THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

031/1   **PHYSICS 1**

(For Both School and Private Candidates)

TIME: 3 Hours   *Friday morning 19/10/2007*

Instructions

1.   This paper consists of sections A, B and C.

2.   Answer **all** questions in section A and B, and **two (2)** questions from section C.

3.   Section A carries 20 marks, section B carries 60 marks and section C carries 20 marks.

4.   Cellular phones are **not** allowed in the examination room.

5.   Write your **Examination Number** on every page of your answer booklet(s).

6.   Where necessary use the following constants:

Acceleration due to gravity g = 9.8 m/s^2

Pi π = $\frac{22}{7}$

SECTION A (20 Marks)

Answer **all** questions in this section.

1. For each of the items (i) - (x) choose the correct answer from among the given alternatives and write its letter beside the item number.

    (i)   A stone is thrown horizontally from the top of a building at a speed of 12 m/s. How long does it take to fall 45 metres vertically? (Assume negligible air resistance).
          A   1.0 sec.   B   5.0 sec.   C   3.0 sec.   D   8.0 sec.   E   2.14 sec.

    (ii) Which of the following statements is correct?
          A   Friction acts in the same direction as motion.
          B   Air friction can cause a body to become hot.
          C   Certain lubricants can reduce friction to zero.
          D   For a given body the frictional force depends on the area in contact with the surface.
          E   Walking would be made easier if friction did not exist.

    (iii) The dew point is defined as the
          A   rate at which water vapour present in the atmosphere evaporates
          B   amount of water on grass found in the morning
          C   amount of water vapour required to saturate air
          D   water vapour content of the atmosphere
          E   temperature at which water vapour present in air is just sufficient to saturate it.

    (iv) When a pipe is played a sound wave x is produced inside the pipe and a sound Y is heard outside the pipe, then
          A   x is transverse and Y is longitudinal
          B   x and Y are both transverse waves
          C   x is progressive and Y is stationary
          D   x is stationary and Y is a progressive wave
          E   x is progressive and Y is longitudinal.

    (v)   When a lighted match is brought near the negatively charged electroscope, the leaf of the electroscope collapses because the
          A   heat increases molecular vibrations which knock off the electrons from the cap
          B   flame provides energy for the electrons to escape from the cap
          C   match emits γ-rays
          D   positive charges from the air ionized by the flame are attracted by the cap
          E   match emits α-particles.

(vi) In the circuit shown in figure 1 the battery and the ammeter have negligible internal resistance. What will be the ammeter reading?
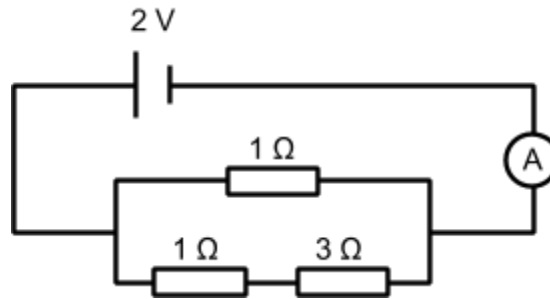
2 V

1 Ω

A

1 Ω   3 Ω

Fig. 1

A   2.5 A   B   0.4 A   C   0.5 A   D   1.6 A   E   2.0 A

(vii) A conductor becomes a magnet when
    A   it is wrapped with a coil of wire
    B   a soft iron core is used
    C   an electric current flows through it
    D   its resistance is increased
    E   It is passed through an electric field

(viii) A mixed beam of α-particles, β-particles and γ-rays enters a magnetic field at right angles to teh direction of the beam. Which of the following best represent the correct paths taken by the radiations?

