ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

PHYSICS 9188/5

PAPER 5

NOVEMBER 2012 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.

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) Define the decay constant, λ.

(ii) Sketch a graph to show how the activity of a radioactive isotope of half-life 30 days varies with time from an initial value A.

(iii) A lubricating oil contains a radioactive isotope X of half-life 25 days and another isotope Y of half-life 5 hours. Initially the oil has an activity of 16 kBq. After 40 days the activity of the oil falls to 2 kBq.

Estimate the initial percentage activity of isotope Y in the mixture.

[8]

(b) (i) Write down Einstein's photoelectric equation.

(ii) Study the circuit shown in **Fig.1.1** and answer questions that follow.

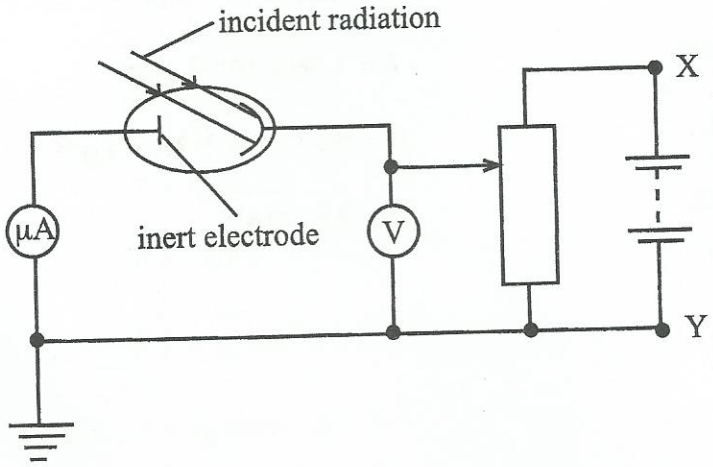

Fig.1.1

1. State the effect of increasing the intensity of the incident radiation.

2. Suggest how this apparatus could be used to determine the maximum kinetic energy of the photoelectrons.

3. The frequency of the incident radiation was varied and the maximum kinetic energy, $K.E_{max}$, of the photoelectrons was found. **Fig. 1.2** shows the results obtained.

