25 copies

ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS

PAPER 3

9188/3

JUNE 2013 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.

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[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,	$\phi = -\dfrac{Gm}{r}$
refractive index,	$n = \dfrac{1}{\sin C}$
resistors in series,	$R = R_1 + R_2 + \ldots$
resistors in parallel,	$1/R = 1/R_1 + 1/R_2 + \ldots$
electric potential,	$V = \dfrac{Q}{4\pi\epsilon_0 r}$
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,	$p = \frac{1}{3}\dfrac{Nm}{V}\langle c^2 \rangle$
radioactive decay,	$x = x_0 \exp(-\lambda t)$
decay constant,	$\lambda = \dfrac{0.693}{t_{\frac{1}{2}}}$
critical density of matter in the Universe,	$\rho_0 = \dfrac{3H_0^2}{8\pi G}$
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,	$R_e = \dfrac{\rho v r}{\eta}$
drag force in turbulent flow,	$F = Br^2\rho v^2$

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) Give any **two** distinctions between random and systematic errors.

(ii) A student used a micrometer screw-gauge to measure the diameter of a thin wire. He did not recognise that the reading was not zero when the gauge was fully closed.

1. Outline how the random error in the measurement of the diameter of a thin wire is reduced.

2. Explain why the readings obtained by the student may be precise but not accurate.

[5]

(b) **Fig. 1.1** shows a textbook resting on a table.

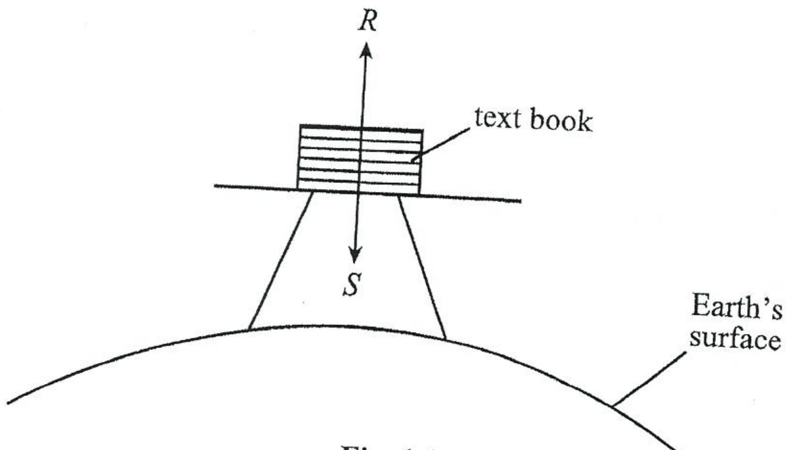

Fig. 1.1

R and *S* are two forces acting on the text book.

(i) 1. From Newton's third law of motion, state the body on which the force that pairs with *S* acts.

2. State **one** way in which *S* and the force which pairs with it are similar.

(ii) If the mass of the text book is 700 g, calculate *S*.

(iii) With reference to Newton's second law of motion and your answer in **(ii)**, comment on the effect of the force which pairs with *S* on the body on which it acts.

[5]

(c) (i) Define gravitational field strength at a point in a gravitational field.

(ii) A body of mass 4.0 kg is held 5.0 m above the surface of the Earth.

1. State the gravitational field strength at the position of the body, given that the gravitational field strength near the earth's surface is a constant.

2. Calculate the gravitational potential at the position of the body.

(iii) Gravitational potential, $\overline{\underline{\phi}}$, is a scalar given by

$$\frac{W}{m} = \overline{\underline{\phi}},$$

where W is the work done in moving a mass, m, from infinity to a point in a gravitational field. Elsewhere the gravitational potential is negative while it is zero at infinity.

Explain why it is negative elsewhere.

[5]

(d) (i) Define *simple harmonic motion.*

(ii) A mass at the end of a helical spring is given a vertical downward displacement of 2.0 cm from its rest position and released.

If the mass moves with simple harmonic motion of period 2.0 seconds, calculate the displacement of the mass during the first 0.75 seconds.

(iii) Simple harmonic motion may be used in wall clocks.

Explain why the oscillating system is normally enclosed inside the clock.

[5]

2 **(a)** Define the term *elastic collision*. [2]

(b) A motorist travelling at 15 m/s on a busy day approaches a traffic light which turns red when he is 20 m away from the stop line.

Given that his reaction time, to start slowing down, is 0.3 seconds and he slows down at 4.5 m/s^2, determine the distance the car stops from the stop line. [6]

(c) From your solution in **(b)** deduce whether an accident is likely to occur. [2]

3 (a) Define the term

(i) *inertia,*

(ii) *velocity.*

[2]

(b) (i) A ball was projected at an angle of 30° above the horizontal with an initial velocity, V, in a vacuum. Another identical ball was projected at 60° to the horizontal from the same point in a vacuum.

