

2528/102
2922/102
ENVIRONMENTAL CHEMISTRY
AND APPLIED SCIENCE
June/July 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;

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 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. Calculate the total surface area of a square prism with 6 cm square base and 10 cm perpendicular height. (4 marks)

2. Solve the following simultaneous equations:

$$\frac{3}{x} + \frac{2}{y} = 14$$

$$\frac{5}{x} - \frac{3}{y} = -2$$



(4 marks)

3. The sag, S , at the centre of a wire is given by the equation

$$S = \sqrt{\frac{3d(L-d)}{8}}$$

Make L the subject of the formula.

(4 marks)

4. A 0.007 kg bullet moving at 250 m/s penetrates into a fixed target and stops in 0.04 s. Calculate the distance penetrated by the bullet.

(4 marks)

5. (a) State Dalton's law of partial pressure.

(2 marks)

- (b) Gases A, B and C occupy a volume of 0.03 m^3 at a pressure of 101 kN/m^2 . The partial pressure of gas A and B are 35.5 kN/m^2 and 42.0 kN/m^2 respectively. Calculate the partial pressure of gas C.

(2 marks)

6. A bicycle tyre was found to have a pressure of $8.5 \times 10^5 \text{ N/m}^2$ at 20°C . The bicycle was left in the sun for 2 hours during which the temperature rose to 28°C . Assuming that the volume of air inside remains constant, calculate the pressure of the tyre given that the atmosphere pressure is $1.01 \times 10^5 \text{ N/m}^2$.

(4 marks)

7. The moon revolves around the earth in 28 days. Assuming that the orbit is circular and has a radius of $4.0 \times 10^8 \text{ km}$, calculate the acceleration of the moon towards the earth.

(4 marks)

8. (a) Name the final products of anaerobic degradation of an organic compound.

(2 marks)

- (b) Describe the stability of chlorinated hydrocarbons in aerobic degradation.

(2 marks)

9. State four effects of releasing untreated organic effluent into a water body.

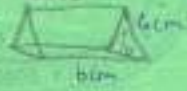
(4 marks)

10. Name any four essential plant micronutrients.

(4 marks)

Phosphorus
Nitrogen

2



V=10

SECTION B (60 marks)

Answer any **THREE** questions from this section.

11. (a) Solve the following trigonometric equation for value of θ between 0° to 360° .
 $5\cos^2\theta - 3\sin\theta - 3 = 0$ (8 marks)
- (b) The total surface area of a closed cylindrical container is 20.0 m^2 . Calculate the radius of the cylinder if its height is 2.8 m . (4 marks)
- (c) Differentiate the following equations:
- (i) $y = \frac{4 \sin 5x}{5x^4}$ (4 marks)
- (ii) $y = 4x^2 \ln x$ (4 marks)

12. (a) The current, I , in Amperes flowing in a capacitor at time, t , seconds is given by
 $I = 8(1 - e^{-\frac{t}{5}})$
- The circuit resistance, R , is $20 \times 10^3 \text{ Ohms}$ and capacitance, C , is $14 \times 10^{-6} \text{ Farads}$. Calculate the:
- (i) time taken for current to reach 5 A . (5 marks)
- (ii) current, I , at time, $0, 0.5, 1.0, 1.5$ and 2.0 seconds then plot the graph of the current (I) against time (t). (10 marks)
- (b) The velocity v of a body at time, t , is given by $v = 2t^3 + 4t + 5$. Determine the distance in metres travelled by the body between 1 second and 5 seconds. (5 marks)

13. (a) State five properties of X-rays. (5 marks)
- (b) Name five applications of X-rays. (5 marks)
- (c) With the aid of a labelled diagram of X-ray tube, describe the production of X-rays. (10 marks)

14. (a) Write a mathematical expression of the Clausius-Clapeyron equation and define all the terms used. (5 marks)
- (b) Calculate the vapour pressure of 1-propanol at 52.8°C if its vapour pressure is 10.00 kPa at 14.7°C ($\Delta H_{\text{vap}} = 47.2 \text{ kJ/mol}$). (6 marks)
- (c) Classify as colloidal solution or suspension the substances: milk; clay in water; blood; foam; sand in water. (5 marks)
- (d) Distinguish between emulsions and gels. (4 marks)



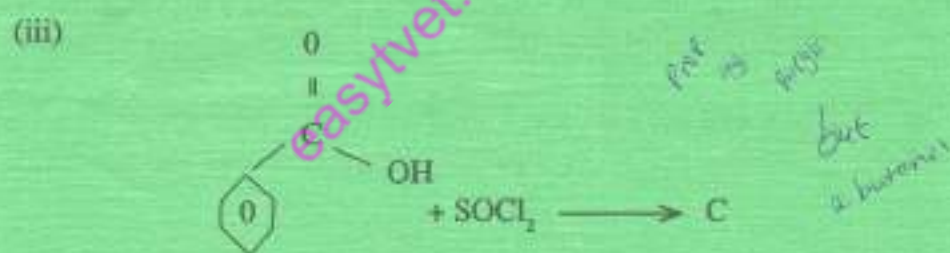
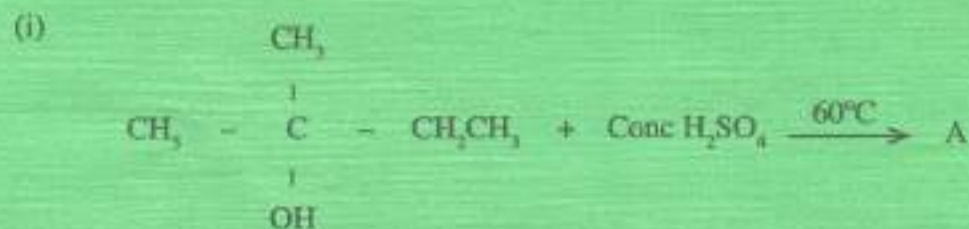
15. (a) Define the following terms as used in organic chemistry:

(i) functional group; (2 marks)

(ii) homologous series. *Group of same* (2 marks)

(b) Outline the three steps involved in the conversion of propene to propanol. (6 marks)

(c) Write the structures of the organic products A, B and C in the following chemical reactions. (3 marks)



(d) Name the products A, B and C above. (3 marks)

(e) (i) Draw a generalised structure of polychlorinated dibenzo-p-furans (PCDFs). (2 marks)

(ii) List any two characteristics of polychlorinated dibenzo-p-dioxins that make them significant environmental pollutants. (2 marks)

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