8 *N* act to maintain horizontal equilibrium of the bar?

A M
B N
C P
D none of the above

8 Two forces 8 *N* and 12 *N* act on a body. Which of the following could not be the magnitude of the resultant force?

A 4 *N*
B 20 *N*
C 80 *N*
D $\sqrt{208}$ *N*

9 The diagram shows a load of mass 20 *kg* being pushed along an inclined plane of length 3 *m* to a height of 1.5 *m*.



What is the minimum work done?

A 30.0 *J*
B 60.0 *J*
C 294.3 *J*
D 588.6 *J*

U46

10 What is the relationship between angular speed and linear speed?

A $\text{linear speed} = \dfrac{\text{radius}}{\text{angular speed}}$

B $\text{linear speed} = \dfrac{\text{angular speed}}{\text{radius}}$

C linear speed = angular speed × radius

D $\text{linear speed} = \dfrac{\text{radius squared}}{\text{angular speed}}$

11 The gravitational potential on the surface of a spherical object of mass M and radius R is given by

A + GM/R.
B – GM/R.
C + GM/R^2.
D – GM/R^2.

12 A free falling object has a velocity, v after loosing gravitational potential energy, E_p. If it w initially at rest what is its mass?

A $\dfrac{2E_p}{v^2}$

B $\dfrac{v^2}{2E_p}$

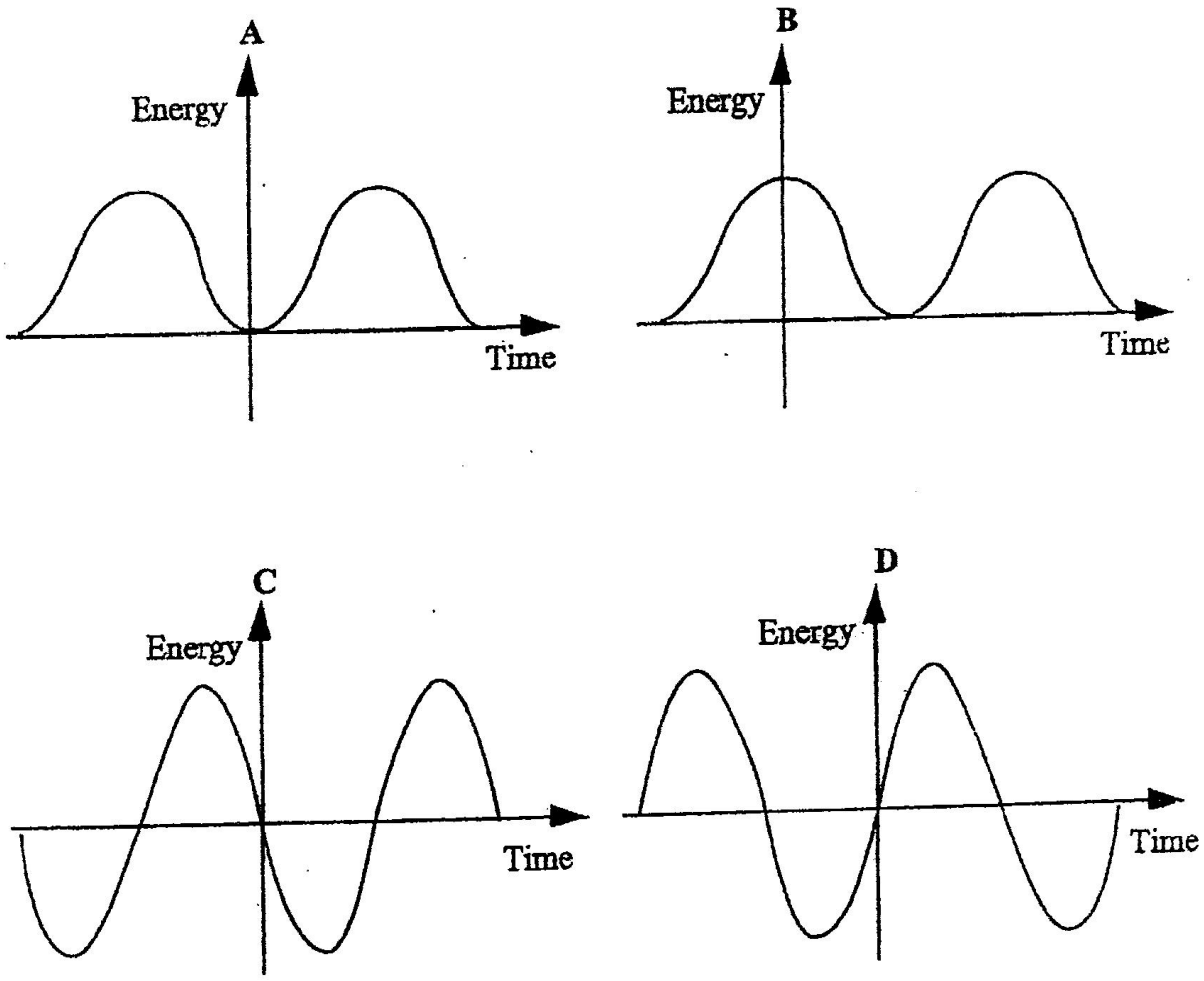
C $\sqrt{\dfrac{v^2}{2E_p}}$

$\sqrt{\dfrac{2E_p}{v^2}}$

Amplitude is

A the closest displacement from the rest position.
B the furthest displacement from the rest position.
C the increase in the x - axis.
D the increase in the y - axis.

14 Which of the following graphs show the potential energy of an object undergoing s.h.m?



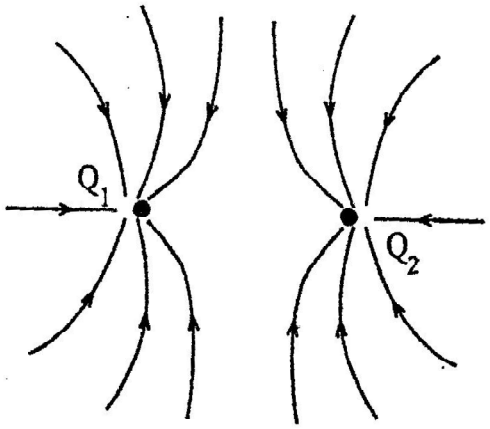
15 Sound waves are said to be longitudinal because

A sound can be reflected from a solid surface.
B sound cannot be polarised.
C sound is diffracted around corners.
D sound is refracted as it passes from hot air to cold air.

16 Which set of conditions gives bright fringes of a double-slit interference pattern that are furthest apart?

	distance between slits	**distance from slits to screen**	**wave length of source**
A	small	large	long
B	large	small	long
C	large	large	short
D	small	small	short

17 The diagram shows an electric field pattern due to charges Q_1 and Q_2 near each other.



Which is true about Q_1 and Q_2?

A They are negative charges of equal sizes.
B They are positive charges of equal sizes.
C They are unlike charges of different sizes.
D They are unlike charges of equal sizes.

18 Two uniform copper wires of equal lengths with diameters d_1 and d_2 have resistances 2 Ω and 4 Ω respectively. The ratio $\frac{d_1}{d_2}$ is

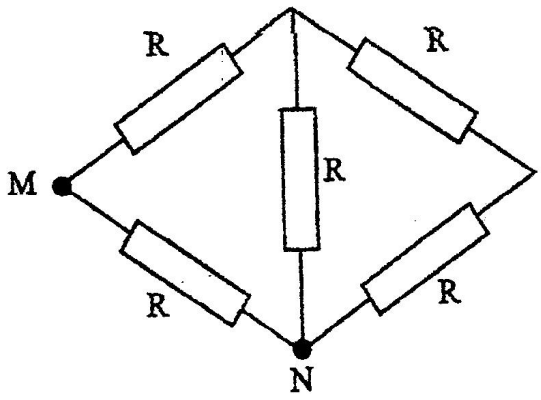
A $\frac{1}{\sqrt{2}}$.

B $\frac{1}{2}$.

C $\sqrt{2}$.

D 2.

19 The circuit diagram shows a network of five identical resistors of resistance R.



What is the effective resistance between points M and N?

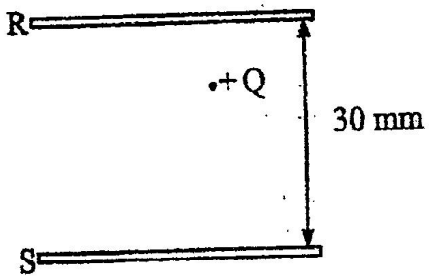
A $\frac{2}{7}R$

B $\frac{1}{2}R$

C $\frac{5}{8}R$

D $\frac{3}{4}R$

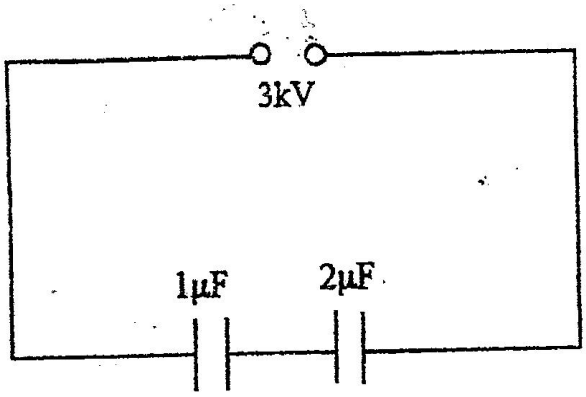
20 The diagram shows a small charge +Q coulombs stationary between two parallel plates R and S of separation 30 mm. A p.d of 150 V is maintained between the plates.



The electric force on the charge in N is

A 5Q upwards.
B 5Q downwards.
C 5×10^3Q downwards.
D 5×10^3Q upwards.

21 Two capacitors A and B of magnitude 1 μF and 2 μF respectively are connected in series so that they are charged by a 3 kV d.c. source as shown in the diagram.



What are the charges on A and B?

	A	B
A	1 *mC*	4 *mC*
B	2 *mC*	2 *mC*
C	3 *mC*	6 *mC*
D	9 *mC*	9 *mC*

22 Which of the following does not affect the magnitude of the induced e.m.f.?

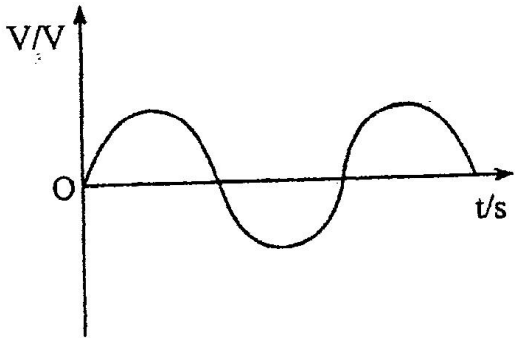
A magnetic flux density
B length
C current
D potential difference

23 What quantities are conserved in Lenz's law and Faraday's law?

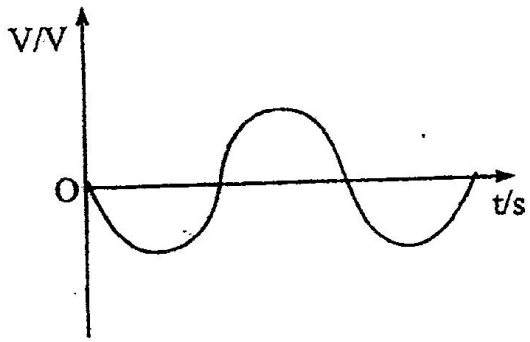
	Lenz's law	Faraday's law
A	energy	charge
B	energy	energy
C	charge	charge
D	charge	energy

24 Which graph shows the output voltage from a full wave rectifier?

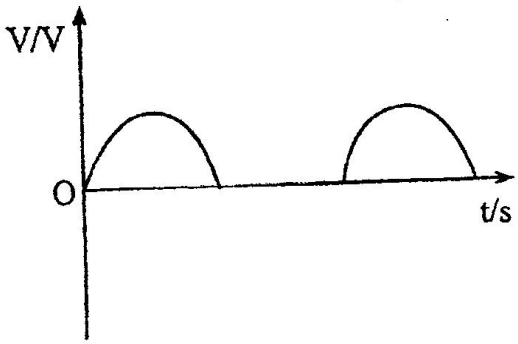
A



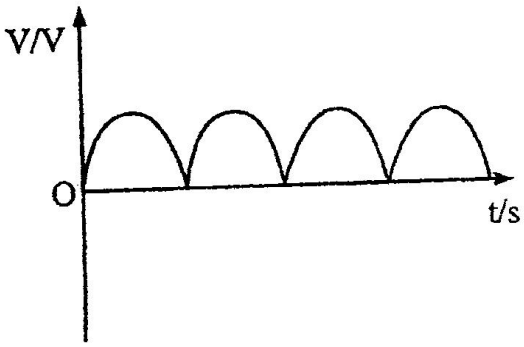
B



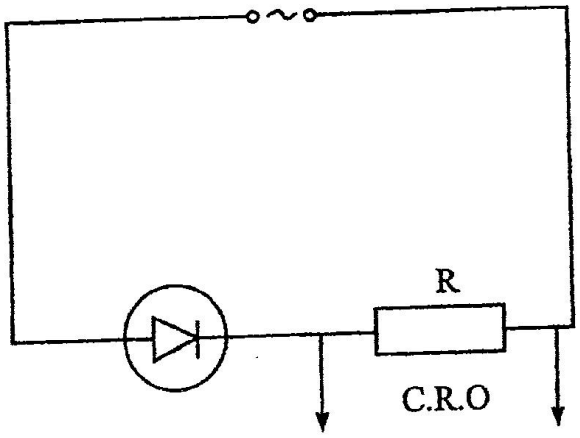
C



D

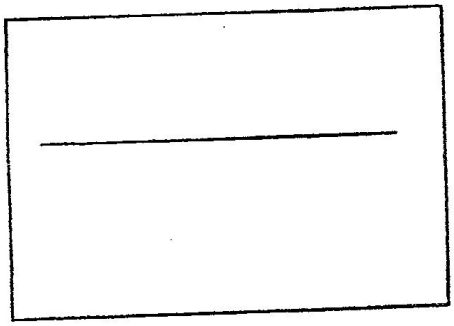


25 In the circuit below a CRO is connected across a resistor.

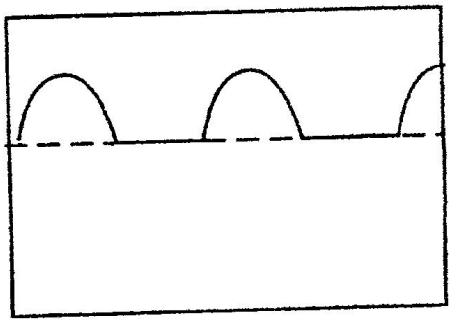


Which of the traces appears on the screen of the CRO?

