

2922/102
ENVIRONMENTAL CHEMISTRY AND
APPLIED SCIENCE
Oct./Nov. 2022
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 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.

SECTION A (40 marks)

Answer ALL the questions in this section.

1. (a) Define the term 'couple' as used in forces. (1 marks)
(b) State three specifications of a couple. (3 marks)
2. Define each of the following as used in circular motion:
(a) angular velocity; (2 marks)
(b) centripetal force. (2 marks)
3. A fluid is placed between two plates 0.03 mm apart. The upper plate moves at a velocity of 0.5 m/s and requires a force of 2 N/m² while the lower plate is stationary. Determine the viscosity of the fluid. (4 marks)
4. Solve the equation $3x^2 - 11x - 4 = 0$ by factorisation method. (4 marks)
5. Write the logarithmic expression $\log 27 - \log 9 + \log 81$ in terms of $\log 3$. (4 marks)
6. Determine the coordinates of the point on the graph, $y = 3x^2 - 7x + 1$ where the gradient is -1. (4 marks)
7. Distinguish between chemotrophic and phototrophic organisms. (4 marks)
8. (a) Define 'Biochemical Oxygen Demand' (BOD). (2 marks)
(b) Explain the purpose of carrying out a BOD test on wastewater. (2 marks)
9. (a) State Henry's law. (2 marks)
(b) Explain why solubility of gases reduces with increase in temperature. (2 marks)
10. Distinguish between hydrophilic and hydrophobic colloids. (4 marks)

SECTION B (60 marks)

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

11. (a) State each of the following laws:
- (i) Boyle's law; (2 marks)
 - (ii) Charles's law; (2 marks)
 - (iii) pressure law. (2 marks)
- (b) State **four** assumptions made in kinetic theory of gases. (4 marks)
- (c) Light of wavelength 4.6×10^{-7} m falls on a certain metal emitting maximum kinetic energy of 0.8 eV. Determine the:
- (i) threshold frequency for the metal; (3 marks)
 - (ii) speed of the emitted electrons. (3 marks)
- Planck's constant = 6.63×10^{-34} J; speed of electromagnetic radiation = 3.0×10^8 m/s; $1 \text{ eV} = 1.60 \times 10^{-19}$ J; mass of electron = 9.1×10^{-31} kg.
- (d) A lamp is placed in front of a convex lens of focal length 10 cm which produces an image 14 cm from the lens on the same side as the object. Determine the position of the object. (4 marks)
12. (a) The distance, s , metres from a fixed point of a vehicle travelling in a straight line with a constant acceleration, $a \text{ m/s}^2$ is given by $s = ut + \frac{1}{2}at^2$, where u is initial velocity and t is time. Given that after 4s, the distance travelled is 84 m and after 8s, the distance travelled is 288 m, determine the:
- (i) initial velocity; (4 marks)
 - (ii) acceleration; (3 marks)
 - (iii) distance travelled after 6s. (2 marks)
- (b) The total surface area of a closed cylindrical container is 20.0 m^2 . Given that the height is 2.8 m, determine its radius. (6 marks)
- (c) Solve the trigonometric equation $5 \sin y = 3$ for angles between 0° and 360° . (5 marks)

13. (a) The angular displacement θ in radians of a flywheel varies with time t in seconds and follows the equation $\theta = 10t^2 - 4t^3$. Determine the:
- angular velocity after 1s. (3 marks)
 - acceleration of the flywheel when time is 0.5 s. (3 marks)
 - time taken when the angular acceleration is zero. (2 marks)
- (b) The velocity v of a body after time t is given by the equation $v = 3t^2 + 5$. Determine the distance moved after 6 seconds. (5 marks)
- (c) The angle at which a rotating shaft turns in t seconds is given by the equation $\theta = 3t + 0.3t^2$. Determine the:
- time taken to complete 4 radians; (3 marks)
 - time taken when the angular velocity is 6 rad/s. (4 marks)
14. (a) (i) Define the term 'soil'. (2 marks)
- (ii) Name any **four** micronutrients in soil. (4 marks)
- (b) (i) Describe the process of nitrogen fixation in soil. (2 marks)
- (ii) Figure 1 shows a schematic diagram of nitrogen pathway.
- Name species labelled A, B and C. (3 marks)
 - Name the process labelled D and E. (2 marks)

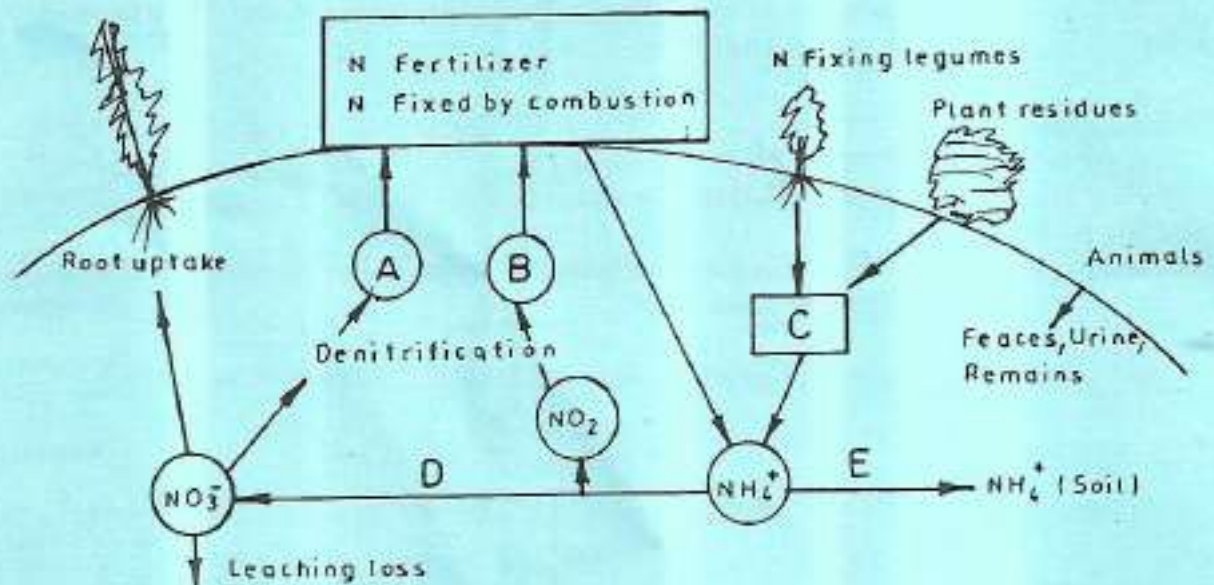


Fig.1

- (c) Explain two negative effects of excessive use of synthetic fertilizer in soil. (4 marks)
- (d) State three reasons why the effectiveness of pesticides applied to the soil reduces over time. (3 marks)
15. (a) (i) Describe the chlorofluorocarbons (CFCs) group of organic compounds. (2 marks)
- (ii) With the aid of chemical equations describe the destruction of stratospheric ozone by CF_2Cl_2 . (7 marks)
- (b) (i) State four properties of polychlorinated biphenyls (PCBs). (4 marks)
- (ii) Explain two characteristics of PCBs that make them environmental pollutants. (4 marks)
- (iii) With the aid of a chemical structure, describe a Biphenyl molecule. (3 marks)

easyvet.com

THIS IS THE LAST PRINTED PAGE.