

2914/102

2915/102

MATHEMATICS AND APPLIED SCIENCE

June/July 2019

Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN APPLIED BIOLOGY

DIPLOMA IN ANALYTICAL CHEMISTRY

MODULE I

MATHEMATICS AND APPLIED SCIENCE

3 hours

### INSTRUCTIONS TO CANDIDATES

*You should have the following for this examination:*

*Answer booklet;*

*Scientific calculator (battery operated).*

*The paper consists of TWO sections; A and B.*

*Answer ALL the questions in BOTH Section A and Section B.*

*Each question in section A carries 4 marks while each question in section B carried 20 marks.*

*Maximum marks for each part of the question are indicated.*

*Candidates should answer all 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: (60 marks)

Answer ALL the questions in this section.

1. (a) State two advantages of using a parabolic reflection in car headlamps. (2 marks)
- (b) A concave mirror has a focal length 20 cm. Determine the position, size and nature of the image when the object is placed 30 cm in front of the mirror. (2 marks)
2. (a) Differentiate between potential difference and electromotive force. (2 marks)
- (b) A wire 0.60 m long and a diameter  $4 \times 10^{-4}$  m has a resistance of  $2 \Omega$ . Determine resistivity of the material. (2 marks)
3. State any four properties of an electromagnetic spectrum. (4 marks)
4. Differentiate between hard X-rays and soft X-rays. (4 marks)
5. (a) Differentiate between scalar and vector quantities. (2 marks)
- (b) Explain why an oil drop spreads on water surface. (2 marks)
6. Given the points A(3,6), B(5,9) and C(9,15).

Find:

- (a) AB and BC. (2 marks)
- (b) The relationship between AB and BC. (2 marks)



7. Integrate with respect to t:

$$\frac{1}{2}t^3 + \frac{1}{3}t^2$$

$$\frac{27500 \times 100}{20}$$

(4 marks)

8. (a) Simplify:

$$p^q \frac{(2p-2q)-(xp+xq)}{p-q} p^{-q}$$

$$27500 \rightarrow 20\% \\ \rightarrow 100\%$$

(2 marks)

- (b) A square has sides x cm. One side of the square is increased by 4 cm while the other side is reduced by 6 cm. The area of the rectangle formed is  $24 \text{ cm}^2$ . Find the length of the side of the square.

(2 marks)

9. (a) State Hooke's law. (2 marks)
- (b) A spring stretches by 2.0 cm when a weight of 5.0 N is hang from it. Determine the force that produces an extension of 2.5 cm. (2 marks)
10. (a) Define Cathode Ray Tube (CRT). (1 mark)
- (b) (i) Name the operational parts of a Cathode Ray Oscilloscope (CRO). (1 mark)
- (ii) State any two uses of CRO. (2 marks)
11. (a) Differentiate between molecular forces and nuclear forces. (2 marks)
- (b) An object has a mass of 250 kg. Find:
- (i) its weight on the surface of the moon given that the gravitational pull on the moon is  $1.7 \text{ N Kg}^{-1}$ . (1 mark)
- (ii) If the same object weighs 1000 N on a certain planet, calculate the acceleration due to gravity on this planet. (1 mark)

12. Explain how Bernoulli's principle affects the aerofoil. (4 marks)

13. Find the constant term in the expansion of:

$$\left(2x - \frac{1}{3x^2}\right)^8$$

$$x \binom{8}{2} (2x)^6 \left(-\frac{1}{3x^2}\right)^2 = 24$$

$$4 - 3$$

$$4 -$$

(4 marks)

14. Solve the following simultaneous equations by matrix method:

$$2x - y = 4$$

$$3x + 2y = -1$$

$$\begin{bmatrix} 2 & -1 \\ 3 & 2 \end{bmatrix}^{-1} \begin{bmatrix} 4 \\ -1 \end{bmatrix}$$

$$2 \times 2$$

(4 marks)

15. A TV set was bought on hire purchase. A down payment of Ksh 5,000 was paid and a 15 monthly instalments of Ksh 1500 was required.

(a) Calculate the total amount paid on hire purchase. (2 marks)

$$2(LW)$$

(b) If hire purchase payment is 20% higher than cash payment, find the cash price. (2 marks)

(2 marks)

Handwritten notes and calculations:

- $S = \frac{P}{A}$
- $F = S \times A$
- Stamp: 13 SEP 2019
- Equations:  $(2x-1) - (3x-1)$ ,  $(2x-2y) - (2x+xq)$ ,  $(p-q) \times (p+q)$ ,  $2(p-q) - 4(p+q)$ ,  $2x = (p-q)$
- Fractional notes:  $\frac{1}{7}$ ,  $\frac{12}{7}$ ,  $\frac{1}{5}$ ,  $\frac{1}{7}$

Turn over

SECTION B: (40 marks)

Answer ALL the questions in this section.

16. (a) A group of students set up an experiment to investigate a physiological process. The set up was as shown in figure 1.