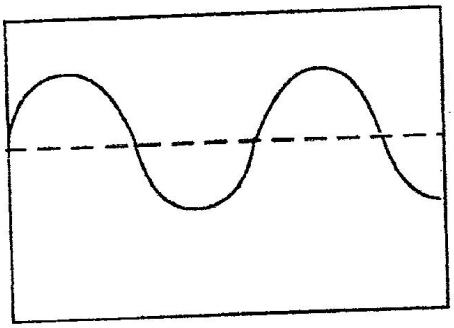
A



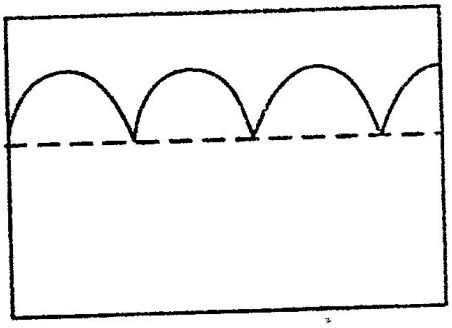
B



C



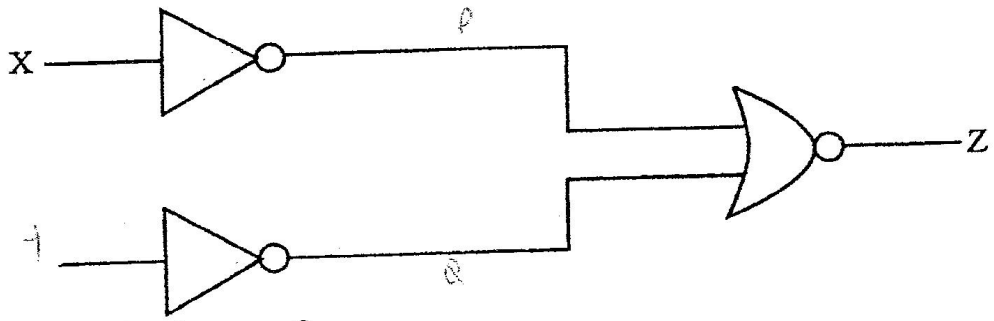
D



26 What is the effect of negative feedback on the gain and stability of an opamp?

A gain is increased and stability is increased
B gain is increased and stability is reduced
C gain is reduced and stability is reduced
D gain is reduced and stability is increased

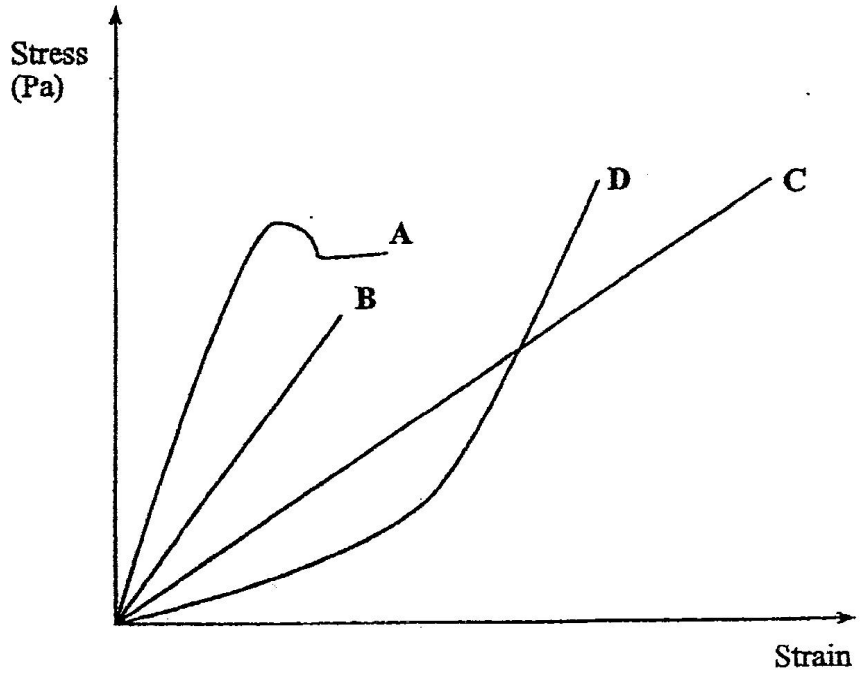
27 The diagram shows a logic combination.



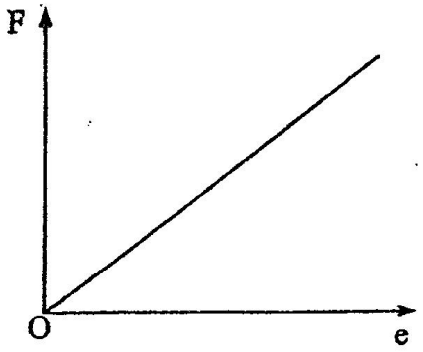
ch alternative is correct?

	A	B	C	D
X	1	0	1	0
Y	0	1	1	1
Z	1	0	1	1

28 The diagram below shows stress-strain graphs of four industrial materials up to breaking point.
Which material is steel?



29 The graph shows the variation of extension, e, of a wire with force, F, applied.



If the original length of the wire is l, its cross-sectional area is A and its Young modulus is E, the gradient of the graph is

A $\frac{El}{A}$.

B $\frac{EA}{l}$.

C $\frac{A}{lE}$.

D $\frac{El^2}{A}$.

30 Which of the following is **not** true about a thermocouple?

A It is good for varying temperatures.
B It has a low heat capacity.
C It has a slow response.
D It is highly sensitive.

31 A platinum wire has resistance of 3 Ω, 3.5 Ω and 4.0 Ω at the ice point, the steam point and a temperature ,t, respectively.

What is the value of t?

A 50 °C
B 67 °C
C 150 °C
D 200 °C

32 For a gas of pressure p and volume V, the quantity pV is measured in

A J.
B N/m.
C N/m^2.
D W.

33 What is the root mean square speed of gas molecules with speeds of 1 kms^{-1}, 3 kms^{-1} and 5 kms^{-1}?

A $\sqrt{\frac{35}{3}}\ kms^{-1}$

B $9\ kms^{-1}$

C $\sqrt{35}\ kms^{-}$

D $3\ kms^{-1}$

34 How much kinetic energy is acquired by a proton of charge q after being accelerated by a p.d. V in a distance of 5 mm?

A qV

B $5qV$

C $5q/V$

D q/V

35 A proton moving at $2.5 \times 10^5 ms^{-1}$ enters a magnetic field of flux density 0.2 T at right angles. What is the radius of its path?

A $5.2\ \mu m$
B $7.1\ \mu m$
C $1.3\ cm$
D $76.6\ m$

36 Which is **not** a conclusion drawn from the photoelectric effect?

A The number of electrons emitted per second is proportional to intensity.
B The maximum velocity of emitted electrons depends on incident light frequency.
C Light has a dual nature, the particle and the wave nature.
D Work functions of metals depend on the temperature of a photocell.

37 What is the wavelength of an electron moving with velocity $5.0 \times 10^6\ ms^{-1}$?

A $2.4 \times 10^{-37}\ m$
B $1.5 \times 10^{-10}\ m$
C $1.7 \times 10^{-8}\ m$
D $6.8 \times 10^{9}\ m$

38 In an α - scattering experiment, α particles were deflected through angles ranging from 0° to 180°. This is explained as due to scattering from

A free electrons.
B bound electrons.
C small but heavy regions of positive charge.
D large and heavy regions of negative change.

39 Isotopes have the same

A charge/mass ratio.
B neutron number.
C nucleon number.
D proton number.

40 A radiocactive nuclide emits an α-particle and two negative β-particles.

Compared with the original nuclide, the resulting nuclide will be an isotope with

A the same proton number.
B the same nucleon number.
C a higher nucleon number.
D a lower proton number.

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

MARKING SCHEME

JUNE 2010

PHYSICS

9188/1

1	B
2	B
3	C
4	C
5	C
6	B
7	D
8	C
9	C
10	C
11	B
12	A
13	B
14	A
15	B
16	A
17	A
18	C
19	C
20	D
21	B
22	D
23	A
24	D
25	B
26	D
27	C
28	A
29	B
30	C
31	D
32	A
33	A
34	A
35	C
36	D
37	B
38	C
39	D
40	A

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS 9188/3

PAPER 3

JUNE 2010 SESSION 50 minutes

Additional materials:
Answer paper
Electronic Calculator and / or Mathematical tables
Ruler (mm)

TIME 50 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer paper/answer booklet.

Answer **three** questions.

Question 1 is compulsory.
Answer any other **two** from the remaining questions.

Write your answers on the separate answer paper provided.
If you use more than one sheet of paper, fasten the sheets together.
All working for numerical answers must be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
You are reminded of the need for good English and clear presentation in your answers.

Candidates are advised to spend 25 minutes on **question 1.**

This question paper consists of 8 printed pages.

[Turn over

Data

speed of light in free space,	$c = 3.00 \times 10^{8}\ \text{m s}^{-1}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7}\ \text{H m}^{-1}$
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12}\ \text{F m}^{-1}$
elementary charge,	$e = 1.60 \times 10^{-19}\ \text{C}$
the Planck constant,	$h = 6.63 \times 10^{-34}\ \text{J s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27}\ \text{kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31}\ \text{kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27}\ \text{kg}$
molar gas constant,	$R = 8.31\ \text{J K}^{-1}\ \text{mol}^{-1}$
the Avogadro constant,	$N_A = 6.02 \times 10^{23}\ \text{mol}^{-1}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23}\ \text{J K}^{-1}$
gravitational constant,	$G = 6.67 \times 10^{-11}\ \text{N m}^2\ \text{kg}^{-2}$
acceleration of free fall,	$g = 9.81\ \text{m s}^{-2}$

Formulae

uniformly accelerated motion, $s = ut + \frac{1}{2}at^2$, $v^2 = u^2 + 2as$

work done on/by a gas, $W = p\Delta V$

gravitational potential, $\phi = -\frac{Gm}{r}$

refractive index, $n = \frac{1}{\sin C}$

resistors in series, $R = R_1 + R_2 + \ldots$

resistors in parallel, $1/R = 1/R_1 + 1/R_2 + \ldots$

electric potential, $V = \frac{Q}{4\pi\epsilon_0 r}$

capacitors in series, $1/C = 1/C_1 + 1/C_2 + \ldots$

capacitors in parallel, $C = C_1 + C_2 + \ldots$

energy of charged capacitor, $W = \frac{1}{2}QV$

alternating current/voltage, $x = x_0 \sin \omega t$

hydrostatic pressure, $p = \rho gh$

pressure of an ideal gas, $p = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$

radioactive decay, $x = x_0 \exp(-\lambda t)$

decay constant, $\lambda = \frac{0.693}{t_{\frac{1}{2}}}$

critical density of matter in the Universe, $\rho_0 = \frac{3H_0^2}{8\pi G}$

equation of continuity, $Av = \text{constant}$

Bernoulli equation (simplified), $p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$

Stokes' law, $F = Ar\eta v$

Reynolds' number, $R_e = \frac{\rho v r}{\eta}$

drag force in turbulent flow, $F = Br^2\rho v^2$

*Answer **question 1 and any other 2** from the remaining questions.*

1 (a) (i) Distinguish between *random* and *systematic* errors.

(ii) Suggest **one** way of reducing each type of error in (i).

(iii) The viscosity of oil, η, is given by $\eta = \frac{mg}{6\pi Rv}$, where R is radius of sphere moving through oil and v is the terminal velocity.

In an experiment to determine the viscosity of oil, the following results were obtained;

diameter, $D = 9{,}0 \pm 0{,}1$ mm,
distance ,s (moved by sphere at v) $= 0{,}200 \pm 0{,}001$ m,
time taken, $t = 0{,}56 \pm 0{,}01$s
mass, $m = 0{,}030 \pm 0{,}001$ kg

Calculate the percentage error in the value of η. [7]
[take the value of $g = 9{,}81 \pm 0{,}01$ ms^{-2}]

(b) (i) Define *displacement* and *velocity*.

Fig. 1.1 shows a 0,100 kg mass moving with a constant velocity of 8.0 ms^{-1} on a table.

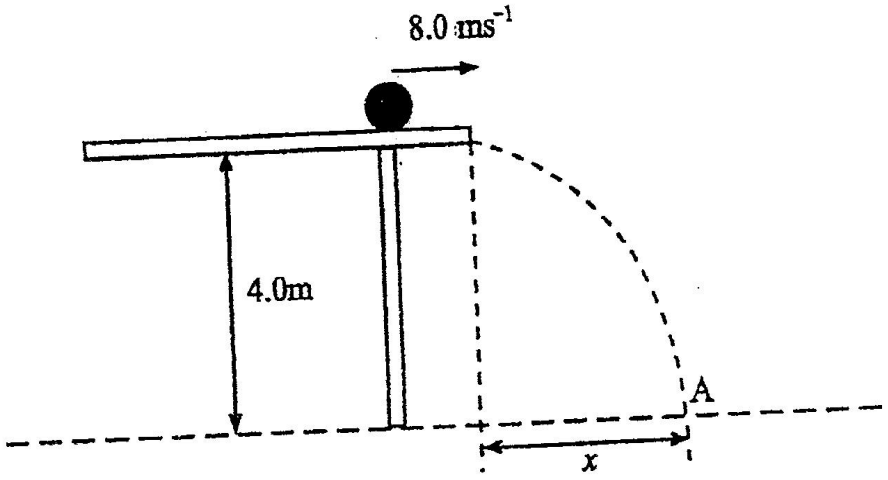


Fig.1.1

The surface of the table is 4.0 m above the ground. The sphere rolls off the table and hits on flat ground at point A at a distance x from the edge of the table.

(ii) Sketch a diagram to show the direction of the velocity just before hitting the ground.

