ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS 9188/5

PAPER 5

JUNE 2011 SESSION 1 hour 15 minutes

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.

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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, $F = Br^2\rho v^2$

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 3** from the remaining questions.*

1 **(a)** **(i)** Sketch magnetic field patterns of a flat circular coil carrying current.

(ii) Define *magnetic flux density*.

(iii)

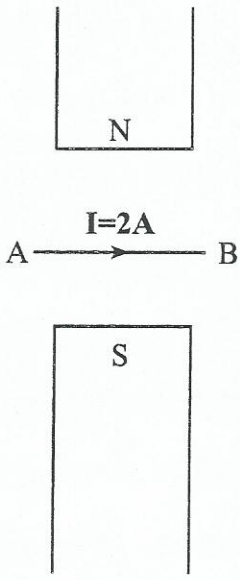

Fig. 1.1

Find the force per unit length acting on the wire AB in **Fig. 1.1** if the magnetic flux density is 2.4×10^{-3} T. [5]

(b) **Fig. 1.2** shows electrons drifting from right to left through a block of a conductor. A magnetic flux density, **B**, is applied upwards as shown.

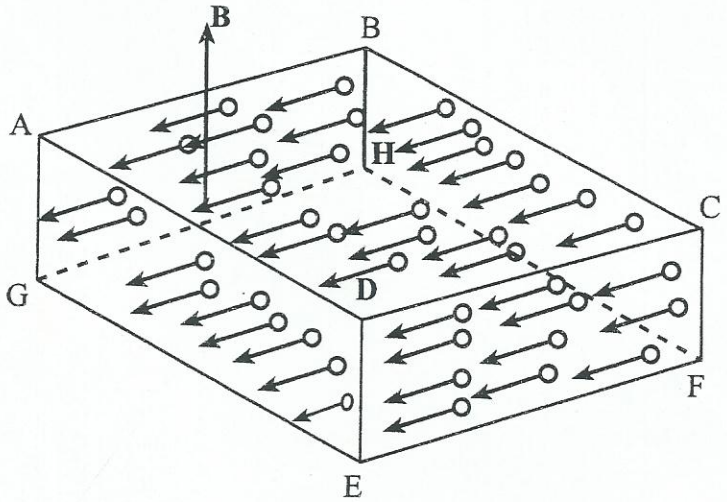

Fig. 1.2

Describe and explain the

(i) effect of the magnetic field on the direction of the movement of electrons,

(ii) movement of electrons if the magnetic field is applied parallel to their movement in **(i)**. [5]

(c) **Fig. 1.3** shows a circuit component found in a calculator.

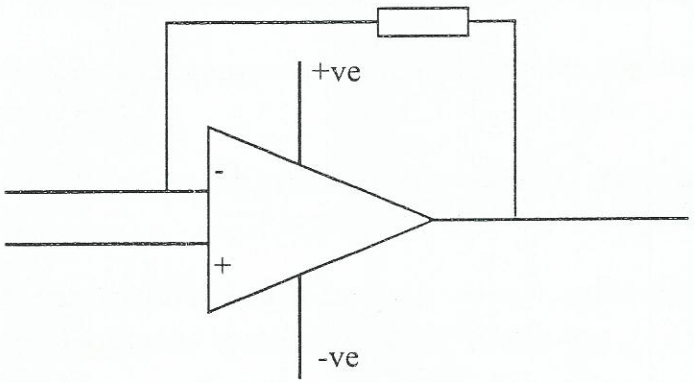

Fig. 1.3

(i) Name the component.

(ii) Give **four** advantages and **one** disadvantage of using such a component in music industry. [6]

(d) $^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{141}_{A}Ba + {}^{B}_{36}Kr + 3{}^{1}_{0}n + Q$

(i) Find the values of A and B.

(ii) Suggest why the neutron is capable of producing the fission above.

(iii) Determine Q in MeV given the data below. [8]

Element	**Atomic mass/u**
Uranium -235	235.1
Barium -141	141.0
Krypton -93	91.9
Neutron	1.009

2 **(a)** Distinguish between *mean speed* and *mean square speed* of a group of molecules. [2]

(b) Explain how gases exert pressure on the walls of a container of the gas. [3]

(c) The density of hydrogen gas at 0°C and 1.01×10^5 Pa pressure is $9.0 \times 10^{-2}\,\text{kgm}^{-3}$.

Determine the root-mean-square speed of hydrogen molecules. [4]

(d) In a reaction chamber, chlorine, hydrogen and oxygen in gaseous state at same temperature are being mixed.

A leak develops on the chamber and it is noticed that the reaction could not proceed because hydrogen mainly had escaped.

Explain this observation given the densities at one atmosphere are $3.2\,\text{kgm}^{-3}$, $1.2\,\text{kgm}^{-3}$, and $0.09\,\text{kgm}^{-3}$ for chlorine, oxygen and hydrogen respectively. [3]

3 **(a)** State what is meant by *an ideal fluid*. [2]

(b) Derive the equation of continuity for an ideal fluid and state the principle on which it is based. [4]

(c) **(i)** State the Bernoulli principle.

