



ZIMBABWE

MINISTRY OF HIGHER AND TERTIARY EDUCATION

**HIGHER EDUCATION EXAMINATIONS COUNCIL
(HEXCO)**

NATIONAL CERTIFICATE

IN

**MACHINESHOP, FABRICATION ENGINEERING, REFRIGERATION
AND AIR CONDITIONING, VEHICLE BODY BUILDING, DRAUGHTING
AND DESIGN TECHNOLOGY, MILLWRIGHTS, POWER PLANT**

SUBJECT: Engineering Mathematics

PAPER NO: 340/S02

OCTOBER/NOVEMBER 2012 EXAMINATION

REQUIREMENTS

1. Non-programmable Scientific Calculator.
2. Graph Paper.

INSTRUCTIONS TO CANDIDATE

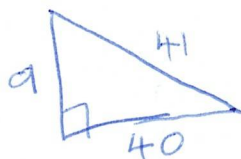
1. Question 1 is compulsory.
2. Answer any four (4) questions from question 2 to question 7.

This paper consists of 4 printed pages.

SECTION A

QUESTION 1

- a) Simply $\frac{6a^2bc}{15a^2b^2c^2} \times \frac{24bc^3}{3ac}$ (5 marks)
- b) Solve $3^{x+1} = 2^{2x-3}$ (5 marks)
- c) i) Transpose for k in $E = \frac{9ck}{c+3k}$ (3 marks)
- ii) Factorise $x^2 + 8x + 7$ (2 marks)
- d) Find the coefficient of $x^{\frac{1}{2}}$ in $(1 + 3x)^{-\frac{1}{2}}$ (5 marks)
- e) Differentiate $f(x) = 3x^3$ from first principles. (5 marks)
- f) If $\sin\theta = \frac{9}{41}$, find the value of $\cos\theta$ and $\tan\theta$. (5 marks)
- g) Prove the identity: $\frac{1+\cot y}{1+\tan y} = \cot y$ (5 marks)
- h) An automatic garden water spray gives out a spray to a distance of 2m and revolves through an angle α which can be varied. If the desired spray catchment area is to be $3m^2$, to what should angle α be set correct to the nearest degree? (5 marks)



$$41^2 - 9^2$$

$$\begin{aligned} \text{SHO} \quad 3^{x+1} &= 2^{2x-3} \\ x+1 \log 3 &= 2x-3 \log 2 \end{aligned}$$

$$1^{-1/3} + \frac{3x^{-1/3}}{1!} +$$

$$\left(1 \times 3x\right)^{-1/3} + \left(1 \times 3x^2\right)^{-1/3} +$$

$$dx(x^2 + 2x dx + dx^2)$$

$$x^2 dx + 2x dx^2 + dx^3$$

$$x^3 + 3x^2 dx + 3x dx^2 + dx^3$$

$$\begin{aligned} \frac{1 + \frac{1}{\tan y}}{1 +} & \quad \frac{\sin}{\cos} \\ 1 + \frac{\cos}{\sin} & \quad \frac{\sin + \cos}{\sin} \end{aligned}$$

TAO

$$\frac{\sin + \cos}{\sin} \div \frac{\cos + \sin}{\cos}$$

$$3k(3)$$

$$x(x^2 + 2x dx + dx^2)$$

$$x^3 + 2x^2 dx + x dx^2 +$$

$$\frac{1 + \frac{\sin}{\cos}}{\cos + \sin}$$

CHA

SECTION B

QUESTION 2

- a) The total area of the metal template shown in Figure Qn 2 is 425.6 cm^2 . Find the value of r . (8 marks)

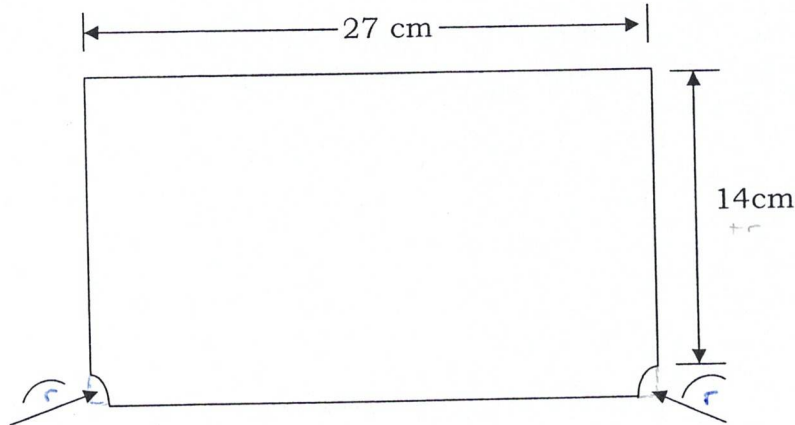


Figure Qn. 2.