(iii) Calculate

1. the time of flight,

2. the distance x,

3. the velocity just before hitting the ground.

[

(c) A particle of mass 0,015 kg undergoes simple harmonic motion with an amplitude of 0,030 m and a period of 0,25s.

(i) Calculate the kinetic energy when the displacement is 0,020 m.

(ii) Sketch the graph of the variation of kinetic energy with displacement.

(iii) State any two assumptions made in c(i).

2 (a) State the laws of reflection. [2]

(b) A beam of white light is incident on a 60° glass prism at an angle of 40° as shown in Fig. 2.1.

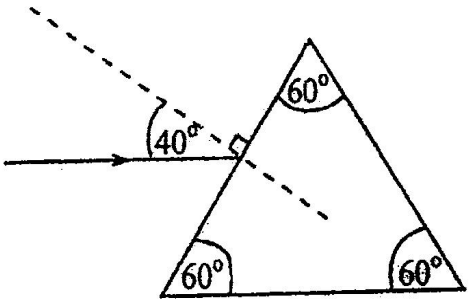


Fig.2.1

The wavelength of blue light is 500 nm. The refractive index of glass when blue light passes through it is 1.50.

(i) Suggest why a spectrum of colours is observed.

(ii) Calculate

1. the angle of refraction for blue light,
2. the frequency of blue light,
3. the angle of incidence of blue light on the glass-air boundary.

[8]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

POSSIBLE ANSWERS

JUNE 2010

PHYSICS **9188/3**

Section A

1 (a) (i) Random – measured value deviates about the true value/AW
Systematic – reading systematically shifted/all measured values shifted by same factor from true value. [2]

(ii) Random – Repeated readings and averaging/AW
Systematic – Adjust instrument/use different instrument
- plotting a graph of results. [2]

(iii) Percentage error in the value of

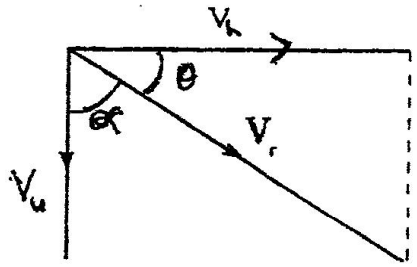
$$\eta = \left(\frac{\Delta m}{m} + \frac{\Delta g}{g} + \frac{\Delta D}{D} + \frac{\Delta s}{S} + \frac{\Delta t}{t}\right) \times 100\%$$

$$= \left(\frac{0{,}001}{0{,}030} + \frac{0{,}01}{9{,}81} + \frac{0{,}1}{9{,}0} + \frac{0{,}001}{0{,}200} + \frac{0{,}01}{0{,}56}\right) \times 100\%$$

$$= 6{,}8\%$$ [3]

(b) (i) Displacement – distance in a specified direction
Velocity – displacement per unit time/AW [2]

(ii) B1



[1]

$$s = ut + \tfrac{1}{2}at^2$$

$$= ut - \frac{1}{2}st^2$$

(iii) 1. From

$$-4 = 0 - 9{,}81\frac{t^2}{2}$$

$$t_f = \left(\tfrac{8}{9{,}81}\right)^{\frac{1}{2}}$$

$$= 0{,}90s$$

[1]

$$x = V_h \times t_f = Vt_f \cos\theta \ (\theta = 0)$$

2. $$= 8.0 \times 0.90s$$

$$= 7{,}2m$$

[1]

3. $V_y = -9.81(0.90) = -8.86 ms^{-1}$

$V_r = \left((8.0)^2 + (8.86)^2\right)^{\frac{1}{2}}$

$= (142.47)^{\frac{1}{2}}$

$= 11.94 ms^{-1}$

$\theta = \cos^{-1}\left(\frac{8}{11.93}\right) = \cos^{-1}(0.6702)$

$= 47,9°$ below horizontal [3]

(c) (i)

$E_K = \frac{1}{2}mv^2$

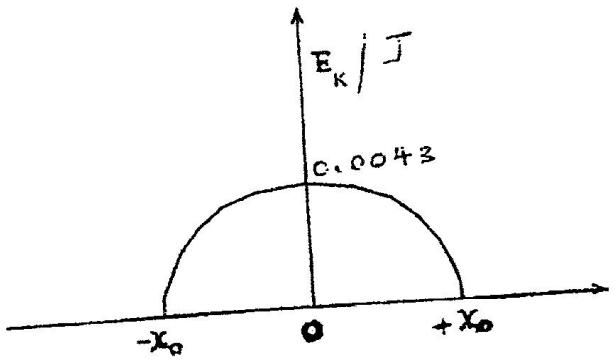
$= \frac{1}{2}mw^2\left(r^2 - a^2\right)$

$= \frac{1}{2} \times 0.015 \times \left(\frac{2\pi}{0.25}\right)^2 \left((0.030)^2 - (0.020)^2\right)$

$= 0,0075 \times 631,65 \times 0,0005$

$= 0,0024 J$ [2]

(ii)



[1]

(iii) zero damping
small amplitude of displacement [2]

2 (a) i = r (angle of incidence i = angle of reflection)
incident ray, reflected ray and normal meet at point of incidence and they all lie in the same plane [2]

(b) (i) Different colours travel at different speeds through glass, white light is a mixture of all wavelengths. [2]

(ii) 1. $1.50 = \frac{\sin 40°}{\sin r_b}$

$r_b = 25,4°$ [2]

2. $f = c/\lambda = 6 \times 10^{14} Hz$ [1]

3. $180 - (64.6 + 60) = 55.4$
Angle of incidence $= 90 - 55.4$
$= 34.6°$ [2]

3 (a) Centripetal force
Centripetal force is provided by gravitational force [1]

(b) (i) Same period as that of the earth
Geostationary satellite [2]

(ii)

$$\frac{GMm}{(R+h)^2} = mw^2(R+h)$$

$$\frac{GM}{w^2} = (R+h)^3$$

$$h = \left(\frac{GM}{w^2}\right)^{1/3} - R$$

$$= \left(6{,}67\times10^{-11}\times6.0\times10^{24}\left(\frac{24\times60\times60}{2\pi}\right)^2\right)^{\frac{1}{3}} - 6.4\times10^{6}$$

$$= 3.6\times10^{7}\ m$$

(3)

$v = 3072.2\ ms^{-1}$

(iii) $\phi = -\frac{GM}{R_h} = \frac{GM}{R+h}$

~~(iii)~~ $= -\frac{6.67\times10^{-11}\times6.0\times10^{24}}{(6.4\times10^{6}+3.6\times10^{7})}$ $[v = \omega r = \omega(R+h)]$

$= -9.44\times10^{6}\ Jkg^{-1}$

[2]

4 (a) In a closed system, total momentum is conserved/AW [1]

(b) (i) 1. $E_K = \frac{1}{2}mv^2$
$= \frac{1}{2}\times9.2\times10^{-3}\times(21)^2$
$= 2.03J$ [2]

2. $m_1u_1 = m_2v_2$
$9.2\times21 = (9.2+55.6)v$
$v = \frac{9.2\times21}{(9.2+55.6)}$
$= 2.98ms^{-1}$ [2]

3. $E_K = \frac{1}{2}mv^2$

$= \frac{1}{2} \times (9.2 + 55.6) \times 10^{-3} \times (2.98)^2$

$= 0.288J$

$mgh = 0.288$

$h = \frac{0.288}{64.8 \times 10^{-3} \times 9.81}$ or $(64.8 \times 10^{-3} \times 9.81)h = 0.288$

$= 0.453m$ [3]

(ii) No drag/air resistance
pellet and cork are a point mass so no external forces [2]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

9188/5

PHYSICS

PAPER 5

JUNE 2010 SESSION 1 hour 15minutes

Additional materials:
Answer paper
Electronic Calculator and / or Mathematical tables
Ruler (mm)

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer paper/answer booklet.

Answer **four** questions.

Question 1 is compulsory.
Answer any other **three** from the remaining questions.

Write your answers on the separate answer paper provided.
If you use more than one sheet of paper, fasten the sheets together.
All working for numerical answers must be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
You are reminded of the need for good English and clear presentation in your answers.

Candidates are advised to spend 30 minutes on **question 1.**

This question paper consists of 8 printed pages.

[Turn over

Data

speed of light in free space,	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7}\ \mathrm{H\,m^{-1}}$
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12}\ \mathrm{F\,m^{-1}}$
elementary charge,	$e = 1.60 \times 10^{-19}\ \mathrm{C}$
the Planck constant,	$h = 6.63 \times 10^{-34}\ \mathrm{J\,s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27}\ \mathrm{kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27}\ \mathrm{kg}$
molar gas constant,	$R = 8.31\ \mathrm{J\,K^{-1}\,mol^{-1}}$
the Avogadro constant,	$N_A = 6.02 \times 10^{23}\ \mathrm{mol^{-1}}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23}\ \mathrm{J\,K^{-1}}$
gravitational constant,	$G = 6.67 \times 10^{-11}\ \mathrm{N\,m^2\,kg^{-2}}$
acceleration of free fall,	$g = 9.81\ \mathrm{m\,s^{-2}}$

Formulae

uniformly accelerated motion, $s = ut + \frac{1}{2}at^2$, $v^2 = u^2 + 2as$

work done on/by a gas, $W = p\Delta V$

gravitational potential, $\phi = -\frac{Gm}{r}$

refractive index, $n = \frac{1}{\sin C}$

resistors in series, $R = R_1 + R_2 + \ldots$

resistors in parallel, $1/R = 1/R_1 + 1/R_2 + \ldots$

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capacitors in series, $1/C = 1/C_1 + 1/C_2 + \ldots$

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pressure of an ideal gas, $p = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$

radioactive decay, $x = x_0 \exp(-\lambda t)$

decay constant, $\lambda = \frac{0.693}{t_{\frac{1}{2}}}$

critical density of matter in the Universe, $\rho_0 = \frac{3H_0^2}{8\pi G}$

equation of continuity, $Av = \text{constant}$

Bernoulli equation (simplified), $p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$

Stokes' law, $F = Ar\eta v$

Reynolds' number, $R_e = \frac{\rho v r}{\eta}$

drag force in turbulent flow, $F = Br^2\rho v^2$

*Answer **question 1 and any other 3** from the remaining questions.*

1 (a) (i) 1. Distinguish between *laminar* and *turbulent flow* as applied to the flow of an ideal fluid.

2. Explain what is meant by *an incompressible fluid.*

(ii) 1. Derive the equation of a continuous flow of an ideal fluid.

2. A water hose with an internal diameter of 20 mm at the outlet discharges 30 kg of water in 60s.

Calculate the water speed at the outlet. [*The density of water is 1 000 kgm^{-3}*]

[8]

(b) (i) Use the definitions of electric current and capacitance to show that

$$C = \frac{I}{fV},$$

where f is frequency and other symbols have their usual meanings.

(ii) **Fig. 1.1** shows a circuit used to investigate the properties of a capacitor. The capacitor is initially not charged.

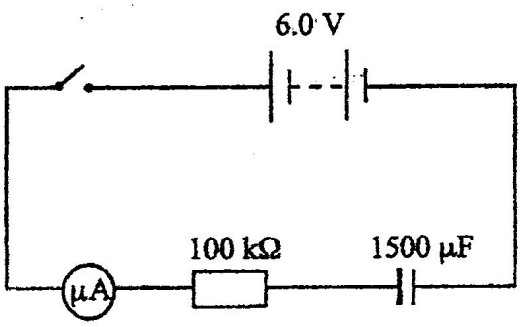

Fig. 1.1

When the switch was closed, the pointer of the ammeter was seen to deflect but after 4.0 minutes there was no deflection at all.

1. Explain this observation.

2. Sketch a graph to show how the voltage, V, across the 100 kΩ resistor varies with time.

3. Calculate the value of the current which flows in the circuit at the instant of closing the switch.

[8]

(c) (i) State the photoelectric emission equation.

(ii) **Fig. 1.2** shows a negatively charged gold leaf electroscope being illuminated by a red light of wave length 500 nm. The threshold frequency of potassium is 3.0×10^{14} Hz.

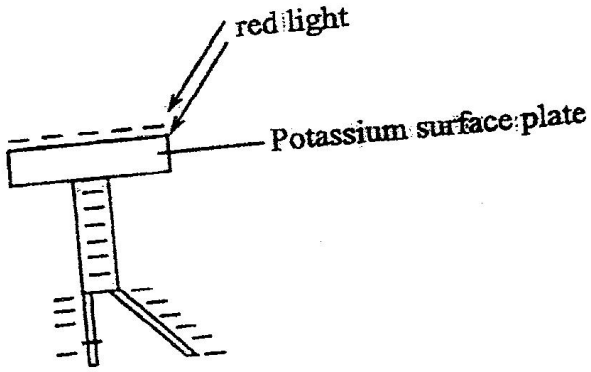

Fig. 1.2

1. Describe and explain the effect of the red light on the electroscope.
2. State the effect of increasing the brightness of the red light on the electroscope.
3. Calculate the maximum velocity of the emitted electrons. [8]

2 (a) State Lenz's law of electromagnetic induction. [1]

(b) **Fig. 2.1** shows a coil fixed to a light trolley. The coil is given an initial push towards the wooden wall.

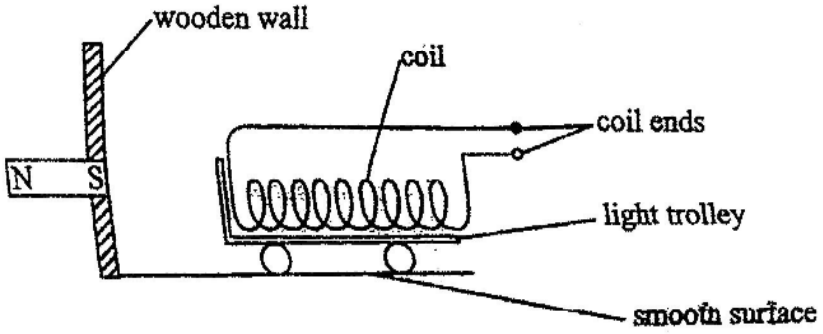

Fig. 2.1

(i) Sketch the variation of the e.m.f. induced in the coil against time if the two ends of the coil are connected to a high resistance voltmeter.