(ii) A Bunsen burner shown in **Fig. 3.1** is commonly used in school science laboratories for heating.

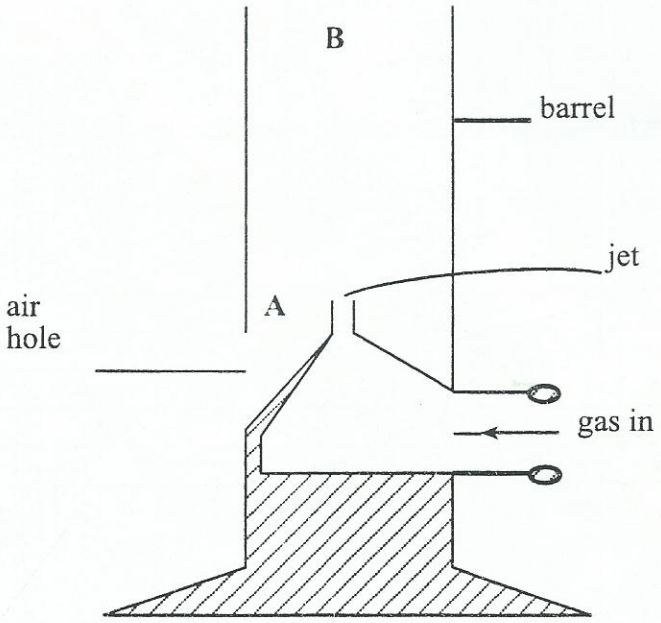

Fig. 3.1

Explain how the Bernoulli effect is applied in the structure of the burner. [3]

(iii) The cross-sectional area of the jet is 7.85×10^{-7} m^2 and the velocity of the gas at that point is 12.5 m/s. The cross-sectional area of the barrel at **B** is 1.18×10^{-4} m^2.

If the gas behaves as an ideal fluid, determine the pressure difference between points **A** and **B**. The density of the gas is 1.6 kgm^{-3} and the atmospheric pressure is 1.01×10^5 Pa.

[3]

(a) Define the term

(i) *density*,

(ii) *specific latent heat of fusion*.

[2]

(b) With reference to the structures of solids, liquids and gases, compare their densities. [4]

(c) A woman scientist wishes to produce a magnetic alloy by mixing 20 cm^3 of copper, 30 cm^3 of cobalt and 50 cm^3 of iron. The scientist decides that by heating iron to 2 500 K and then adding powdered samples of copper and cobalt in the suggested amounts, she will be able to have a molten mixture at the melting point of iron.

Use data in **Table 2** to answer the questions below.

Table 2

substance	density (kgm^{-3})	melting point (K)	specific latent heat of fusion (J/kg) $\times 10^4$	liquid or solid specific heat capacity (Jkg^{-1}K^{-1})
copper	8 930	1 360	21	385
iron	7 870	1 810	14	480
cobalt	8 900	1 770	25	420

(i) Calculate

1. the heat that would be lost by iron,

2. the total energy that would be needed by copper and cobalt if iron temperature is 28°C.

(ii) Deduce whether the scientist's decision is achievable. [6]

5 **(a)** Describe the use of an Operational Amplifier as a summing amplifier in the inverting mode. [3]

(b) The circuit shown in **Fig. 5.1** is a simple combination locking system which will allow access to a bank safe if the correct combination is set to A, B, C and D. If there is any wrong combination the alarm will sound.

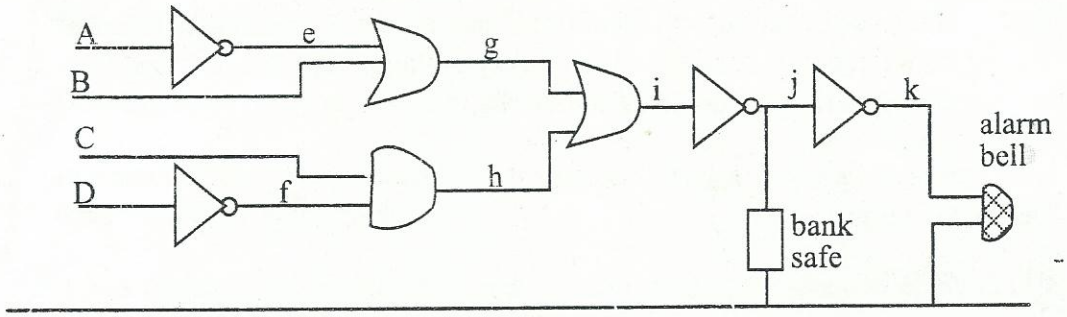

Fig. 5.1

(i) Work out the correct codes to open the bank safe.

(ii) Give **one** advantage of this method.

[5]

(c) Describe the three parts of a radio system in terms of the *input*, *electronic circuit* and the *output device*. [3]

(d) State **one** negative impact of electronics in society. [1]