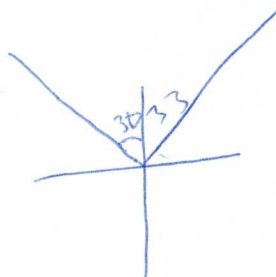
- b) The power of a mechanical device is given by: $P = aN + \frac{b}{N}$ where a and b are constants. Find the value of a and b if $P=13$ when $N=3$ and $P=12$ when $N=2$. (7 marks)

QUESTION 3

Determine the approximate area between the curve $y = x^3 + x^2 - 4x - 4$, the ordinates $x = -3$ and $x = 3$ and the x -axis by integration. (15 marks)

QUESTION 4

A man leaves a point walking at 6.0 km/h in a direction $S30^\circ W$. Another man leaves the same point at the same time cycling at a constant speed in a direction $S23^\circ E$. After 4.0 hours the two men are 100km apart. Find the speed of the cyclist. (15 marks)



$$S = \frac{D}{T}$$

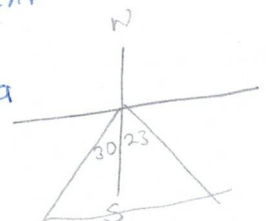
$$378 + 2r - 425.6 = \frac{1}{2}\pi r^2$$

$$\pi r^2$$

$$13 = a$$

$$13 - \frac{b}{3} =$$

$$11664$$



$$(27-2r)(14-2r) = 425.6$$

$$378 - 54r - 28r + 4r^2$$

$$27 \times 14 + r$$

$$425.6 = 27 \times 14 + r$$

$$(27+2r)(14+r)$$

$$\frac{1}{2}\pi r^2$$

$$425.6$$

$$378 + 2r$$

$$425.6 -$$

$$378 + 2r - 425.6$$

$$(15 \text{ marks})$$

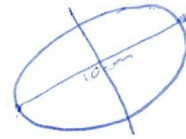
$$47.6 = 2$$

$$r = 23.8$$

$$425.6$$

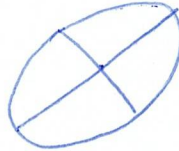
$$36$$

$$62$$

QUESTION 5

An ellipse is produced by slipping a loop of cord around two fixed points, 10 cm apart and then sliding a pencil along the cord in such a way to keep it taut at all points. If the loop cord is 25 cm in length, find:

- The length of the minor and major axis. (7 marks) ✓
- The perimeter of the ellipse. (4 marks)
- Area of the ellipse. (4 marks)

QUESTION 6

- Derive the formula for the volume of a cone using the theorem of Pappus (Guldun), given that the centroid of triangle lies at a distance of $\frac{h}{3}$ from the base where h is the perpendicular height. (5 marks)
- Calculate the volume of an anchor ring formed by rotating a circle of radius 6 cm about an axis at a distance of 20 cm from its centre. (3 marks)
- A quadrant of a circle of radius r is rotated 360° about one of its radii form a hemisphere. Using the theorem of Pappus, find the distance of the centroid of the quadrant from the centre of the circle. (7 marks)

QUESTION 7

The intensity of illumination I , provided by a particular lamp when it is at a distance d from a light meter is given by the following data:

I (Units)	270	120	67.5	43.2	30.0	16.9
D (m)	1.0	1.5	2.0	2.5	3	4

Illustrate this data on a graph, using horizontal scale of 20 mm = 0.5m for d and a vertical scale of 20 mm = 50 units for I . (10 marks) ✓

- Use the graph to determine the value of I when $d = 2.4$ m. (1 mark)
- Use the graph to determine the number of lamps to provide a total value of I for 140 units when $d = 2.7$ m. (4 marks)

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