(ii) Explain the shape of your graph in (i)

(iii) Describe and explain what would happen to the motion of the trolley if the experiment was repeated with the coil ends connected together.

(iv) Calculate the e.m.f. induced in the coil if the rate of change of magnetic flux is 0.5 Wb/hr and the number of turns of coil is 5 000. [11]

3 (a) (i) Describe the structure of a thermocouple thermometer.

(ii) State one *merit* of a thermocouple thermometer over other thermometers.

(iii) The potential differences across the junctions of a thermocouple thermometer, when the hot junction is at $0°C$, $100°C$ and θ, are 6.0 mV, 8.4 mV and 14.4 mV respectively.
Find the value of θ. [7]

(b) (i) Define *specific latent heat of vaporisation.*

(ii) Explain why one feels cold when wind blows on one's wet body. [5]

4 (a) Explain what is meant by *quantisation of charge*. [1]

(b) State and explain what happens to the kinetic energy of a charged body moving through a uniform magnetic field. [2]

(c) In the Millikan experiment, to find the charge of an electron, e, the following results were obtained for various sizes of oil drops.

Experiment number	1	2	3	4	5	6
Charge/x10^{-19}C	11.35	12.96	3.24	4.82	6.40	6.42

Determine the value of e from these results. [4]

(d) (i) An electron emitted from a hot cathode in an evacuated tube is accelerated by a p.d. of 1.2×10^3 V.

Calculate the kinetic energy and the speed acquired by the electron.

(ii) Explain any changes that would occur if the electron is accelerated in air. [5]

(a) Fig. 5.1 shows an alarm circuit to wake up school children in the morning.

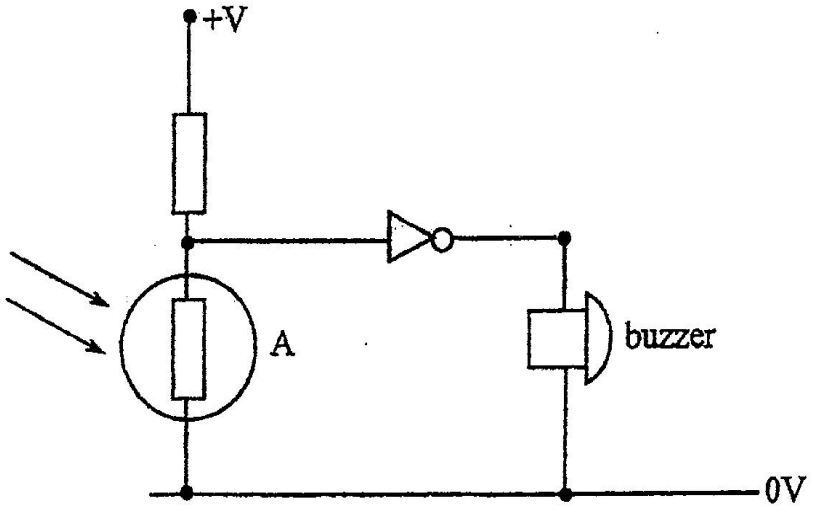

Fig. 5.1

(i) State the name of component **A.**

(ii) Describe and explain how the circuit operates.

(iii) Draw a truth table for the circuit. [7]

(b) Briefly outline **three positive and two negative** impacts of modern electronic technology on society. [5]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

POSSIBLE ANSWERS

JUNE 2010

PHYSICS

9188/5

1 (a) (i) 1. *Lamina*: one in which streamlines are parallel

Turbulent: streamlines do cross each other [2]

2. Fluid with a constant density [1]

(ii) 1. mass that enters per second equals mass that leaves per second

$\rho A_1 V_1 = \rho A_2 V_2$

density of fluid is the same/fluid incompressible

AV = constant

2. ρAV = mass flow per sec. [3]

$$V = \frac{30}{60} \times \frac{4}{\pi\left(20 \times 10^{-3}\right)^2 1000}$$

$V = 1.59 m/s$ [2]

(b) (i) $I = \frac{Q}{t} = Qf$

$C = \frac{Q}{V} = \frac{I}{f.V}$ [2]

(ii) 1. Initially capacitor charges and current flows
when capacitor is fully charged no current flows. [2]

2.

See text.

[2]

3. $I = \frac{6.0}{100 \times 10^3}$

$= 6.0 \times 10^{-5} A$ [2]

(c) (i) $hf = \phi + \frac{1}{2}mv^2$, terms explained correctly

(ii) 1. leaf will converge/fall
emitted electrons escape

electrons repelled by electric field around the charged plate [3]

[1]

2. faster convergence

3. $V = \sqrt{2\frac{(hf - hf_o)}{9.1\times10^{-31}}}$

$f = \frac{c}{\lambda} = 6\times10^{14}$

[3]

$v = 6.6\times10^{5} m/s$ [1]

2 (a) Induced magnetic flux opposes the flux change causing it

(b) (i)

Shape

magnitude of first $\frac{1}{2}$ cycle> 2nd $\frac{1}{2}$ cycle [3]
two e.m.f. cycles in opposite direction

(ii) *Explanation*:

- energy lost due to collision [2]
- trolley reverses direction

(iii) Trolley does not reach wall
since current produced produces B field in coil
flux induced oppose the flux due to magnet
trolley comes to rest since mechanical energy is converted to heat [4]

(iv) $E = (-)N\frac{d\phi}{dt}$

$= (-)5000\times\frac{0.5}{3600}$

[3]

$= (-)0.69V$

3 (a) (i) (Diagram showing) two junctions
- evidence of two metals
- voltmeter connected

[3]

(ii) Can measure rapidly changing temperatures [1]

(iii) $\theta = \frac{V\theta - Vo}{V_{100} - Vo} \times 100$

$= \frac{(14.4 - 6.0)}{8.4 - 60} 100$

$= 350°C$ [3]

(b) (i) energy per unit mass
required to change a liquid into vapour at constant temperature [2]

(ii) water molecules gain energy from body (less than lv)
body loses energy to wind
water molecules gain energy from wind also so have enough energy to escape from body (Lv) [3]

4 (a) Charge can only be found as a whole number of multiples of the elementary charge e/AW [1]

(b) magnetic force does not change magnitude of velocity.
Kinetic energy α to (velocity)^2 [2]

(c) $12.96 - 11.35;\ 4.82 - 3.24;\ 6.40 - 4.82;\ 6.42 - 4.82$

$\frac{(1.61 + 1.58 + 1.58 + 1.60)10^{-19}}{4}$

$= 1.59 \times 10^{-19} C$ [4]

(d) (i) $E_k = eV = 1.6 \times 10^{-19} \times 1.2 \times 10^3$
$= 1.92 \times 10^{-16} J$

$\frac{1}{2}mv^2 = 1.92 \times 10^{-16}$

$v = 2.05 \times 10^7 m/s$ [3]

(ii) less speed
collision with air molecules [2]

5 (a) (i) light dependant resistor/LDR [1]

(ii)
- when light falls on LDR p.d. across it decreases
- causes a low input to NOT gate
- therefore high output and buzzer sounds

[3]

- when dark, p.d across LDR is very high so low output from NOT gate and buzzer does not sound. [1]

(iii)

INPUT	OUTPUT
Dark	No sound
Light	Sound

Accept use of defined "1" and "0" [2]

(b) *Negatives* e.g.

- unemployment as machinery can perform same tasks in place of people
- military surveillance for wanton destruction
- cultural decadence due to exposure to pornography or other cultures

[Max 2]

Positives e.g.

- high speed communication through use of cellphones, satellites, etc
- efficient reporting
- reduction in size of home gadgets etc
- improved security for houses
- etc

[Max 3]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS 9188/1

PAPER 1 Multiple Choice

NOVEMBER 2010 SESSION 1 hour

Additional materials:
Electronic calculator and/or Mathematical tables
Multiple Choice answer sheet
Soft clean eraser
Soft pencil (Type B or HB is recommended)

TIME 1 hour

INSTRUCTIONS TO CANDIDATES

Do not open this booklet until you are told to do so.

Write your name, Centre number and candidate number on the answer sheet in the spaces provided unless this has already been done for you.

There are **forty** questions in this paper. Answer **all** questions. For each question there are four possible answers, **A, B, C** and **D**. Choose the **one** you consider correct and record your choice in **soft pencil** on the separate answer sheet.

Read very carefully the instructions on the answer sheet.

INFORMATION FOR CANDIDATES

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

This question paper consists of 15 printed pages and 1 blank page.

Formulae

uniformly accelerated motion, $s = ut + \frac{1}{2}at^2$, $v^2 = u^2 + 2as$

work done on/by a gas, $W = p\Delta V$

gravitational potential, $\phi = -\frac{Gm}{r}$

refractive index, $n = \frac{1}{\sin C}$

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resistors in parallel, $1/R = 1/R_1 + 1/R_2 + \ldots$

electric potential, $V = \frac{Q}{4\pi\epsilon_0 r}$

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pressure of an ideal gas, $p = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$

radioactive decay, $x = x_0 \exp(-\lambda t)$

decay constant, $\lambda = \frac{0.693}{t_{\frac{1}{2}}}$

critical density of matter in the Universe, $\rho_0 = \frac{3H_0^2}{8\pi G}$

equation of continuity, $Av = \text{constant}$

Bernoulli equation (simplified), $p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$

Stokes' law, $F = Ar\eta v$

Reynolds' number, $R_e = \frac{\rho v r}{\eta}$

drag force in turbulent flow, $F = Br^2\rho v^2$

1 The relationship between $\propto$, p, q and t is given by $\propto = q + pt$ where t is time in seconds.

If p has units of ms^{-1} what are the units of q?

A ms^{-1}
B ms^{-2}
C ms
D m

2 Which of the following is a vector?

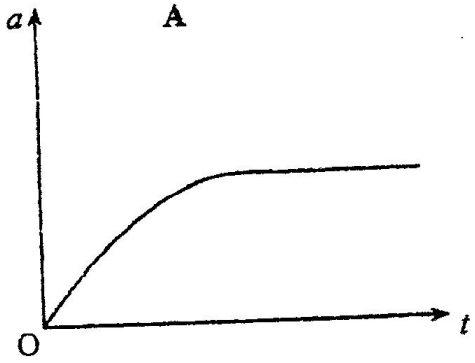
A charge
B electric current
C potential difference
D resistance

3 Which statement is true?

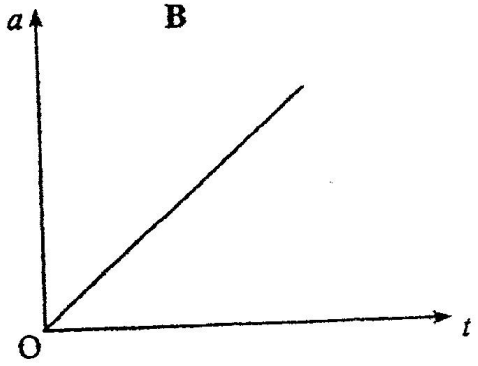
A A measurement is most accurate if the percentage error is smallest.
B A measurement is most accurate if the reading is obtained from digital meters.
C A measurement is most precise if repeated readings show greater deviation.
D A measurement is most precise if repeated readings are taken with various instruments.

4 Which acceleration - time graph represents a ball falling from the top of a very tall building in still air?

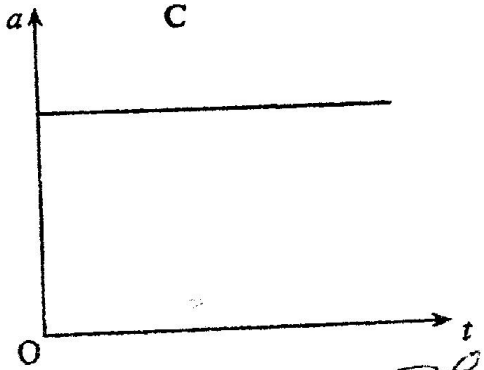
A



B



C



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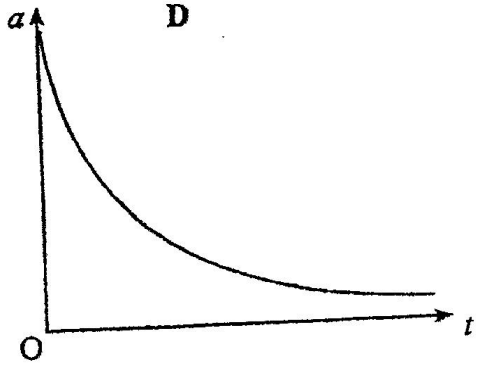


5 Two toy cars of mass 2 kg and 4 kg were travelling in the same direction with speeds 4 ms^{-1} and 1 ms^{-1} respectively. They move off together after impact.

What is the amount of kinetic energy lost?

A 4 J
B 6 J
C 12 J
D 18 J

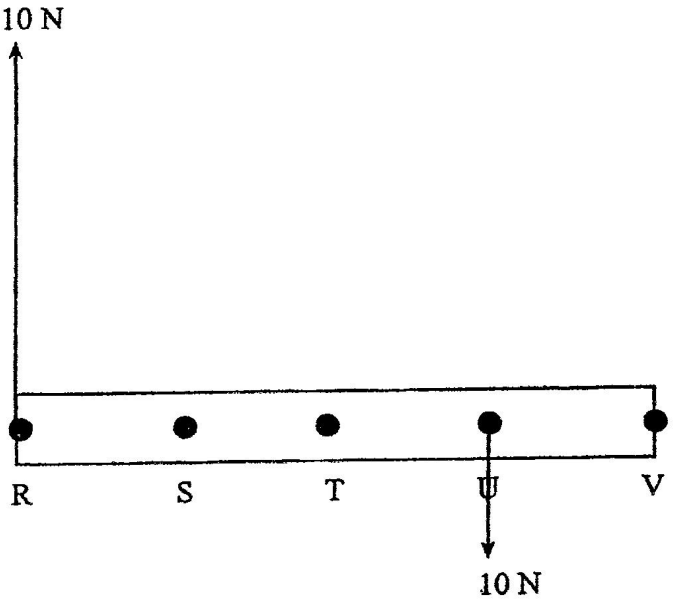
6 When a constant force ,*F*, acts on a truck over a distance ,*s*, for a time ,*t*. The momentum gained by the truck is given by

A $F \times s$
B $\frac{1}{2} F \times s$
C $F \times t$
D $F \times t \times s$

7 What can be said about the resultant force acting on a body moving with uniform velocity?

A it is zero
B it is constant
C it increases uniformly with time
D it decreases uniformly with time

8 A uniform bar RV of weight 15 N is held horizontal by vertical forces as shown in the diagram. The points R, S, T, U and V are at equal intervals along the bar. (**N.B.** ***forces not drawn to scale***)



At which point must an upward force of 15 N act to keep the bar in equilibrium?