E   D   C   A   B
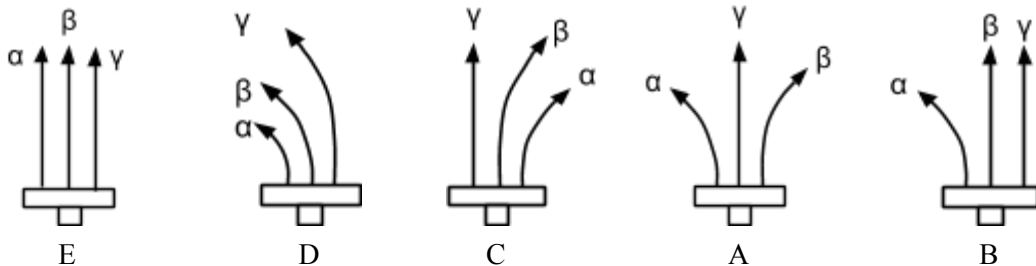
(ix) A semi conductor diode is used for
    A   producing a.c. from a d.c. power supply
    B   rectification
    C   controlling energy losses
    D   amplification
    E   supplying heat in some electrical devices.

(x) Saturn as a member of the solar system
    A   is the largest planet with no known satellites
    B   is the planet seen by naked eye satellites with a temperature -200°C
    C   is the planet only seen through telescope and is the furthest from the sun
    D   has five moons and a ring system
    E   is the second largest planet with known natural satellites and a ring system.

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2. Match the responses in **List B** with the words/phrases in **List A** by writing the letter of the correct response beside the item number.

| List A	List B
(i) Hooke's law	A Electrophorus
(ii) Transfer of heat by radiation	B Converts sound waves into electric currents
(iii) Total internal reflection	C Occur in gases and vacuum
(iv) Production of many positive charges in small amounts	D Extensions is proportional to plasticity
	E Positively charged particles of the nucleus
(v) Ohm's law not applicable	F Detects and counts all radioactive radiations and x-rays
(vi) Longitudinal waves	G Converts electric currents into sound waves
(vii) Proton	H Extension of spring is proportional to the applied force
(viii) Telephone earpiece	I Van der Graaf generator
(ix) Geiger-muller counter	J Detects and counts α-particle radiation only
(x) Collector-base in common base mode	K Light must pass from a denser medium to a less dense medium
	L Helium nucleus
	M Emitter-base is reverse biases
	N When physical conditions of a wire are altered
	O Light passes from less dense to a denser medium
	P Travel parallel to the direction of the wave
	Q Reversed biased
	R Occur in the atmosphere
	S Travel perpendicular to the direction of the wave
	T When there occurs no loss of p.d. in an electric circuit.

SECTION B (60 marks)

Answer **all** questions in this section.

3. (a) (i) Define relative density **(1 mark)**
   In an experiment using Hare's apparatus, the lengths of methanol and water columns were found to be 16 cm and 12.80 cm respectively.
   (ii) Find teh relative density of methanol. **(2 marks)**
   (iii) If the length of methanol column was altered to 21.50 cm what would be the new height of the water column? **(1 mark)**

   (b) The letter "g" can be used to denote an acceleration or the amount of force. State the conditions and the SI units under each use. **(2 marks)**

   (c) An uniform half metre rule is freely pivoted at the 15 cm mark and balances horizontally when a body of mass 40 g is hung at the 2.0 cm mark.
   (i) Make a clear sketch to show the forces and their positions in the arrangement.

   (2 marks)
   (ii) Calculate the mass of the half-metre rule. **(2 marks)**

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4. (a) What is meant by
    (i)   upper fixed point?
    (ii) lower fixed point?   **(1 mark)**

    (b) (i)   List down the **four (4)** advantages of mercury over alcohol as thermometric liquids.
                                                                                (2 marks)
         (ii) Give **two (2)** similarities and **two (2)** differences between a maximum thermometer and a
               minimum thermometer.   **(2 marks)**

    (c) (i)   How are the heat losses in a thermos flask checked?   **(2 marks)**
         (ii) Determine the final temperature obtained when 500 g of water at 100°C was mixed with
               500 g of water at 10°C and well stirred. (Note: The specific heat capacity of water
               $C = 4,20$ J kg^{-1} °C^{-1}).   **(3 marks)**

