Name: _____   Index No: _____/_____

2705/102   2709/102
2707/102   2710/102
MATHEMATICS I AND
PHYSICAL SCIENCE
June/July 2015
Time: 3 hours

Candidate's Signature: _____

Date: _____

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN BUILDING TECHNOLOGY
DIPLOMA IN CIVIL ENGINEERING
DIPLOMA IN ARCHITECTURE
MODULE I

MATHEMATICS I AND PHYSICAL SCIENCE

3 hours

INSTRUCTIONS TO CANDIDATES

Write your name and index number in the spaces provided above.
Sign and write the date of the examination in the spaces provided above.
You should have a calculator and drawing instruments for this examination.
*This paper consist of **EIGHT** questions in **TWO** sections; A and B.*
*Answer **FIVE** questions choosing **TWO** questions from section A, **TWO** questions from section B and **ONE** question from either section in the spaces provided in this question paper.*
All questions carry equal marks.
Maximum marks for each part of a question are as shown.
Candidates should answer the questions in English.

For Examiner's Use Only

Section	Question	Maximum Score	Candidate's Score
A	1	20	
	2	20	
	3	20	
	4	20	
B	5	20	
	6	20	
	7	20	
	8	20	
	Total Score		

This paper consists of 16 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: MATHEMATICS I

*Answer at least **TWO** questions from this section.*

1. (a) Solve the equations:

    $2^x + 3^y = 251$

    $2^{(x+3)} + 3^{(y+2)} = 2251$ (5 marks)

    (b) Make h the subject of the formula:

    $A = \pi r^2 + \pi r \sqrt{h^2 + r^2}$ (5 marks)

    (c) Express $\dfrac{x+7}{(2x-1)(x^2+1)}$ into partial fractions.   (5 marks)

    (d) Solve the equation:

    $\log(x+3) = \log 6 - \log(x+2)$ (5 marks)

2. (a) Given that

    $\sin(x - \alpha) = \sqrt{2} \cos(x + \alpha)$

    (i) show that

    $$\tan x = \frac{\sqrt{2} + \tan \alpha}{1 + \sqrt{2}\tan \alpha}$$ (5 marks)

    (ii) Given that $\alpha = \dfrac{\pi}{4}$ radians, solve for x.   (3 marks)

    (b) Given that t - 2, 2t - 6, 4t - 8 form an arithmetic progression:

    Determine:

    (i) the value of t;

    (ii) the sum of the first 10 terms.   (6 marks)

    (c) (i) Using binomial theorem expand $(1-x)^{-\frac{1}{2}}$ in ascending powers of x as far as the term in x^3.

    (ii) Use the expansion in (i) above to approximate the value of $\sqrt{\dfrac{5}{4}}$.   (6 marks)

3. (a) An aeroplane flies along a latitude from a town P(50°S, 25°E) to a town Q(50°S, 30°W) in 4 hours. Determine:

   (i) the distance in nautical miles from P to Q.

   (ii) the speed of the aeroplane in knots

   (5 marks)

   (b) Points A(2,20) and B(10,4) are on a plane. Point C divides line AB in the ratio 1:3. Determine:

   (i) the position vector of C;

   (ii) the coordinates of C.

   (6 marks)

   (c) Given the points A(3,2,-5), B(5,-4,-10) and C(2,-3,5);

   (i) Write in terms of unit vectors AB and AC;

   (ii) Determine the angle between vectors AB and AC.

   (9 marks)

4. (a) A batch of 16 articles consists of 10 good ones, 4 with only minor defects and 2 with major defects. Two articles are drawn at random without replacement. Use a tree diagram to find the probability that:

   (i) one article is good while the other has a major defect.

   (ii) one article has a major defect while the other has a minor defect.

   (7 marks)

   (b) The following are marks obtained by 60 students in a civil engineering examination.

93	59	65	57	67	82	97	63	40	52
47	61	37	25	33	77	67	80	70	88
46	63	42	64	41	50	66	20	60	79
57	37	47	23	79	56	35	57	54	84
49	34	52	34	77	55	41	32	24	67
92	66	95	60	62	81	96	64	28	58

   (i) Classify the data starting with 20-29, 30-39, ...

   (ii) Use the classified data to calculate the mean and standard deviation.

   (13 marks)

SECTION B: PHYSICAL SCIENCE

*Answer at least **TWO** question from this section.*

5.　(a)　State any **two** nature of the image formed by a plane mirror.　　　(2 marks)

　　(b)　Figure 1 shows a ray of light incident on a plane mirror. The mirror is inclined at 50° to the second mirror.
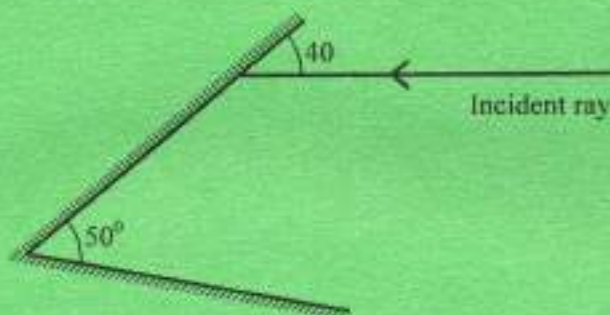

Fig. 1

　　　(i)　Determine:

　　　　(I)　the angle of incidence on the first mirror.　　　(1 mark)

　　　　(II)　the angle of incidence of the reflected ray on the second mirror.　　　(1 mark)