A R
B S
C T
D V

[Turn over

9 A force of 60 N acts horizontally on a stationary mass of 20 kg for 40 s. The kinetic energy gained by the mass is

A 1200 J
B 48 J
C 72 kJ
D 144 kJ

10 A body of mass, m, moves at a constant angular speed, ω, in a horizontal circle of radius, r.

What is the work done on the body in one revolution?

A. $2\pi mr^2\omega^2$
B. $m\omega^2r^2$
C. $\frac{1}{2}mr^2\omega^2$
D. zero

11 Two satellites R and S describe circular orbits of radii 6 000 km and 7 000 km respectively about the centre of the earth.

If R and S complete one full orbit of the earth in times T_R and T_S respectively, then the ratio T_R/T_S is

A $(7/6)^{3/2}$
B $(6/7)^{2/3}$
C $(6/7)^{3/2}$
D $(7/6)^{2/3}$

12 A body in simple harmonic motion makes n complete oscillations per second.

What is the angular frequency of this motion?

A n rads^{-1}

B $\frac{2\pi}{n}$ rads^{-1}

C $2\pi n$ rads^{-1}

D $\frac{1}{n}$ rads^{-1}

13 Which electromagnetic waves have the lowest frequency?

A X-rays
B ultra-violet
C infrared
D microwaves

14 When a white source of light is used in the Young's two slit experiment,

A the fringes on the screen are all white.
B the blue fringes are further apart than red fringes.
C the central fringe of the system is white.
D no fringes are produced.

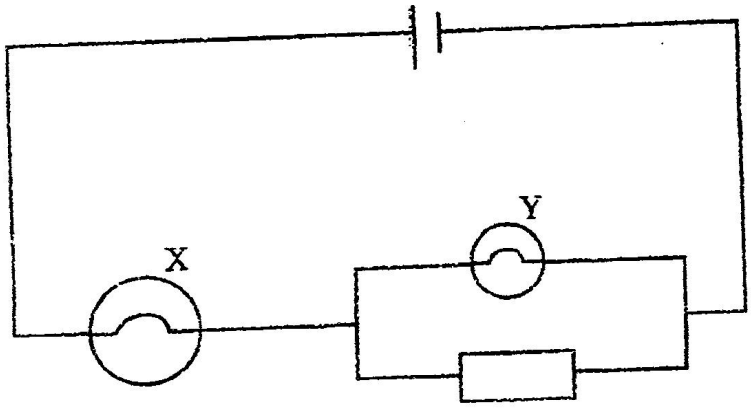
15 Which statement explains the increase in the resistance of copper with temperature?

A The positive ion impedes the electrons more effectively at higher temperatures.
B Electrons are most likely to be captured by positive ions at higher temperatures.
C Electrons move further between collisions at higher temperatures.
D Positive ions begin to move randomly at higher temperatures.

16 Why is it difficult to quote a value for the resistance of a filament lamp?

A current used may be alternating or direct
B current through the filament is not always r.m.s
C filament is always of negligible resistance
D resistance varies with temperature

17 The diagram shows a circuit with two identical lamps X and Y and a resistor.



How does an increase in the resistance of the resistor affect the brightness of the lamps?

	lamp X	lamp Y
A	dimmer	dimmer
B	dimmer	brighter
C	brighter	dimmer
D	brighter	brighter

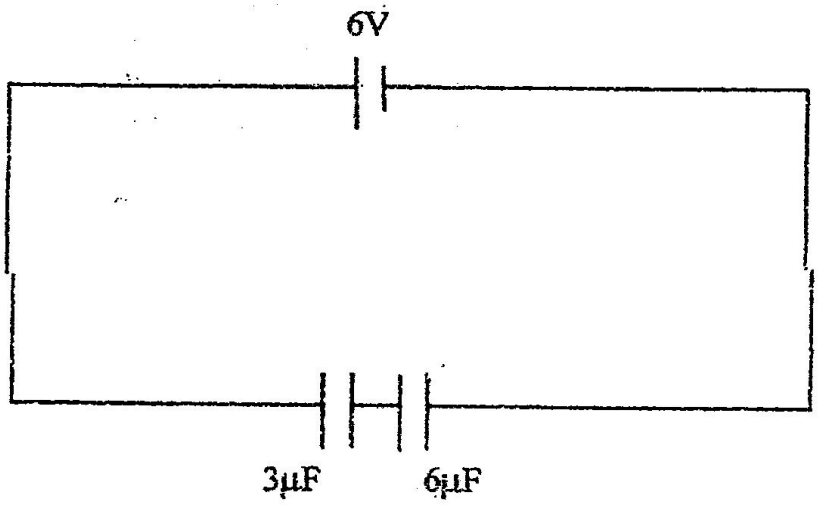
18 What quantities are conserved in Kirchoff's laws?

	law 1	law 2
A	energy	power
B	energy	charge
C	charge	energy
D	current	charge

19 Which statement is correct about a uniform electric field?

A All charged particles experience the same force.
B All electric field lines are parallel.
C All charged particles move with the same velocity.
D All electric field lines are directed towards positive charges.

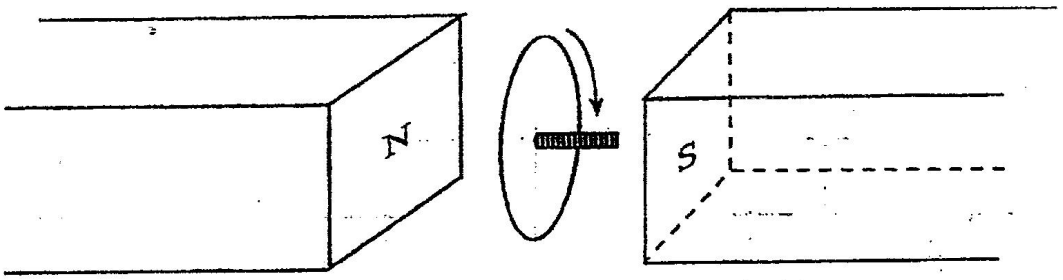
20 The diagram shows capacitors in series.



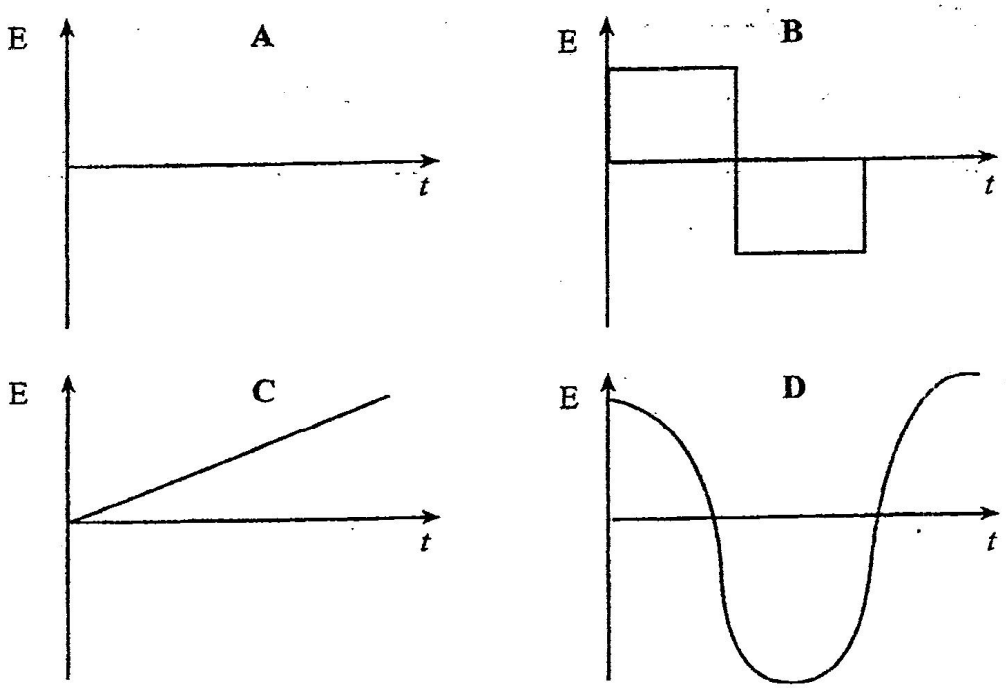
Which statement about the circuit is not correct.

A The combined capacitance is 2 μF.
B The total energy stored is 36 μJ.
C The p.d across the 3 μF capacitor is twice the p.d across the 6 μF capacitor.
D The 6 μF capacitor stores twice the charge that the 3 μF capacitor stores.

21 The diagram shows a copper disc rotating steadily about its centre in a uniform magnetic field perpendicular to the plane of the disc.



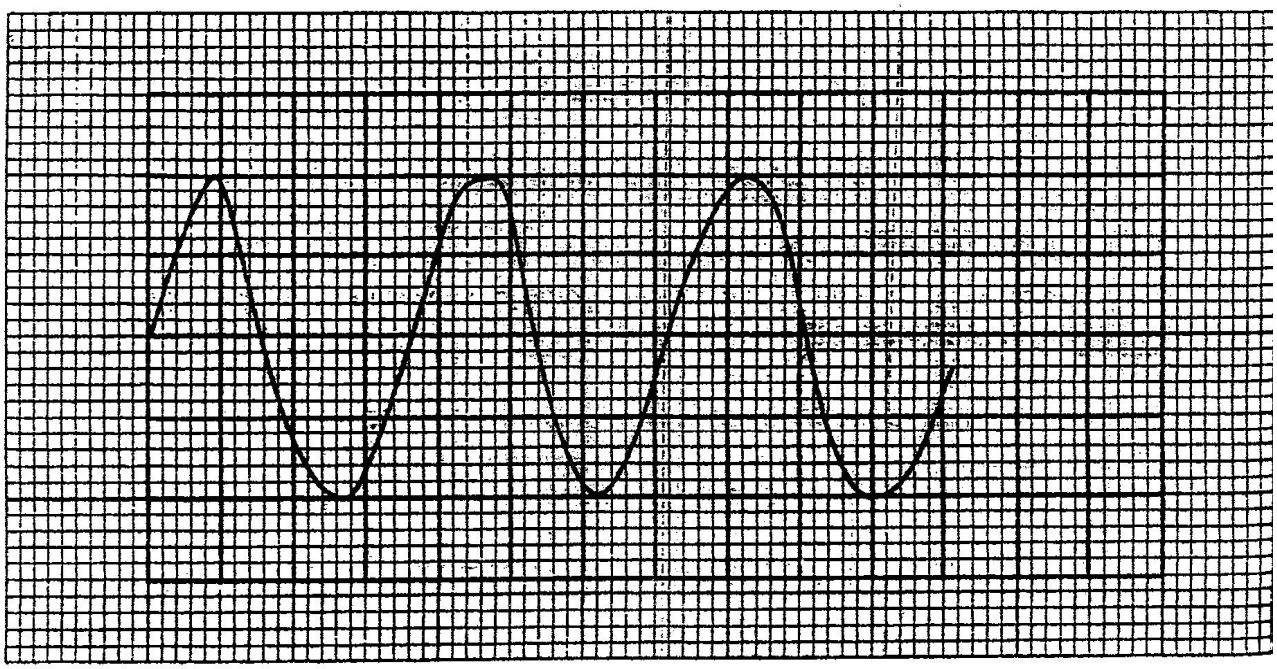
Which graph shows the variation of the induced emf ,E, between the axle and a point ,R, on the rim of the disc with time, t?



22 Which combination correctly matches a law of electromagnetic induction and its implication?

	Law	Implication
A	Faraday's	conservation of energy
B	Lenz's	conservation of energy
C	Faraday's	conservation of mass
D	Lenz's	conservation of mass

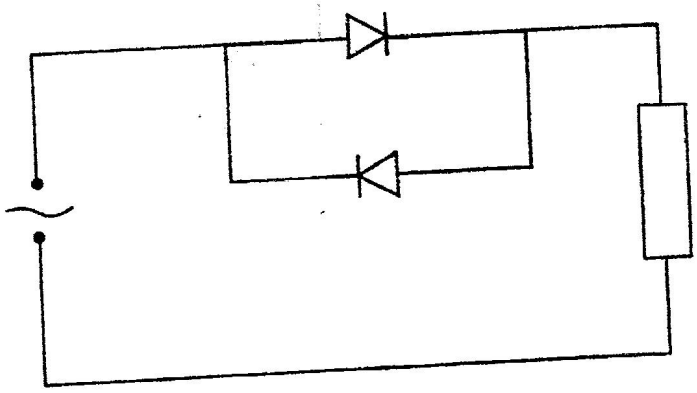
23 The diagram shows an alternating voltage displayed on the screen of a C.R.O. with the Y amplitude control at 6 V/cm.



What is the peak voltage?

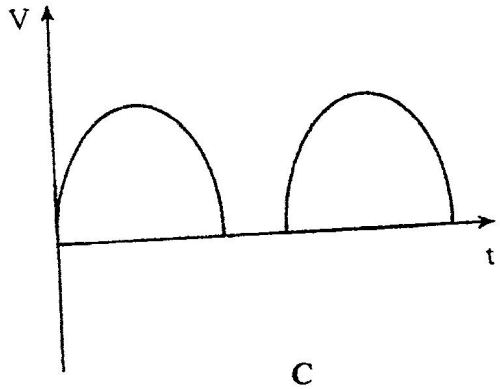
A 6 V
B 9 V
C 12 V
D 24 V

24 A sinusoidal voltage is applied as shown below.

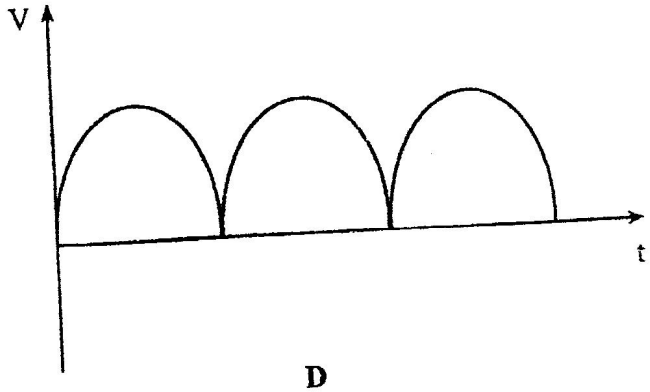


Which graph shows the voltage across the resistor?

