

2528/102  
2922/102  
ENVIRONMENTAL CHEMISTRY  
AND APPLIED SCIENCE  
Oct./Nov. 2017  
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN ENVIRONMENTAL SCIENCE AND TECHNOLOGY

MODULE I

ENVIRONMENTAL CHEMISTRY AND APPLIED SCIENCE

3 hours

#### INSTRUCTIONS TO CANDIDATES

*You should have the following for this examination:*

*Answer booklet;*

*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 4 printed pages.**

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



SECTION A (40 marks)

Answer ALL the questions in this section.

1. Without the use of a calculator or mathematical table, evaluate

$$\frac{\log 25 - \log 125 + \frac{1}{2} \log 625}{3 \log 5} \quad (4 \text{ marks})$$

2. Show that  $\frac{1 + \cot \theta}{1 + \tan \theta} = \cot \theta$ . (4 marks)

3. Determine the area of a regular hexagon whose side length is 10 cm. (4 marks)

4. Calculate the length of wire used to make the paper clip shown in Figure 1. (4 marks)

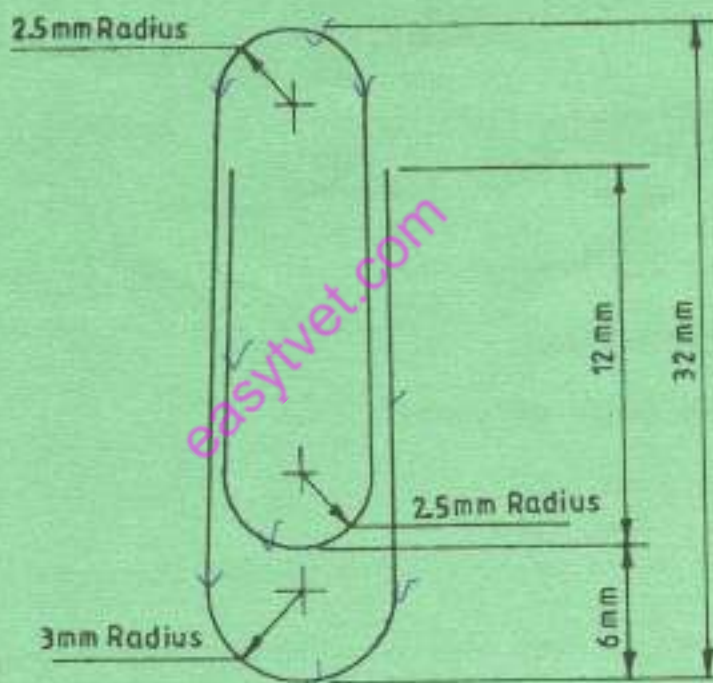


Fig. 1

5. A mercury-in-glass thermometer has a mercury thread of length 1 cm at the ice point and 12 cm at steam point. Calculate the temperature of water when the mercury thread length is 6 cm. (4 marks)

6. Define the following terms:

(a) elasticity; (2 marks)

(b) strain. (2 marks)



7. State the **two** laws of refraction. (4 marks)
8. List **four** segments of the environment. (4 marks)
9. Describe the relationship between specific conductivity and concentration of an electrolytic solution. (4 marks)
10. Differentiate between a true solution and a colloidal solution in terms of its effect on light. (4 marks)

**SECTION B (60 marks)**

*Answer any THREE questions from this section.*

11. (a) Joseph has more money than James. If Joseph gave James Ksh. 200, they would have the same amount and if James gave Joseph Ksh. 220, Joseph would then have twice as much as James. Calculate the amount of money that each have. (6 marks)
- (b) A rectangular building is 15 m long by 10 m wide. A concrete path of constant width is laid around the building. The total area of the path is  $60 \text{ m}^2$ . Calculate the width of the path. (6 marks)
- (c) A force of 3 N acts on a point at an angle of  $18^\circ$ . Another force of 7 N acts on the same point at an angle of  $115^\circ$ . Calculate the:
- (i) magnitude of the resultant force; (6 marks)
- (ii) direction of the resultant force. (2 marks)
12. (a) Differentiate the equation  $y = 3x^3 \sin 4x$  (4 marks)
- (b) Determine the coordinates of the point on the curve  $y = \frac{x^3}{3} + 2x^2 + 5x$ , where the gradient is 1. (6 marks)
- (c) A proton moves in an electric field such that its acceleration in  $\text{cm}^2/\text{s}$  is given by the equations  $a = 2t + 5$ , where  $t$  is time in seconds. Determine the:
- (i) velocity as a function of time if  $v = 10 \text{ cm/s}$ , when  $t = 0$ . (5 marks)
- (ii) time when velocity reaches 30 cm/s. (5 marks)
13. (a) (i) State the Newton's law of viscosity. (2 marks)
- (ii) Oil with a density of  $800 \text{ kg/m}^3$  flows in a 5 cm diameter tube at a velocity of 4 m/s. The static height of the oil in the tube measured 10 cm apart, dropped by 1 cm. Use Poiseville equation to calculate the viscosity of the oil. Take the gravitational acceleration,  $g$ , as  $9.81 \text{ m/s}^2$ . (6 marks)
- (b) State the **four** assumptions made in the application of kinetic theory of gases. (4 marks)



- (c) A spherical balloon filled with air has a volume of  $200 \text{ cm}^3$  at the earth's surface where temperature and pressure is  $20^\circ\text{C}$  and  $760 \text{ mm Hg}$ . The balloon is allowed to ascend to a height where the temperature is  $0^\circ\text{C}$  and the pressure is  $100 \text{ mm Hg}$ . Calculate the diameter of the balloon at this height. (8 marks)
14. (a) State the Newton's Law of cooling. (2 marks)
- (b) State three factors that affect the thermal conductivity of a material. (3 marks)
- (c) A  $100 \text{ g}$  metal was removed from boiling water and placed in a copper calorimeter of mass  $20 \text{ g}$  containing  $200 \text{ g}$  of water at  $24^\circ\text{C}$ . After stirring, the final temperature rises to  $56^\circ\text{C}$ . Calculate the specific heat capacity of the metal. ( $C_p$  of water =  $4.18 \text{ kJ/kg K}$ ,  $C_p$  of copper =  $0.376 \text{ kJ/kg K}$ ). (6 marks)
- (d) (i) Define the term momentum. (2 marks)
- (ii) A force of  $150 \text{ N}$  acts on a body of mass  $3 \text{ kg}$  starting from rest. Calculate the:
- I acceleration; (2 marks)
- II velocity after 10 seconds; (2 marks)
- III distance travelled. (3 marks)
15. (a) Arrange the plant nutrients  $Zn$ ,  $NO_3^-$ ,  $K^+$  in ascending order of their potential mobility in soil. (3 marks)
- (b) With the aid of equations, explain the effect of continuously applying large amounts of ammonium - containing fertilizers to a well aerated soil. (7 marks)
- (c) Explain the effect of the following soil conditions on nitrogen availability to a plant after applying ammonium nitrate fertilizer:
- (i) water logging; (4 marks)
- (ii) presence of decomposing organic matter; (3 marks)
- (iii) freezing soil temperatures. (3 marks)

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