　　　(ii)　State the effect on the reflected ray on striking the second mirror.　　　(1 mark)

　　(c)　(i)　An electric lamp is placed behind a screen with a hole. The position of a concave mirror is adjusted until a sharp image of the hole is formed on the screen. The distance between the mirror and the screen is 40cm. Determine the focal length of the mirror.　　　(2 marks)

　　　(ii)　State **two** advantages of using a convex mirror as a driving mirror.　　　(2 marks)

　　(d)　State the **two** laws of refraction.　　　(2 marks)

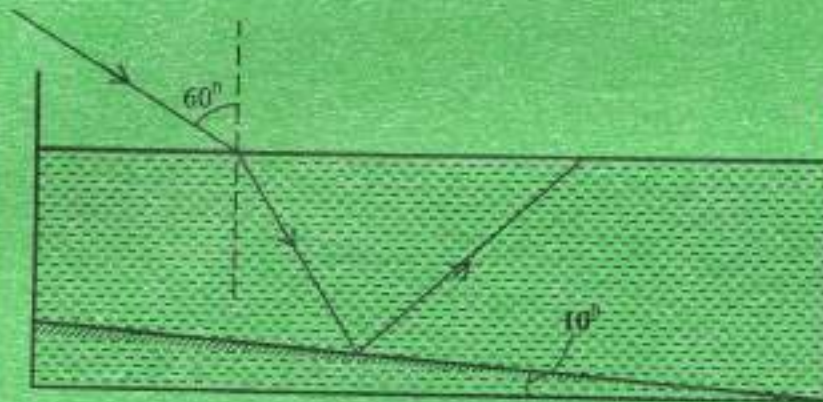(e)   A ray of light is incident on the surface of water in a beaker as shown in figure 2.

Fig. 2

The refracted ray is reflected by a plane mirror placed at 10° to the bottom of the beaker. Taking the refractive index of water as 1.3, determine:

(i)   the angle of refraction of the ray as it enters water.

(ii)   the angle of incidence on the surface of water of the ray after reflection from the plane mirror.

(9 marks)

6.   (a)   (i)   Define the moment of a force about a point.

(ii)   State the principle of moments.

(4 marks)

(b)   Figure 3 shows a system of forces acting on a light uniform rod of length 3 metres. The rod is hinged at A in a vertical position.
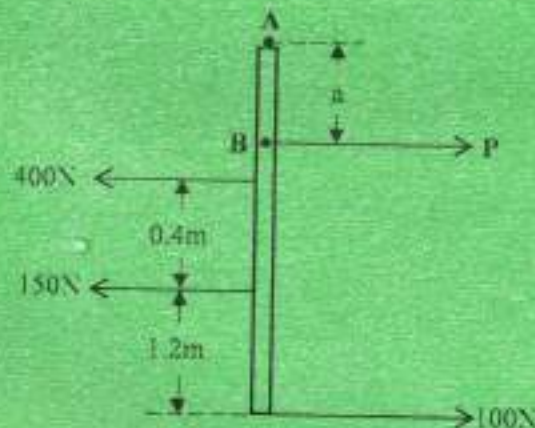

Fig. 3

Given that the system of forces are in equilibrium, determine:

(i) the magnitude of the force P.

(ii) the distance "a" between A and B.

(6 marks)

(c) In an experiment in a laboratory a tunning fork of frequency 520Hz is struck on a rubber bang. The prongs of the force are seen to vibrate and sound is heard a few metres from the fork.

(i) Explain how the sound from the fork reaches the observer. (3 marks)

(ii) State the frequency of the sound reaching the observer. (1 mark)

(iii) If the speed of sound in air is 340 ms^{-1} determine the wavelength of the waves produced. (3 marks)

(d) A mass m is placed on a turntable. The frequency of rotation of the turntable is gradually increased until it is very high. It is observed that beyond a certain frequency the mass slips off. Explain this observation. (3 marks)

7. (a) (i) State the **two** types of polymers.

(ii) Give any **two** examples of each type stated in (i) above.

(6 marks)

(b) Explain the following methods of polymerisation:

(i) Addition;

(ii) Condensation.

(4 marks)

(c) (i) With reference to alkanes explain the term "isomerism". (1 mark)

(ii) Describe the process of preparing soap in a laboratory. (7 marks)

(iii) State any **two** uses of synthetic rubber. (2 marks)

8. (a) (i) State **three** factors which determine the quantity of products liberated at the electrodes during electrolysis.

(ii) Explain the term "oxidation number" of an element.

(4 marks)

(b) (i)   State any **two** examples of double salts.   (2 marks)

     (ii)   Explain any **two** methods of removing permanent hardness of water.

            (4 marks)

(c) (i)   With reference to structure and bonding of elements explain the following:

        (I)   Ionic bond

        (II)   Covalent bond.

            (4 marks)

     (ii)   Table 1 gives elements represented by letters J, K, L, M, N and Q.

Table 1

Element	J	K	L	M	N	Q
Atomic number	12	13	14	15	16	17
Electron configuration						

        (I)   Complete table 1.   (2 marks)

        (II)   Determine the period of the elements.   (1 mark)

(d)   The isotope $^{14}_{6}C$ has a half life of 5600 years.

Determine the:

   (i)   number of protons and neutrons present in the nucleus of carbon 14.

   (ii)   time taken for a sample of carbon 14 to decay to $\frac{1}{32}$ of the original sample.

            (3 marks)