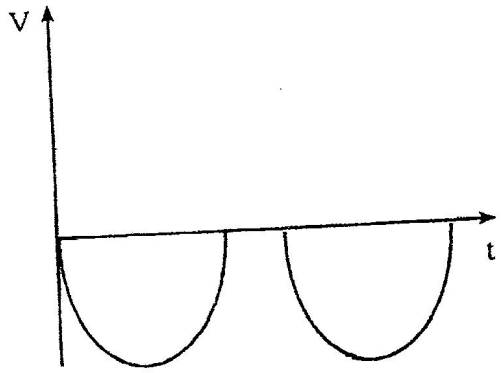
A



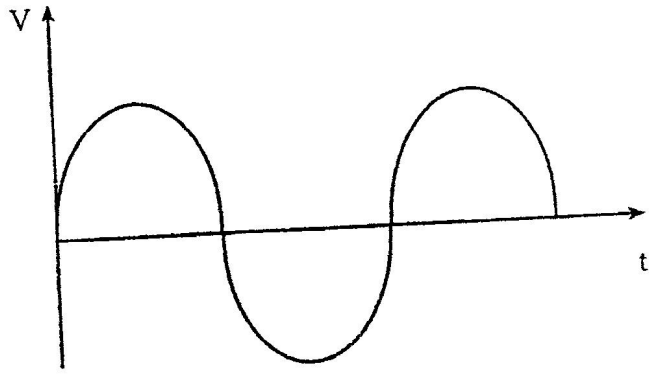
B



C



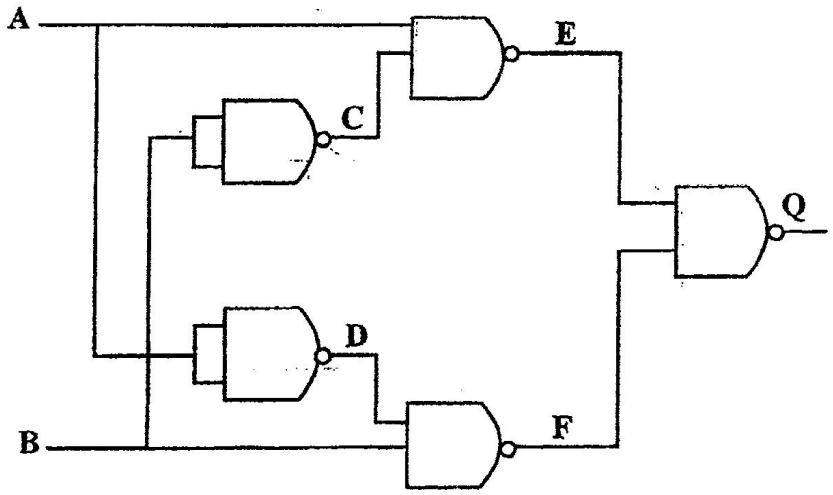
D



25 What is the effect of negative feedback on the gain of an operational amplifier?

A The gain increases.
B The gain decreases.
C The gain remains unchanged.
D The gain increases and decreases.

26 What logic gate is equivalent to the network of gates shown below?



A AND
B EX-OR
C EX-NOR
D NAND

27 Which phenomenon is a consequence of applying cyclic stress insufficient to cause immediate failure to a material?

A fatigue
B creep
C elastic deformation
D plastic deformation

28 What does the area under a force-extension graph represent?

A stress
B strain
C work done
D Young Modulus

29 Liquid-in-glass thermometers have limited use because

A glass expands and contracts just taking many hours to reach correct size.
B the accuracy of calibration depends upon whether or not the thermometer is upright.
C they can not follow rapidly changing temperature.
D non-uniform above limits the accuracy to about 1°C.

30 For an expanding ideal gas, the first law of thermodynamics can be written as

$\Delta Q = \Delta U + \Delta W$.

Which statement is correct?

A ΔW is work being done on the gas.
B ΔU is zero when no heat leaves or enters the gas.
C ΔW is work being done by the gas.
D $\Delta Q = -\Delta W$ when temperature increases slowly.

31 Which statement is **not** a correct assumption of the kinetic theory of ideal gases?

A The duration of a collision is negligible compared with the interval between collisions.
B The volume of the molecules is negligible compared with the volume in which they move.
C There is negligible attraction between molecules in a system.
D There is negligible momentum change on collision between molecules and container walls.

32 When watering using a hose pipe squeezing the end of the pipe squirts the water and makes the jet of water travel a long distance from the end of the pipe.

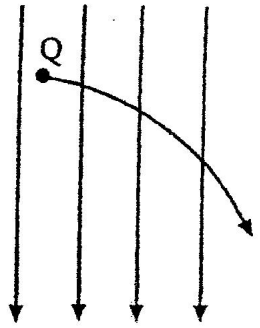
This is because

A rate of water flow has increased.
B speed with which the water leaves the pipe has increased.
C pressure with which the water leaves the pipe has increased.
D rate of water flow has decreased.

33 The element of a geyser is at the bottom and not at the top to allow

A conduction.
B convection.
C radiation.
D evaporation.

34 The diagram shows the motion of a particle Q moving in a uniform field



Which conditions could apply to the particle?

	particle	field
A	electron	electric
B	electron	gravitational
C	proton	electric
D	proton	gravitational

35 Which statement explains why a charged particle in a magnetic field may not experience a force?

A The particle is moving at a high speed.
B The particle is moving parallel to the magnetic field lines.
C The particle is moving at a low speed.
D The particle is moving perpendicular to the magnetic field lines.

36 In photo electricity, threshold wavelength of a metal surface

A is given by hc/W_0, where W_0 is work function.
B increases with the frequency of incident light.
C decreases with the intensity of the incident of the incident light.
D is given by hW_0/c, where W_0 is work function.

37 Einstein's equation for the photoelectric effect is

A $hf = hf_o + eV_s$.
B $hf_o = hf + \frac{1}{2}mv^2_{max}$.
C $\frac{1}{2}mv^2 = \phi + hf$.
D $\phi = \frac{1}{2}mv^2_{max} - hf$.

38 Isotopes are atoms with different

A proton numbers.
B neutron numbers.
C electron numbers.
D atomic numbers.

39 A piece of a radioactive element has initially N_o atoms. Each atom decays to form a more stable daughter. The half life of the radioactive element is 2 days.

The number of daughters formed in 6 days is

A $N_o/2$.
B $N_o/4$.
C $N_o/8$.
D $7N_o/8$.

40 Which of the following has the highest ionising ability?

A α particle
B β particle
C γ- ray
D X-ray

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

MARKING SCHEME

NOVEMBER 2010

PHYSICS

9188/1

1	D
2	B
3	A
4	D
5	B
6	C
7	A
8	D
9	C
10	D
11	C
12	C
13	D
14	C
15	A
16	D
17	B
18	C
19	B
20	D
21	A
22	B
23	C
24	D
25	B
26	B
27	A
28	C
29	C
30	C
31	D
32	B
33	B
34	C
35	B
36	A
37	A
38	B
39	D
40	A

Candidate Name	Centre Number	Candidate Number

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

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PHYSICS 9188/2

PAPER 2

NOVEMBER 2010 SESSION 1 hour 15 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator and/or Mathematical tables

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.
For numerical answers, **all** working should be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

This question paper consists of 12 printed pages.

Formulae

uniformly accelerated motion, $s = ut + \frac{1}{2}at^2$, $v^2 = u^2 + 2as$

work done on/by a gas, $W = p\Delta V$

gravitational potential, $\phi = -\frac{Gm}{r}$

refractive index, $n = \frac{1}{\sin C}$

resistors in series, $R = R_1 + R_2 + \ldots$

resistors in parallel, $1/R = 1/R_1 + 1/R_2 + \ldots$

electric potential, $V = \frac{Q}{4\pi\epsilon_0 r}$

capacitors in series, $1/C = 1/C_1 + 1/C_2 + \ldots$

capacitors in parallel, $C = C_1 + C_2 + \ldots$

energy of charged capacitor, $W = \frac{1}{2}QV$

alternating current/voltage, $x = x_0 \sin \omega t$

hydrostatic pressure, $p = \rho gh$

pressure of an ideal gas, $p = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$

radioactive decay, $x = x_0 \exp(-\lambda t)$

decay constant, $\lambda = \frac{0.693}{t_{\frac{1}{2}}}$

critical density of matter in the Universe, $\rho_0 = \frac{3H_0^2}{8\pi G}$

equation of continuity, $Av = \text{constant}$

Bernoulli equation (simplified), $p_1 + \frac{1}{2}\rho v_1^2 = p_2 + \frac{1}{2}\rho v_2^2$

Stokes' law, $F = Ar\eta v$

Reynolds' number, $R_e = \frac{\rho v r}{\eta}$

drag force in turbulent flow, $F = Br^2\rho v^2$

*Answer **all** questions.*

1 (a) (i) Explain the meaning of *a base unit*.

_____

_____ [1]

(ii) The speed v of sound in a gas is given by $v = \sqrt{\frac{\delta p}{\rho}}$

where p is the pressure of the gas of density ρ and δ is a constant.

Determine the unit of δ.

unit of δ = _____

[2]

(b) A coin has a diameter of $(0{,}50 \pm 0{,}02)$ mm.

Calculate its cross-sectional area and its uncertainty.

cross - sectional area = _____ ± _____

[3]

2 (a) Define

(i) *inertia*,

(ii) *momentum*.

[2]

(b) (i) Using Newton's second law, show that the external force, F, is given by F = ma, where all symbols have their usual meanings.

(ii) Hence explain the importance of 'bumpers' on vehicles.

[5]

3 (a) **Fig. 3.1(a)** shows the variation of displacement y with distance s along a wave at a given time and **Fig. 3.1(b)** shows how displacement, y, varies with time, t, of wave motion.

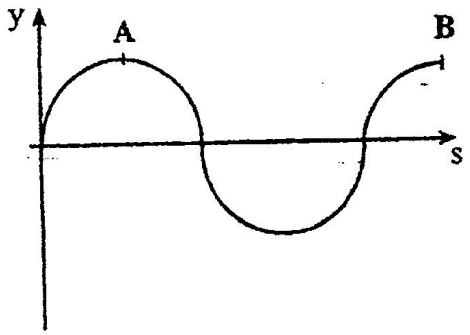

Fig. 3.1(a)

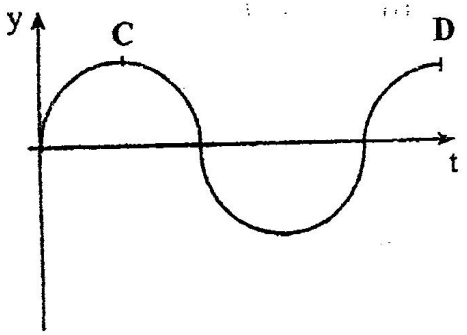

Fig 3.1(b)

State what is represented by

(i) **AB** on **Fig. 3.1(a)**,

_____

(ii) **CD** on **Fig. 3.1(b)**,

_____

(iii) $\frac{\mathbf{AB}}{\mathbf{CD}}$.

_____ [3]

(b) Define

(i) *critical angle*,

_____

_____

(ii) *total internal reflection.*

_____

_____

_____ [3]

4 A cell of emf 2.2 V and negligible internal resistance is connected to a combination of resistors as shown in **Fig. 4.1**.

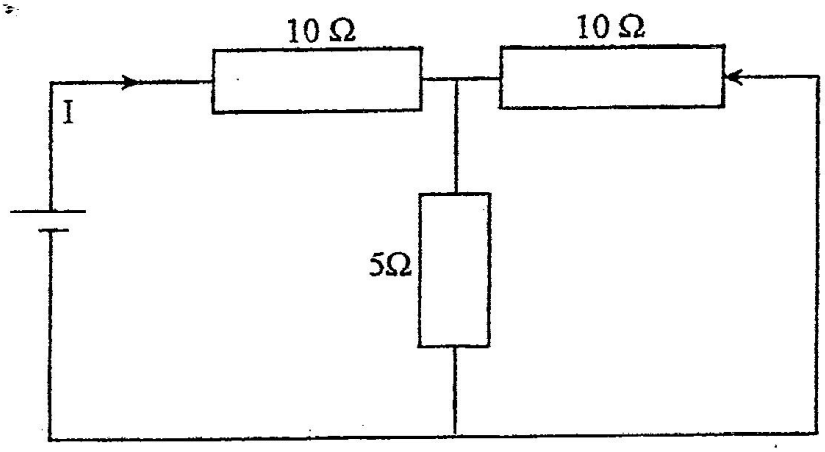

Fig. 4.1

Calculate

(i) effective resistance across the terminals of the cell,

resistance = _____ [3]

(ii) the current, I,

I = _____ [1]

(iii) p.d. across the 5 Ω resistor.

p.d = _____ [2]

5 (a) Define *the farad.*

_____

_____

_____ [1]

(b) Two uncharged capacitors of capacitance 30 μF and 25 μF are connected in series with a 12 V supply.

Calculate

(i) the total capacitance,

total capacitance = _____

(ii) the charge delivered by the supply,

charge = _____

(iii) the p.d. across the 30 μF capacitor.

p.d = _____ [6]

6 (a) (i) Define *magnetic field strength*

_____

_____

_____ [2]

(ii) A test wire of length 0.05 m was placed at 30° to the field lines between the poles of a horse-shoe magnet. When a current of 2.5 A is passed through the test-wire, the wire experiences a force of 0.025 N.

Calculate the magnetic field strength of the magnet.

magnetic field strength = _____ [2]

(iii) Describe what happens to the force when the angle of inclination, θ, between the wire and field lines is 0°.

_____

_____

_____ [1]

(b) **Fig. 6.1** shows a current-carrying wire, out of paper, held at right angles to the magnetic field of a horse-shoe magnet.

