THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN ENVIRONMENTAL SCIENCE AND TECHNOLOGY

MODULE I

ENVIRONMENTAL CHEMISTRY AND APPLIED SCIENCES

3 hours

## INSTRUCTIONS TO CANDIDATES

*You should have the following for this examination*
*answer booklet;*
*A non-programmable scientific calculator.*

*This paper consists of TWO sections; A and B.*
*answer ALL the questions in section A and any THREE questions from section B in the answer booklet provided.*

*Each question in section A carries 4 marks while each question in section B carries 20 marks.*
*Maximum marks for each part of a question are as shown.*
*Candidates should answer the questions in English.*

*This paper consists of 5 printed pages.*

*Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.*

Turn over

SECTION A (40 marks)

*Answer ALL the questions in this section.*

1. Solve for x in the following equation:

$$\log(x^2 - 3) - \log x = \log 2$$

(4 marks)

2. A cylindrical vessel contains 18 litres of petrol. Calculate the depth in metres of the liquid if the vessel diameter is 600 mm.

(4 marks)

3. A man cycles 24 km due South and 21 km East. Another man, starting at the same time as the first man, cycles 32 km East and then 8 km South. Calculate the distance between the two men at the end of the journey.

(4 marks)

4. A motorcycle starts from rest and is uniformly accelerated to a velocity of 12 m/s in 6 seconds. This velocity is then maintained for 1 minute. The motorcycle is then uniformly retarded until it comes to rest in a further 24 seconds.

  (a) Sketch a velocity - time graph for the motion.

(2 marks)

  (b) Calculate the distance travelled.

(2 marks)

5. Define the following units of measurement:

  (a) Joule;

(2 marks)

  (b) Newton.

(2 marks)

6. A body having a mass of 0.45 kg is tied to a string and whirled in a horizontal circle of radius 2.5 m with a speed of 3.5 m/s. Calculate the tension in the string.

(4 marks)

7. Define the following terms as used in heat transfer:

  (a) heat;

(1 mark)

  (b) heat capacity;

(1 mark)

  (c) specific heat capacity;

(1 mark)

  (d) latent heat of vaporisation.

(1 mark)

8.   (a) Explain the effect of aquatic organic matter decomposition on dissolved oxygen concentrations in water.

(2 marks)

  (b) Explain the small contribution of algae photosynthesis to the dissolved oxygen amounts in a water body containing a lot of algae.

(2 marks)

9. Describe any two classes of water pollution.

(4 marks)

10.   (a) Draw the structures of the products for the reaction between propene and hydrogen bromide.

(2 marks)

  (b) Give the systematic names of the products obtained in 10(a).

(2 marks)

2

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SECTION B (50 marks)

*Answer any THREE questions from this section.*

11.   (a) The concentration, C, of a toxic substance released into a stream was measured over time, t, and the results were as shown in Table 1.

Table 1

| Time, t (hours) | 0.52 | 0.73 | 0.94 | 1.23 | 1.57 |
|---|---|---|---|---|---|
| Concentration, C g/L | 2.83 | 2.05 | 1.60 | 1.22 | 0.95 |

The law relating concentration (C) and time (t) is given by:

$$C = kt^n$$

where k and n are constants.

   (i) Determine by using a graph the values of n and k.

(11 marks)

   (ii) Determine the concentration of the toxic substance after 2 hours.

(2 marks)

  (b) The length, L in metres of a certain metal rod at a temperature, T °C is given by:

$$L = 1 + (3 \times 10^{-5})T + (4 \times 10^{-7})T^2$$

Determine the rate of change of length in mm/°C when the temperature is 100°C.

(3 marks)

  (c) The force, F, in Newtons acting on a body at a distance x from a fixed point is given by:

$$F = 3x + 2x^2$$

If the work done is given by the area under the curve, determine the work done when the body moves between a distance of 1 m and 3 m.