5. (a) (i)   State the conditions necessary for total internal reflection to occur.   **(2 marks)**
         (ii) Why does an object appear coloured when light falls onto it?   **(1 mark)**

    (b) (i)   What is meant by the term complimentary colours?   **(1 mark)**
         (ii) Explain why the result of mixing blue and yellow paints is very different from that of
               mixing blue and yellow lights?   **(3 marks)**

    (c) A screen is placed 80 cm from an object. A lens is used to produce on the screen an image with
         magnification 3. Calculate the
         (i)   distance between the object and lens.   **(1 mark)**
         (ii) focal length of the lens.   **(2 marks)**

6. (a) (i)   What are the essential features of a capacitor?   **(1 mark)**
         What role does a capacitor play when used in
         (ii) d.c. circuits?
         (iii) a.c. circuits?
         Give one example for each.   **(2 marks)**

    (b) (i)   What happens when a wire is connected to a charged capacitor?   **(1 mark)**
         (ii) An insulated plate A having a negative charge is joined to a plate B of positive charge by a
               resistance wire. If a charge of 10^6 C flows through the wire of resistance 2 Ω in 10^{-6}
               seconds how much heat is dissipated in the wire?   **(1 mark)**

    (c) Discuss the charge distribution on
         (i)   the surface of a solid conductor of irregular shape
         (ii) a hollow conductor
         (iii) a lightning conductor as clouds pass over its spikes.   **(2 marks)**

7. (a) (i) **List three (3)** factors that affect the resistance of a wire and discuss how they affect the resistance. **(3 marks)**

(ii) In the circuit shown in figure 2 the total resistance between X and Y is 2.0 Ω. Calculate the unknown resistance Q. **(2 marks)**
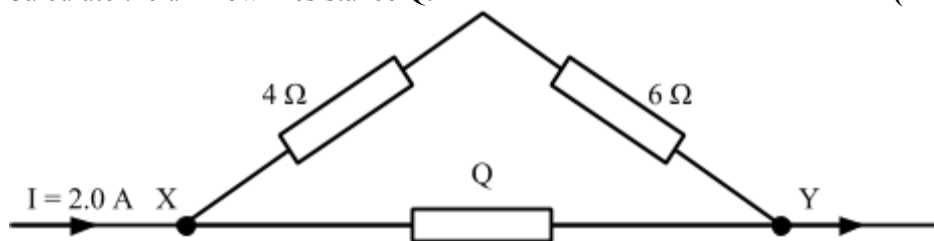
(b) (i) How does the electromotive force e.m.f. differ from the potential difference of a cell?

(ii) Would you expect two identical cells in parallel to drive more current through a resistor than one cell does? Explain. **(2 marks)**

(c) A 2.0 m long resistance wire of cross section 0.5 mm^2 has a resistance of 2.2 Ω. Find the

(i) resistivity of the material

(ii) length of the wire that would give a total resistance of 1.0 Ω when placed in parallel. **(3 marks)**

8. (a) (i) Name **three (3)** basic radiation that occur naturally.

(ii) Discuss briefly the properties of the radiations mentioned in 8(a)(i) above in terms of penetrating power **(3 marks)**

(b) (i) Define mass number and atomic number **(2 marks)**

(ii) Thorium disintegrates in the following manner
$$^{232}_{90}\text{Th} \rightarrow \ ^{228}_{88}\text{Ra} \rightarrow \ ^{228}_{89}\text{Ac} \rightarrow \ ^{228}_{90}\text{Th} \rightarrow \ ^{224}_{88}\text{Ra}$$
State the particles emitted at each part of the disintegration. **(2 marks)**

(c) A thorium 228 radioactive source placed in a polythene bottle decayed into a radioactive gas thoron. The decay process was recorded by the Geiger-Muller (G-M) tube as follows:

Time in minutes	0	4	8	12	16	20
Count rate	40	30	20	14	10	7

(i) Draw the graph of the count rate against time.