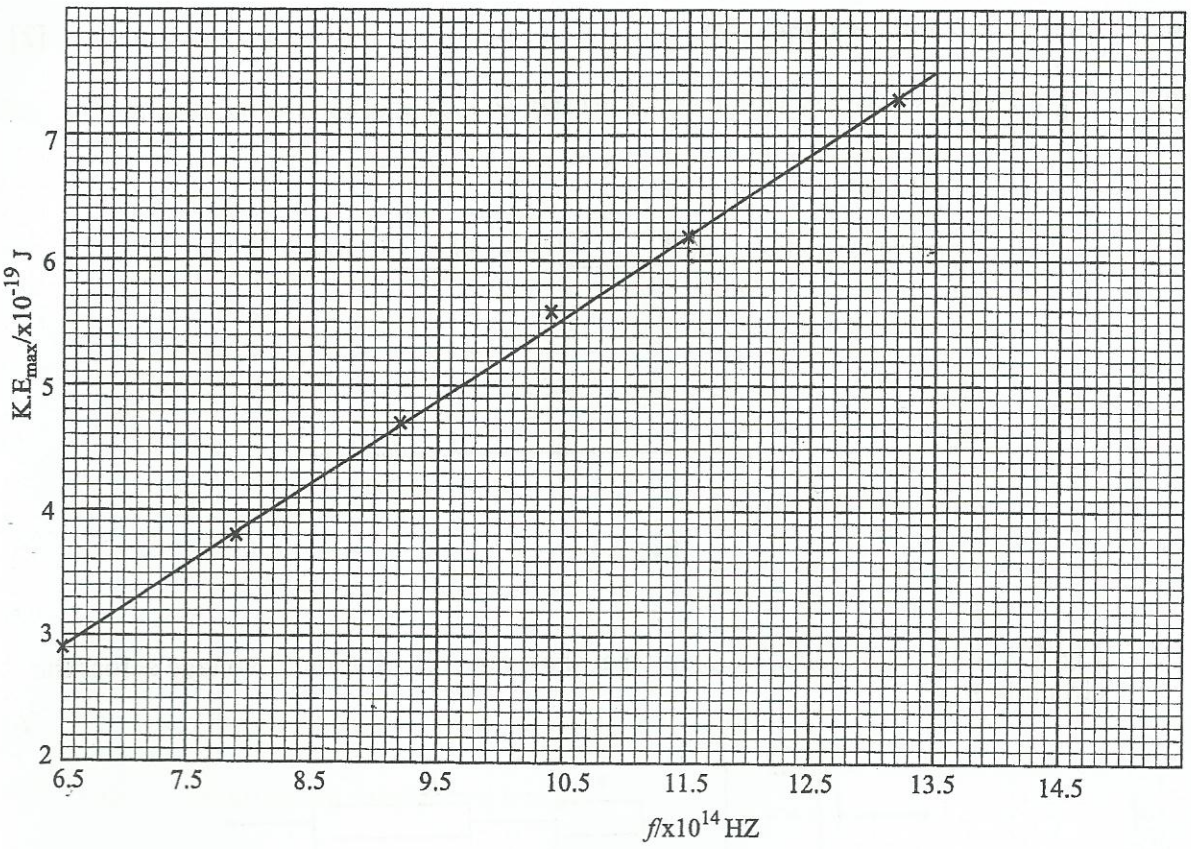

Fig. 1.2

Use **Fig1.2** to determine the Plank constant, the threshold frequency and the work function of the metal.

[13]

(c)

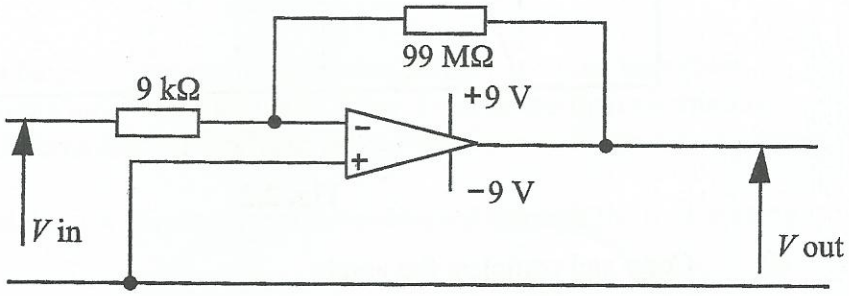

Fig.1.3

(i) State the mode in which the amplifier shown in **Fig. 1.3** is operating.

(ii) Calculate the gain of the amplifier.

[3]

2 (a) Define *resistance* and *the Ohm.* [2]

(b) **Fig 2.1** shows a battery with internal resistance, *r*, connected to a resistor, *R*.

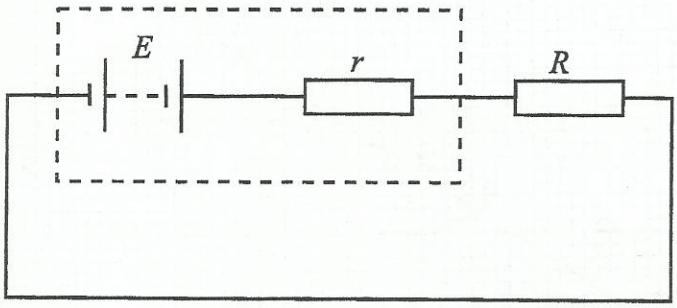

Fig 2.1

Fig. 2.2 shows an incomplete graph that shows the distribution of voltage across the circuit in **Fig 2.1.**

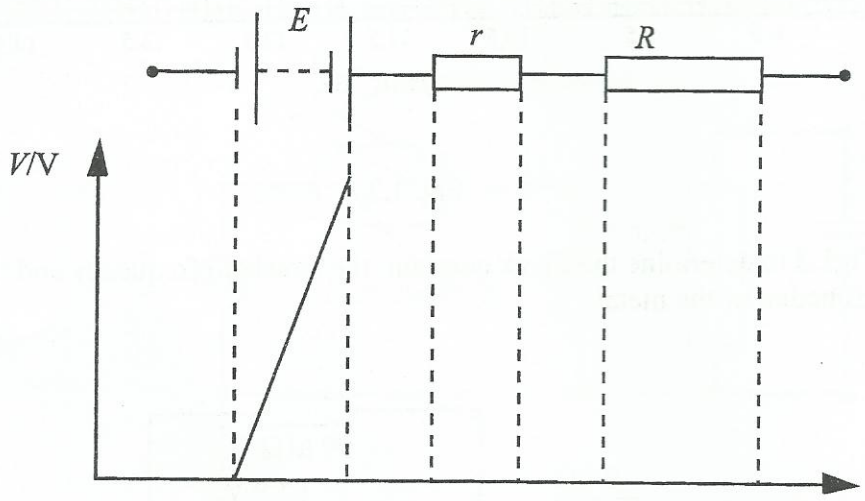

Fig. 2.2

(i) Copy and complete the graph.