(4 marks)

3     **Turn over**

12. (a) Figure 1 shows a 12 V battery having an internal resistance of 0.7 Ω. It is connected to three resistors A, B and C having resistance of 1.2 Ω, 4.5 Ω and 6 Ω respectively. Determine the current in each resistor. (11 marks)
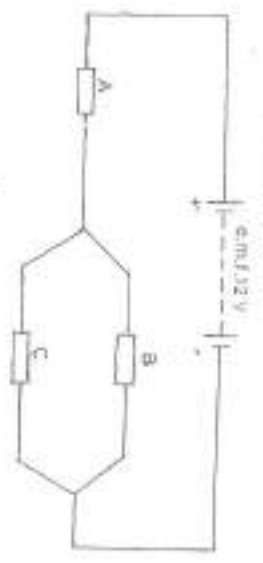


Fig. 1

(b) (i) Define the term thermionic emission. (1 mark)

    (ii) With the aid of a diagram, outline the production of cathode rays in a cathode ray tube. (8 marks)

13. (a) State the principle of conservation of momentum. (2 marks)

(b) A bullet of mass 25 g travelling at a velocity of 20 m/s penetrates a sand bag and is brought to rest in 0.06 s. Calculate the:

    (i) depth of penetration; (7 marks)

    (ii) average retarding force of the sand. (3 marks)

(c) Define the following terms as used in fluids:

    (i) Laminar flow; (2 marks)

    (ii) Newtonian fluids. (2 marks)

(d) Determine the pressure at point X in reference to the U-tube manometer shown in Figure 2. Take g = 9.81 m/s² (4 marks)



water density 1000 kg/m³
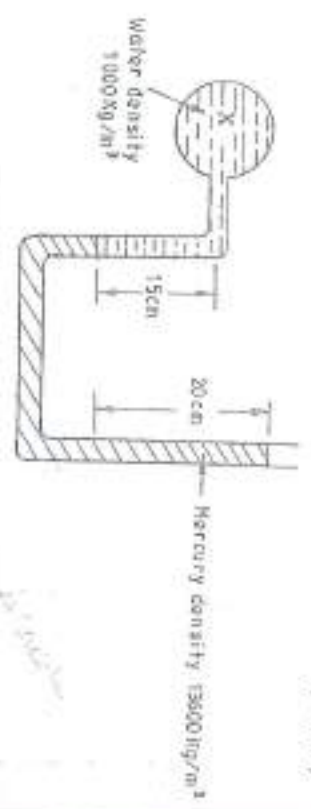
15 cm        20 cm

Mercury density 13600 kg/m³

Fig. 2

14. (a) Describe the two characteristics of lyophilic colloids. (4 marks)

(b) (i) Explain the reason for the observed blue color of the sky. (2 marks)

    (ii) Explain the effect of passing an electric current through a colloidal solution. (3 marks)

(c) (i) Define the term emulsion. (1 mark)

    (ii) Describe the two types of emulsions. (4 marks)

    (iii) Explain the use of soap as emulsifier. (6 marks)

15. (a) (i) Explain three factors that make nitrogen a very important nutrient to plants. (6 marks)

    (ii) Define the term biological nitrogen fixation. (2 marks)

    (iii) Outline the mechanism of nitrogen fixation by nitrogenase. (4 marks)

(b) Describe the effect of the following factors in limiting biological nitrogen fixation:

    (i) excessive moisture; (2 marks)

    (ii) drought; (2 marks)

    (iii) availability of sunlight. (2 marks)

(c) Give two disadvantages of using municipal waste as fertilizers. (2 marks)

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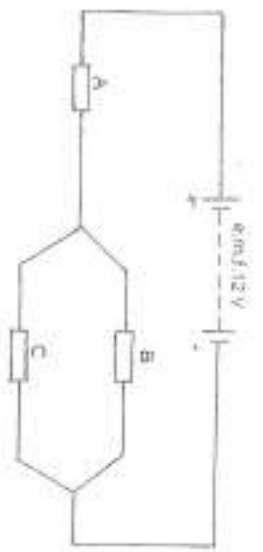


Fig. 1

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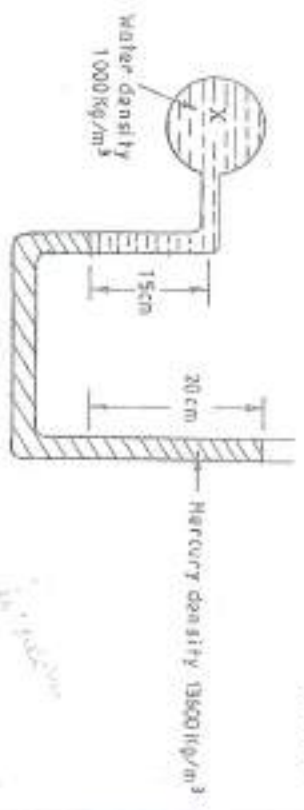
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