(ii) From the graph determine the half-life of thoron. **(3 marks)**

SECTION C (20 marks)

Answer **two (2)** questions from this section.

9. (a) (i) State Archimede's principle. **(1 mark)**

A block of metal of density 2700 kg/m^3 has a volume of 4.0 x 10^{-2} m^3. Calculate the:

(ii) mass of the block **(1 mark)**

(iii) apparent weight when immersed in brine of density 1200 kg/m^3. **(1 mark)**

(b) What energy transformation occurs in the following
  (i)   bullet fired from the nozzle of a gun.   **(1 mark)**
  (ii) battery used to light a bulb torch.   **(1 mark)**

(c) How is kinetic energy distinguished from potential energy?   **(1 mark)**

A bullet of mass 3.0 g moving at 400 ms^{-1} hits a tree trunk and comes to rest inside the tree after penetrating a depths of 60 mm, calculate the:
  (i)   kinetic energy of the bullet as it hits the tree.   **(2 marks)**
  (ii) average force of retardation as it passes through the tree.   **(2 marks)**

10. (a) (i)   State Ohm's law.   **(1 mark)**
    (ii) Describe the factors affecting resistance.   **(2 marks)**
    (iii) A 5 Ω resistor and a 1 Ω resistor are connected in parallel to a cell of e.m.f. 6 V and internal resistance 0.5 Ω. Calculate the current flowing round the circuit.   **(2 marks)**

(b) (i)   Why is it economical to transmit electricity over long distances by high voltages rather than low voltages? Explain.   **(1 mark)**
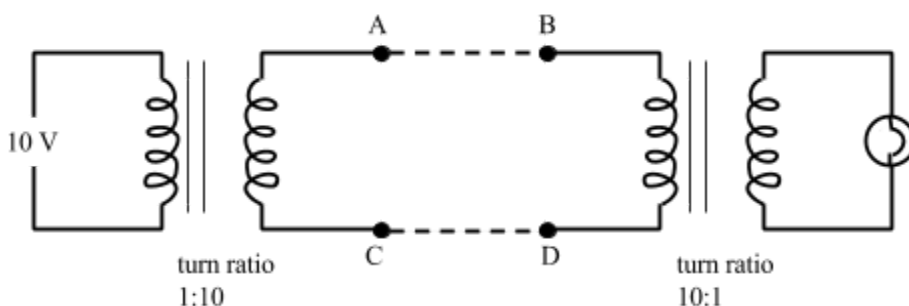

Fig. 3

Figure 3 shows a model of an electrical transmission system. AB and CD each represent a long length of cable each having a resistance of 4 Ω. The current in AB is 0.1 A, find the:
  (i)   power lost by AB and CD.
  (ii) p.d. across BD.
  (iii) current through the bulb.   **(3 marks)**

(c) State the factors which determine the size of an induced e.m.f.   **(1 mark)**

11. (a) (i)   Explain why cathode ray tubes (CRT) are evacuated.   **(1 mark)**
    (ii) What happens to the CRT when a gas is maintained?   **(1 mark)**
    (iii) If a gas is maintained in a CRT, will the image be formed onto the screen? Explain.
                                                                            (1 mark)

(b) In the production of x-rays what are the roles of
  (i)   low voltage?
  (ii) high voltage?
  (iii) tungsten target?   **(3 marks)**

(c) How are hard x-rays produced?   **(1 mark)**

(d) (i) Discuss the differences between conductors and semiconductors in terms of their sensitivities and conduction bands. **(2 marks)**

    (ii) Use the following information to calculate the current gain of a C-E amplifier.

$I_B \times 10^{-6}$ A	100	200	300	400	500
$I_C \times 10^{-3}$ A	5	10	15	20	25

(1 mark)

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