1. Show that both balls had the same range.

2. Sketch, on the same axes, the path followed by each ball.

(ii) A boy at the top of a tower, 4.905 m high, threw a ball horizontally as shown in **Fig. 3.1**

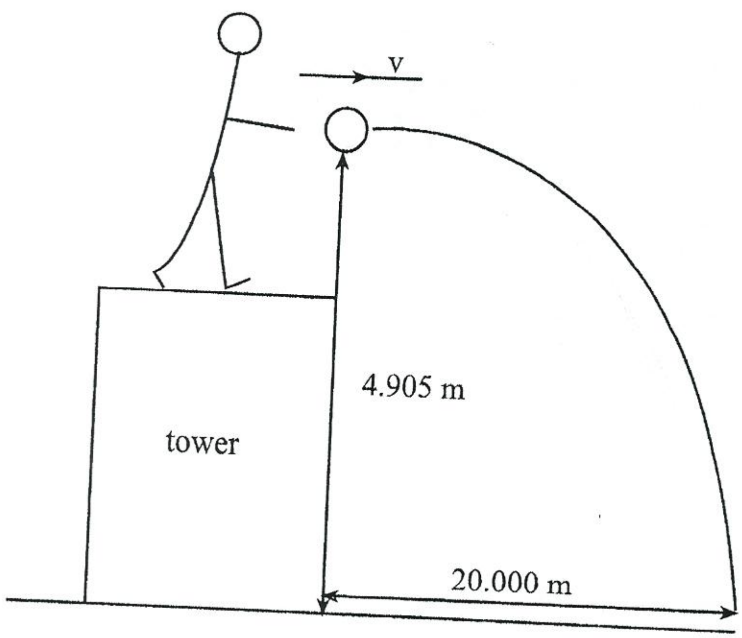

Fig. 3.1

Calculate the velocity, v, of the ball as it left the hand of the boy.

[6]

(c) A ball was launched in the earth's atmosphere at an angle θ to the horizontal.

Describe, with the aid of a diagram or otherwise, the effects of the atmosphere on the range and maximum height of projection.

[2]

4 (a) (i) Imaging is one of the uses of X-rays in Medicine.

Give **two** kinds of cases where X-rays would produce the best images.

(ii) In medical diagnosis, X-rays are passed through a filter before they pass through a patient. After the patient, the rays pass through a grid before they reach the X-ray film as shown in **Fig.4.1**

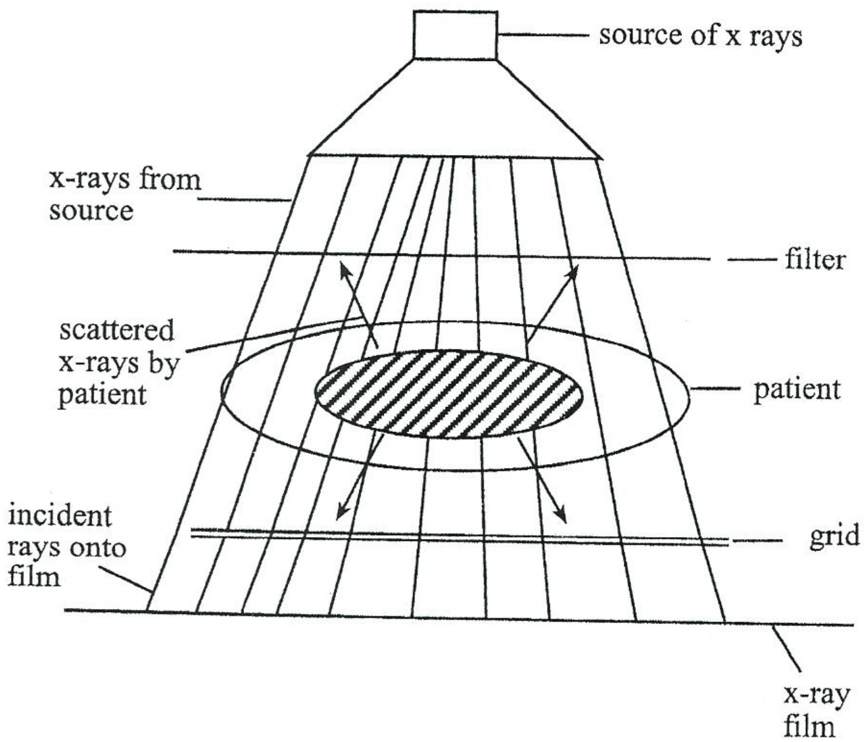

Fig. 4.1

State and explain the advantages of this procedure regarding the patient and quality of the image.

[8]

(b) Lasers are used in medical treatment in a variety of ways.

(i) State any **one** common medical use of lasers.

(ii) Briefly explain how lasers are used in **(i)**.

[2]