(ii) If $E = 12$ V and $r = 0.1\,\Omega$, calculate energy lost per unit charge in the battery itself. [5]

(c) Suggest **one** advantage and **one** disadvantage of having a large internal resistance in a battery. [2]

(d) (i) Sketch the *I* - *V* characteristics of a filament lamp.

(ii) Explain the shape of your graph. [3]

3 **Fig. 3.1** shows a transformer circuit.

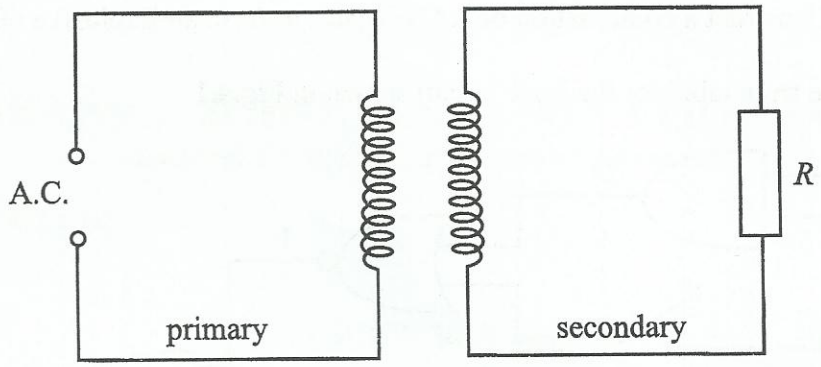

Fig 3.1

(a) Explain the effect on the current flowing in the primary circuit of

(i) a fall in the supply frequency,

(ii) a reduction in the number of turns in the secondary circuit.

(b) **(i)** Calculate the current which flows in a resistance of 40 Ω connected to a secondary coil of 60 turns if the primary has 1 200 turns and is connected to a 240 V.

(ii) State any **one** assumption made in making your calculation.

[7]

(c) The *Dragline* is a large current-drawing machine used in mining industries. Direct current motors have more torque to drive the dragline than alternating current motors. Alternating current from the mains is converted to direct current.

Describe and explain how direct current is maintained through the motor using four diodes. [5]

4 (a) (i) Write down the truth table for a two input Exclusive OR gate.

(ii) Construct a combination of NAND gates to form an Exclusive OR gate. [3]

(b) Draw the truth table for the logic circuit shown in **Fig.4.1.** [6]

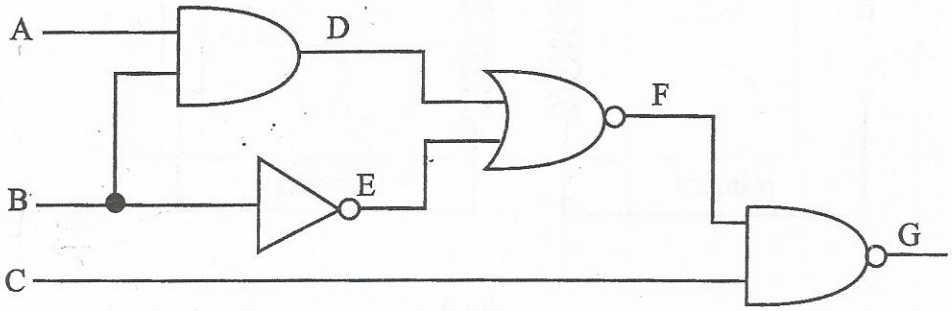

Fig. 4.1

(c) Receiving information of events in the world such as sporting news and natural disasters is almost instantaneous.

State **three** aspects of modern communication which have made this possible. [3]

5 (a) (i) State the method(s) of heat transfer in a liquid.

(ii) Explain how conduction is different from radiation. [4]

(b) (i) Define *specific latent heat of vaporisation.*

(ii) Describe an electrical method for the determination of the specific latent heat of vaporisation. [6]

(c) In an experiment to determine the specific latent heat of vaporisation of a liquid, a 60 W heater is used to boil a liquid for 8 minutes and 50 g of liquid is collected.

Determine the heat lost to the surroundings given that the specific latent heat of vaporisation of the liquid is 4.3×10^5 Jkg^{-1}. [2]