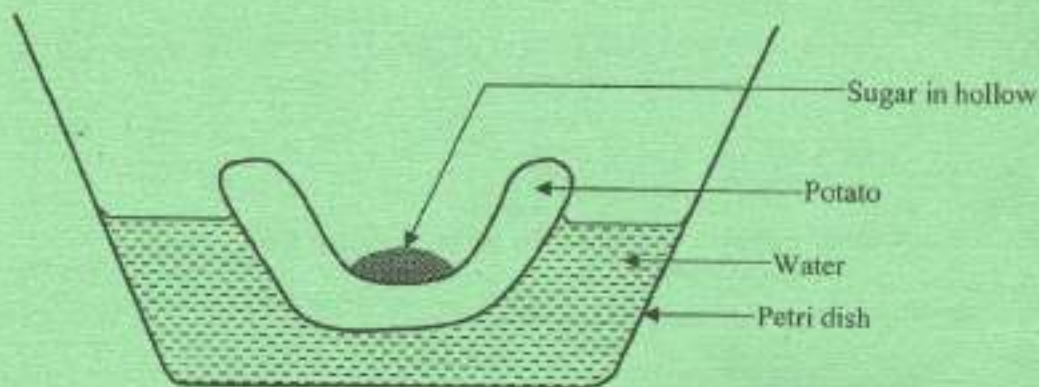


Fig. 1

After some time the student observed that the level of the sugar solution had risen.

- (i) Identify the physiological process investigated. *osmosis* (1 mark)
- (ii) Account for the rise in the level of sugar solution in the experiment. (4 marks)
- (iii) With reasons, suggest the observations if the experiment was repeated using a piece of boiled potato. *no change* (4 marks)
- (b) (i) State the structural differences between arteries and veins in mammals. *boiled potato - no water potato enzymes* (3 marks)
- (ii) Describe the process of ultrafiltration in the mammalian kidney. (8 marks)
17. (a) A solution of sodium carbonate of concentration  $0.100 \text{ mol dm}^{-3}$  is used to standardise a solution of hydrochloric acid.  $25.0 \text{ cm}^3$  of the standard solution of the sodium carbonate requires  $35.0 \text{ cm}^3$  of acid for neutralisation. Calculate the concentration of the acid. (10 marks)
- (b) (i) Define the term electrolysis. *substance that produces electricity in liquid form - becomes in water to produce electricity.* (2 marks)
- (ii) Distinguish between a strong and a weak electrolyte. (2 marks)



- (iii) Figure 2 shows an incomplete diagram of a set-up intended to measure the standard electromotive force of a cell.

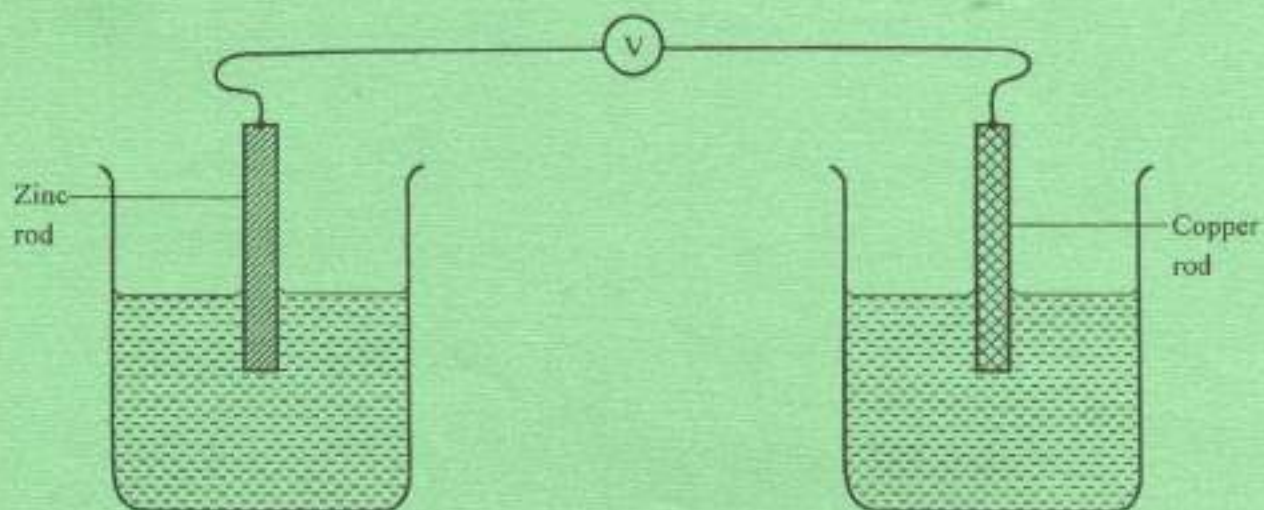


Fig. 2

Using a piece of copper, a piece of zinc, 1.0 M copper sulphate, 1.0 M zinc sulphate and saturated solution of potassium chloride. Complete the diagram. (6 marks)

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