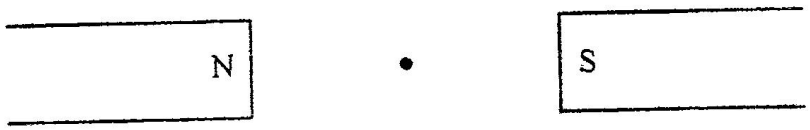

Fig. 6.1

On **Fig. 6.1**, show the resultant magnetic field lines of the magnetic fields due to the magnet and current. [2]

7 (a) State **two** features of an ideal operational amplifier.

_____

_____ [2]

(b) Distinguish between **negative** and **positive feedback**.

_____

_____

_____

_____ [2]

(c) **Fig. 7.1** shows an inverting amplifier.

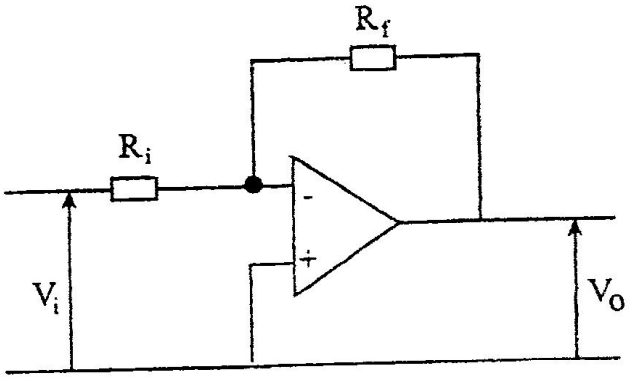

Fig. 7.1

(i) On **Fig. 7.1** label the virtual earth, E. [1]

(ii) Derive an expression for the gain of this amplifier.

[3]

8 (i) State **two** magnetic effects that contribute to the inefficiency of a power transformer.

1. _____

2. _____

(ii) Give **two** reasons why oil is used in large power transformers.

1. _____

2. _____

(iii) Explain how a buzzing sound is produced in large power transformers.

_____

_____

_____

[6]

9 A radioactive isotope contains 10^{15} atoms and has a *half-life* of 24 hours.

(i) Define the term *half-life*.

_____

_____

(ii) Calculate

1. the decay constant,

decay constant = _____

2. the number, N, of the remaining atoms after 36 hours.

N= _____

[7]

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POSSIBLE ANSWERS

NOVEMBER 2010

PHYSICS

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1 (a) (i) A base unit is independent of other units i.e. not derived from other units. 1

(ii) $\delta = \frac{v^2 \rho}{p}$

Base units of $\delta = \frac{(ms^{-1})^2 kgm^{-3}}{kgm^{-1}s^{-2}}$

$(= \quad 1)$ 1

$\therefore$ δ has no units/dimension less 1

(b) Cross-sectional area = $\pi r^2 = \frac{22}{7}\left(\frac{0.50}{2}\right)^2$

$= \quad 0.196 \text{ mm}^2$ 1

Uncertainty in area = $\frac{2\Delta d}{d} . A$

$= \quad 2.\frac{0.02}{0.50} . 0.196 \text{ mm}^2$

$= \quad 0.016 \text{ mm}^2$ 1

$\therefore$ Area = $(0.20 \pm 0.02) \text{ mm}^2$ 1

2 (a) (i) the tendency of a body to resist change of its dynamic state (velocity) 1

(ii) the product of mass (m) and velocity (v) 1

(b) (i) $F \propto \frac{mv - mu}{t}$

$F = K\left(\frac{mv - mu}{t}\right) = Km\left(\frac{v - u}{t}\right) = kma$ 1

By definition if F = IN, m = 1 kg and a = ~~1 ms^{-2}~~ 1 ms^{-2} then k = 1 1

$F = ma \qquad$ since $a = \frac{v - u}{t}$ 1

(AO)

(ii) Bumpers make the time of impact longer/reduce rate of change of momentum 1

damage reduced on vehicle or occupants as F is reduced 1

3 (a) (i) wavelength 1
(ii) period 1
(iii) wave speed 1

(b) (i) critical angle – angle of incidence at which the refracted ray passes along the boundary i.e. angle of refraction is 90° 1

(ii) Total internal reflection occurs when angle of incidence exceeds the critical angle 1

and light is reflected in the optically denser medium 1

4 (i) $\frac{1}{R}=\frac{1}{5}+\frac{1}{10}$ C1

$R = 3.33\ \Omega$ 1

Effective resistance $= 10\ \Omega + 3.33\ \Omega$
$= 13.33\ \Omega$ 1

(ii) $I=\frac{V}{R}=\frac{2.2}{13.33}=0.165A/0.17A$ 2

(iii) pd across 5Ω, $V_{5\Omega} = 2.2 - 10\ I$ 1

$= \quad 2.2V - 1.65\ V$

$= \quad 0.55\ V$ 1

5 (a) $C = Q/V$, Q and V defined/ is the capacitance when IC charge is stored across a potential difference of IV 1

(b) (i) $\frac{1}{C}=\frac{1}{C_1}+\frac{1}{C_2}$

$C=\frac{C_1C_2}{C_1+C_2}=\frac{30.25}{30+25}$ 1

$= \quad 13{,}64\ \mu F$ 1

(ii) $Q = CV = 13{,}6 \times 10^{-6} \times 12$ 1

$= \quad 1{,}63 \times 10^{-4} C$ 1

(ii) $p.d = \frac{Q}{C}=\frac{1{,}6\times10^{-4}}{30\times10^{-6}}$ 1

$= \quad 5{,}45\ V$ 1

6 (a) (i) is the magnetic force per unit length per unit current, on a current carrying conductor at right angles to the field lines; 2

(ii) $B = \frac{F}{Il\sin\theta}$ 1

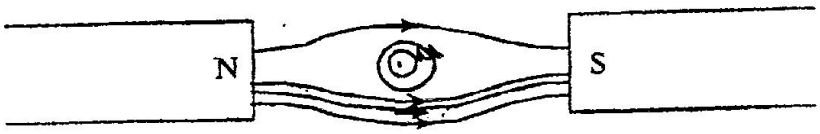
$= \frac{0.025}{2.5 \times 0.05 \sin 30°}$

$= 0.4\ T$ 1

(iii) $F = BIl\sin\theta$

$\theta = 0° \Rightarrow F = 0$ i.e. no force on the conductor 1

(b)



* Distribution of field lines; 1

* Arrows showing direction of lines; 1

7 (a)
- infinite input impedance 1
- zero output impedance 1
- infinite open loop gain 1
- infinite bandwidth 1
- infinite slew rate 1

Max 2

(b) negative feedback – part of the output signal is fed to inverting input. 1

positive feedback – part of the output signal is fed to the non-inverting input. 1

(c) (i) E – at where the lines for the Rf and Ri meet 1

(ii) At virtual earth current = 0

$\frac{Vi}{Ri} + \frac{Vo}{Rf} = 0$ 1

$\frac{Vo}{Rf} = -\frac{Vi}{Ri}$

$\frac{Vo}{Vi} = -\frac{Rf}{Ri}$ 1

8 (i) 1. Eddy currents 1

2. hysteresis 1

(ii) 1. Heat is generated/oil is a coolant/AW 1

2. Oil is an efficient insulating medium (at normal (hot) opening temperature)/AW 1

(iii) expansion 7 contraction of core; 1
At frequency double that of mains/at sound frequency/AW; 1

9 (i) The time taken for the number of active nuclei present in sample to decay to half of the original value 1

(ii) 1.

$$\lambda = \frac{0.693}{T_{\frac{1}{2}}} = \frac{0.693}{24 \times 60 \times 60}$$

$= 8.021 \times 10^{-6}\ S^{-1}/0{,}029\ hr^{-1}$ 1

2. $N = \left(\frac{1}{2}\right)^n No = \left(\frac{1}{2}\right)^{1.5} 10^{15}$ 1

$= 3.54 \times 10^{14}$ atoms 1

Or

$N = Noe^{-\lambda t}$

$= 10^{15} e^{-(8.021 \times 10^{-6} \times 36 \times 60 \times 60)}$ 1

$= 3.54 \times 10^{14}$ *atoms* 1

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

9188/3

PHYSICS

PAPER 3

NOVEMBER 2010 SESSION

50 minutes

Additional materials:
- Answer paper
- Electronic Calculator and / or Mathematical tables
- Ruler (mm)

TIME 50 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer paper/answer booklet.

Answer **three** questions.

Question 1 is compulsory.
Answer any other **two** from the remaining questions.

Write your answers on the separate answer paper provided.
If you use more than one sheet of paper, fasten the sheets together.
All working for numerical answers must be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
You are reminded of the need for good English and clear presentation in your answers.

Candidates are advised to spend 25 minutes on **question 1.**

This question paper consists of 7 printed pages and 1 blank page.

[Turn over

Data

speed of light in free space,	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$
permeability of free space,	$\mu_0 = 4\pi \times 10^{-7}\ \mathrm{H\,m^{-1}}$
permittivity of free space,	$\epsilon_0 = 8.85 \times 10^{-12}\ \mathrm{F\,m^{-1}}$
elementary charge,	$e = 1.60 \times 10^{-19}\ \mathrm{C}$
the Planck constant,	$h = 6.63 \times 10^{-34}\ \mathrm{J\,s}$
unified atomic mass constant,	$u = 1.66 \times 10^{-27}\ \mathrm{kg}$
rest mass of electron,	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$
rest mass of proton,	$m_p = 1.67 \times 10^{-27}\ \mathrm{kg}$
molar gas constant,	$R = 8.31\ \mathrm{J\,K^{-1}\,mol^{-1}}$
the Avogadro constant,	$N_A = 6.02 \times 10^{23}\ \mathrm{mol^{-1}}$
the Boltzmann constant,	$k = 1.38 \times 10^{-23}\ \mathrm{J\,K^{-1}}$
gravitational constant,	$G = 6.67 \times 10^{-11}\ \mathrm{N\,m^2\,kg^{-2}}$
acceleration of free fall,	$g = 9.81\ \mathrm{m\,s^{-2}}$

*Answer **question 1** and **any other 2** from the remaining questions.*

1 (a) (i) Explain the terms *mole* and *Avogadro constant.*

(ii) A group of Physics students measured the mass of a piece of iron. One student quoted the mass as 23 moles and another student gave it as 1.344 kg.

Determine whether these students gave the same value for the mass. [Relative molecular mass for iron is 56] [5]

(b) (i) State Newton's Laws of Motion.

(ii) A bird rests on a telephone cable.

1. Explain why the cable sags no-matter how tight it maybe.

2. If the tension in the sagged part of the cable is 6.0 N, deduce an expression for the weight of the bird. [8]

(c) (i) State two differences between the properties of *microwaves* and *radiowaves.*

(ii) 1. Microwaves from a transmitter are directed normally at a metal plate. A small detector is moved slowly along a line between the metal plate and the transmitter. As the detector moves along the line, the meter reading fluctuates from zero to a maximum.

Explain why the meter reading varies with the position of the probe.

2. Explain how the observations would differ if the metal plate was replaced by a flat cardboard sheet. [7]

2 (a) Express the S.I. unit of pressure in base units. [1]

(b) A gas in a cylinder is allowed to expand at constant pressure so that the volume increased as shown in **Fig. 2.1.**

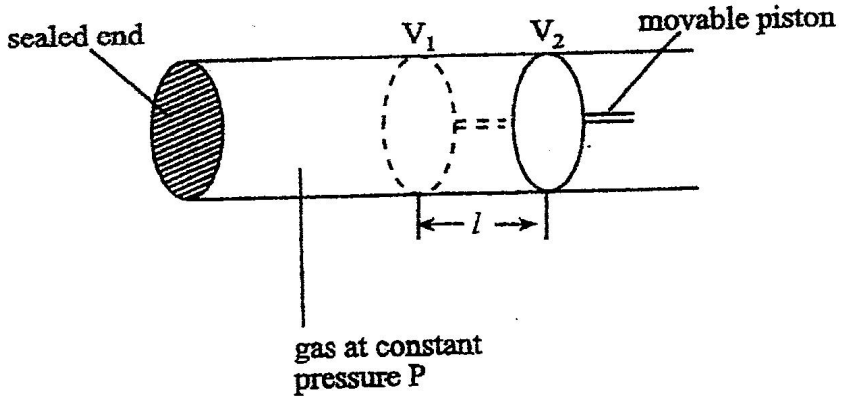


Fig. 2.1

Show that the work, W, done by the gas in expanding is given by

$$W = p(V_2 - V_1).$$ [3]

(c) **Fig. 2.2** shows the variation of pressure of a gas with its volume.

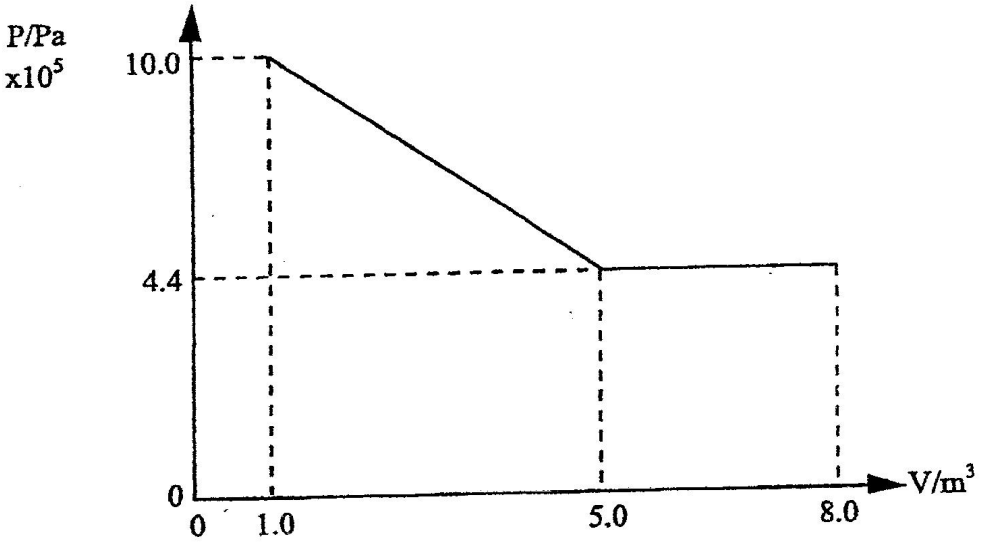


Fig. 2.2

(i) Calculate the workdone by the gas in expanding from 1.0 m^3 to 8.0 m^3.

(ii) An electric heater of 70.8% efficiency was used to heat the gas to make it do the work calculated in c(i) above.

Calculate the cost of using the heater when electricity costs \$20.00 per unit. [6]

3 (a) Define *power* and hence show that power, P, can be expressed as a product of force, F, and velocity, V. [3]

(b) A car of weight 7000 N travels at a constant speed of 8 ms^{-1} up a uniform incline at 15° above the horizontal. The car's motion is opposed by a constant frictional force of 5000 N.

Calculate

(i) the gain in potential energy per second,

(ii) the work done per second against friction,

(iii) the car's engine power.

[5]

(c) The car in (b) now travels down the incline with the same engine thrust and friction.

Calculate its acceleration. [2]

4 (a) (i) Describe how x-rays are produced.

(ii) Explain the use of x-rays in imaging of broken bones. [7]

(b) Describe how lasers can be used in clinical therapy as a scalpel. [3]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

MARKING SCHEME

NOVEMBER 2010

'HYSICS

9188/3

1 (a) (i) mole: amount of substance which has got the same number of particles as are in 12g of C-12 B1

Avogadro constant: number of particles found in 12g of C-12 (Reject $N_A = 6.02 \times 10^{23}$ only) B1

(ii) 23 moles of iron = 56 x 23g C1

= 1.288kg A1

Since 1.288 ≠ 1.344kg, students did **not** give same value B1

(b) (i) The three laws B3

(ii) 1. Bird has weight, vertical components of tension in sagged cable to balance the weight of the bird B1

2.

B1

$W = T\cos\theta + T\cos\theta$ (θ explained) C1

$W = 12\cos\theta$ A1

(c) Wavelength of radiowaves > λ microwaves;

Microwaves have more energy than radiowaves;

Microwaves absorbed by non metals radiowaves not; Max B2

(i) A stationary wave is formed B1
by super position of original and reflected waves B1
zero reading is at every node B1

(ii) - continuous pulse (no falls) B1

- microwaves are absorbed by non-metals B1

2 (a) [Pressure] = N/m^2

$= kgms^{-2}/m^2$

$= kgm^{-1}s^{-2}$ A1

(b) $W = F \times d$ C1

$F = p \times A$ C1

$W = p \times A \times l$

$A \times l = V_2 - V_1$ B1

$\therefore W = p(V_2 - V_1)$ AO

(c) (i) W = area under graph C1

$= 1/2(10 + 4.4)(4.0)10^5 + 4.4 \times 3.0 \times 10^5$ C1

$= 4.2MJ$ A1

(ii) $70.8\% = 4.2MJ$

$\therefore 100\% = 5.93MJ$ C1

1 unit of electricity $= 3.6 \times 10^6 J$ C1

$\therefore$ cost of $5.93MJ = \frac{5.93 \times 10^6}{3.6 \times 10^6} \times 20$

$= \$55.60$ A1

3 (a) rate of energy transfer/rate of doing work/word done per sec B1

$P = \frac{W}{t} = \frac{F.s}{t}$ B1

but $\frac{s}{t} = V$

$P = F.V$ B1

(b) (i) $\Delta PE_{/sec} = mgh = 7000 \times 8 \sin 15$ C1

$= 1.45 \times 10^4 J$ A1

(ii) $W_F = 5000N \times 8M = 4.0 \times 10^4$ J A1

(iii) Engine Power $= (5000 + 7000 \sin 15) \times 8$ C1

$= 6811.7 \times 8$

$= 5.45 \times 10^4 J$ A1

*Answer **question 1** and **any other 3** from the remaining questions.*

1 (a) (i) Explain

1. peak value,
2. r.m.s value of an alternating voltage.

(ii) An alternating voltage is represented by $V = 200\cos 20\pi t$

Determine its

1. frequency,
2. peak value,
3. r.m.s value. [8]

(b) (i) Describe the principles of operation of an ideal transformer.

(ii) Electrical energy is transmitted as high alternating voltage.

Explain the advantages of using

1. alternating voltage,
2. high voltage. [8]

(c) (i) State **four** properties of an ideal opamp.

(ii) Explain negative feedback.

(iii) State **two** advantages and **one** disadvantage of negative feedback. [8]

2 (a) (i) State the Bernoulli effect.

(ii) Give the conditions under which the Bernoulli effect is valid.

(iii) With the aid of a labelled diagram, explain how the Bernoulli effect is applied in atomizers. [8]

(b) Fig. 2.1 shows an ideal incompressible fluid of density 790 kgm^{-3} flowing from A to B in a tube of varying cross-section. The cross-sectional area decreases from 390 mm^2 at A to 210 mm^2 at B. The fluid has a speed of 5.2×10^{-3} ms^{-1} at A.

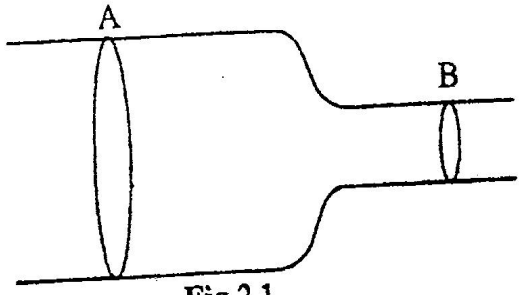


Fig 2.1

Calculate

1. the speed of the fluid at B,

2. the pressure difference between A and B. [4]

3 (a) Define electric field strength and state its unit. [2]

(b) Fig. 3.1 shows **two** parallel plates each of length 2.5 *cm* and a distance 15 *mm* apart. The upper plate is maintained at a potential of 50 *V* and the lower plate at a potential of −50 *V*.

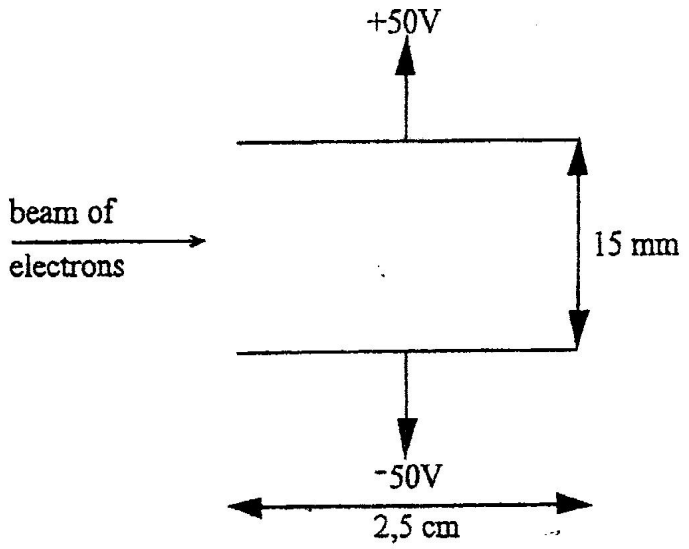


Fig. 3.1

A beam of electrons enters the electric field at right angles to the field at a speed of $5.5 \times 10^7 ms^{-1}$.

Calculate the

(i) time spent by the electrons between the plates.

(ii) electric strength between the plates.

(iii) force on each electron.

(iv) acceleration of the electron.

(v) speed of the electron as it leaves the plates.

[8]

(c) State the change(s) which must be made to **Fig. 3.1** for these electrons not to be deflected. [2]

4 (a) State **four** basic assumptions of an ideal gas. [4]

(b) (i) State what is meant by *internal energy of a system.*

(ii) Explain why the internal energy of an ideal gas is wholly kinetic. [2]

(c) When 150 J was supplied to an ideal gas at 1000 kPa its volume changed from $2{,}5\times10^{-4}\,m^3$ to $5.8\times10^{-4}\,m^3$.

Determine the

(i) potential energy of the gas,

(ii) work done by the gas,

(iii) change in internal energy and state if this is an increase or decrease. [6]

5 (a) Define (i) *capacitance,*

(ii) *electric potential.*

[2]

(b) An isolated metal sphere of radius, r, has a charge, Q, concentrated at its centre.

(i) Give an expression of the electric potential, V, at the surface of the sphere.

(ii) Hence show that the capacitance, C, of the capacitor is

$$C = 4\pi\varepsilon_o r.$$

[3]

(c) A capacitor marked "$15\,\mu F$, $20\ V$" is charged by connecting it to a $3\ V$ battery.

(i) Explain the significance of $20\ V$.

(ii) Calculate the

1. energy supplied to the capacitor,
2. energy stored by the capacitor.

(iii) Comment on your answers in (ii) above.

[7]

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

MARKING SCHEME

NOVEMBER 2010

PHYSICS 9188/5

1 (a) (i) 1. peak value is the maximum value of an alternating current. B1

2. r.m.s value is the steady voltage which dissipates the same energy in a resistor as the alternating voltage of the same value. B1 B1

(ii) 1. $V = V_o \cos wt.$

$w = 2\pi f = 20\pi$ M1

$f = 10H_z$ A1

2. peak value $V_o = 200V$ B1

3. $Vrms = \frac{V_o}{\sqrt{2}} = \frac{200}{\sqrt{2}}$ C1

$= 141,4V$ A1

(b) (i) B1

- consists of primary and secondary windings B1

- laminated to reduce eddy currents i.e. so that flux linkage between primary and secondary is as high as possible B1

- a.c. in primary is set up on an alternating magnetic field in iron core which in turn induces an a.c. in secondary coil B1

- primary voltage and secondary affected by the turns ratio

$\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s}$ B1

(i) 2. high voltage implies low currents hence less energy losses $\left(P = I^2R\right)$ due to joule heating max 4 B1

1. alternating voltages can be stepped up and down hence necessitating the use of thinner cables B1 B1

an economic advantage B1

(c) (i) - infinite input impendance B1

- infinite open loop gain B1

- zero output impendance B1

- infinite slew rate B1

- infinite bandwidth B1 Max 4

9 2 8

(ii) negative feedback is when part of output is fed back into the inverting input — B1

(iii) Advantages
- increases bandwidth — B1
- improves stability — B1
- gain predictable — B1
- reduces distortion of signal — B1

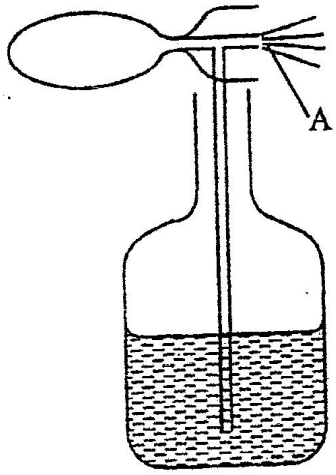
Max 2

Disadvantage
- reduces gain — B1

2 (a) (i) An increase in pressure results in a decrease in velocity or vice versa — B1

(ii)
- fluid is incompressible — B1
- fluid is non viscous — B1

(iii)



B1

- C -- squeezed — B1
- air moves out of high speed at *A* — B1
- making pressure at *A* lower than in *B* — B1
- pressure difference forces perfume out — B1

(b) 1. $A_A V_A = A_B V_B$

$3.90 \times 10^{-4} \times 5.2 \times 10^{-3} = 2.10 \times 10^{-4} V_2$

M1

$V = 9.66 \times 10^{-3} ms^{-1}$ A1

2. $P_A - P_B = \frac{1}{2}\rho\left(V_B^2 - V_A^2\right)$

$= \frac{1}{2}\ 790\left(9.66 \times 10^{-3^2} - 5.2 \times 10^{-3^2}\right)$ C1

$= 0.026Pa$ A1

3 (a) Electric field strength is force **per** unit positive charge B1

unit = NC^{-1} A1

(b) (i) $t = \frac{d}{s} = \frac{2{,}5 \times 10^{-2}}{5{,}5 \times 10^{7}}$ C1

$= 4{,}55 \times 10^{-10} s$ A1

(ii) $E = \frac{v}{d} = \frac{100}{15 \times 10^{-3}}$ C1

$= 6{,}67 \times 10^{3}\ Vm^{-1}$

(iii) $F = QE = 1{,}6 \times 10^{-19} \times 6.67 \times 10^{3}$ A1

$= 1.07 \times 10^{-15} N$ A1

(iv) $F = ma \Rightarrow a = \frac{1{,}07 \times 10^{-15}}{9{,}11 \times 10^{-31}}$

$= 1{,}17 \times 10^{15} ms^{-2}$ A1

$V_x = 5{,}5 \times 10^{7} m/s$ A0

considering vertical motion

(v) $Vy^2 = u^2 + 2as$

$Vy^2 = 2 \times 1{,}17 \times 10^{15} \cdot \frac{15 \times 10^{-3}}{2}$

$Vy = 4{,}19 \times 10^{6} ms^{-1}$ C1

$V = \sqrt{V_x^2 + V_y^2}$ A1

$= 5{,}52 \times 10^{7} ms^{-1}$

(c) A magnetic field is placed perpendicular to the electric field B1

and into paper B1

4 (a) - Newtonian mechanics can be applied B1

- negligible intermolecular forces B1

- volume of molecules negligible compared to volume occupied by gas B1

- molecules are perfectly elastic spheres B1

- duration of collision is negligible compared to time between collisions B1

- collisions between molecules and walls of container are perfectly elastic B1

- velocity of molecules uniform between collisions max 4

(b) (i) sum of all the microscopic kinetic and potential energies of molecules B1

(ii) no intermolecular forces imply zero potential energy B1

(c) (i) $pe = 0$ A1

(ii) $W = p\Delta V = 1000 \times 10^3 \times (5{,}8 - 2{,}5) \times 10^{-4}$ C1

$= 330J$ A1

(iii) $\Delta U = Q + W$ C1

$= 150 + 330$

$= 480J$ A1

Its an increase. B1

5 (a) (i) charge per unit voltage B1

(ii) work done per unit positive charge in bringing the charge from infinity to the point B1

(b) (i) $V = \frac{Q}{4\pi\varepsilon_o r}$ B1

(ii) $C = \frac{Q}{V} \Rightarrow V = Q/C$ B1

$\frac{Q}{C} = \frac{Q}{4\pi\varepsilon_o r}$ C1