**3.3.2   Mathematics Alt. A Paper 2 (121/2)**

SECTION I (50 marks)

*Answer **all** the questions in this section in the spaces provided.*

1   The sum of n terms of the sequence; 3, 9, 15, 21, ... is 7500. Determine the value of n. (3 marks)

2   A quadratic curve passes through the points $(-2, 0)$ and $(1, 0)$. Find the equation of the curve in the form $y = ax^2 + bx + c$, where a, b and c are constants.   (2 marks)

3   Make d the subject of the fomula,

$$P = \tfrac{1}{2} mn^2 - \frac{qd^2}{n}$$ (3 marks)

4   Solve the equation
    $2 \log x - \log (x - 2) = 2 \log 3.$ (3 marks)

5   (a)   Using a pair of compasses and ruler only, construct an escribed circle to touch side XZ of triangle XYZ drawn below.   (3 marks)
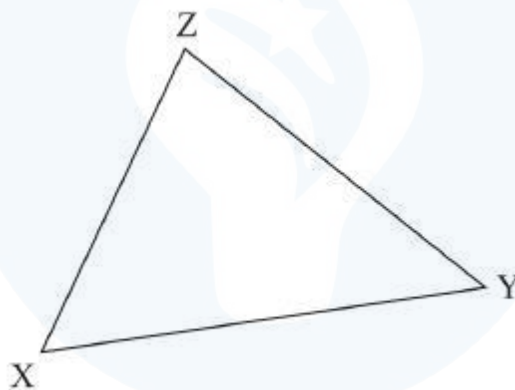
(b)   Measure the radius of the circle.   (1 mark)

6   The equation of a circle is given by $x^2 + 4x + y^2 - 2y - 4 = 0$. Determine the centre and radius of the circle.   (3 marks)

7   (a)   Expand $(1 - x)^5$.   (1 mark)

(b)   Use the expansion in (a) up to the term in x^3 to approximate the value of $(0.98)^5$.   (2 marks)

8   The position vectors of points F, G and H are *f*, *g* and *h* respectively. Point H divides FG in the ratio $4:-1$. Express *h* in terms of *f* and *g*.   (2 marks)

28

9. Two machines, M and N produce 60% and 40% respectively of the total number of items manufactured in a factory. It is observed that 5% of the items produced by machine M are defective while 3% of the items produced by machine N are defective.
If an item is selected at random from the factory, find the probability that it is defective.

(3 marks)

10. Two taps A and B can each fill an empty tank in 3 hours and 2 hours respectively. A drainage tap R can empty the full tank in 6 hours. Taps A and R are opened for 5 hours then closed.

   (a) Determine the fraction of the tank that is still empty. (2 marks)

   (b) Find how long it would take to fill the remaining fraction of the tank if all the three taps are opened. (2 marks)

11. Simplify the expression $\dfrac{\sqrt{48}}{\sqrt{5} + \sqrt{3}}$, leaving the answer in the form $a\sqrt{b} + c$ where a, b and c are integers. (3 marks)

12. A point P moves inside a sector of a circle, centre O, and chord AB such that $2\,cm < OP \le 3\,cm$ and angle $APB = 65°$. Draw the locus of P. (4 marks)

13. The table below shows income tax rates in a certain year.

| Monthly income in Kenya shillings	Tax rate in each shilling
Up to 9 680	10%
from 9 681 to 18 800	15%
from 18 801 to 27 920	20%
from 27 921 to 37 040	25%
over 37 040	30%

   In that year, a monthly personal tax relief of Ksh 1 056 was allowed. Calculate the monthly income tax paid by an employee who earned a monthly salary of Ksh 32 500. (4 marks)

14. Solve the equation $6\cos^2 x + 7\sin x - 8 = 0$ for $0° \le x \le 90°$. (4 marks)

15. The positions of two towns are $(2°S, 30°E)$ and $(2°S, 37.4°E)$. Calculate, to the nearest km, the shortest distance between the two towns. (Take the radius of the earth to be 6 370 km) (2 marks)

16. The vertices of a triangle T are A(1, 2), B(4, 2) and C(3, 4). The vertices of triangle T', the image of T are A'($\frac{1}{2}$, 1), B'(2, 1) and C'($\frac{3}{2}$, 2).

   Determine the transformation matrix $M = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$ that maps T onto T'. (3 marks)

SECTION II (50 marks)

*Answer only **five** questions from this section in the spaces provided.*

17 The Hire Purchase (H.P.) price of a public address system was Ksh 276 000. A deposit of Ksh 60 000 was paid followed by 18 equal monthly instalments. The cash price of the public address system was 10% less than the H.P. price.

(a) Calculate:

    (i)   the monthly instalment;   (2 marks)

    (ii)   the cash price.   (2 marks)

(b) A customer decided to buy the system in cash and was allowed a 5% discount on the cash price. He took a bank loan to buy the system in cash. The bank charged compound interest on the loan at the rate of 20% p.a. The loan was repaid in 2 years. Calculate the amount repaid to the bank by the end of the second year.   (3 marks)

(c) Express as a percentage of the Hire Purchase price, the difference between the amount repaid to the bank and the Hire Purchase price.   (3 marks)

18 In the figure below, PR is a diameter of the circle centre O. Points P, Q, R and S are on the circumference of the circle. Angle PRQ = 72°, QS = QP and line USV is a tangent to the circle at S.
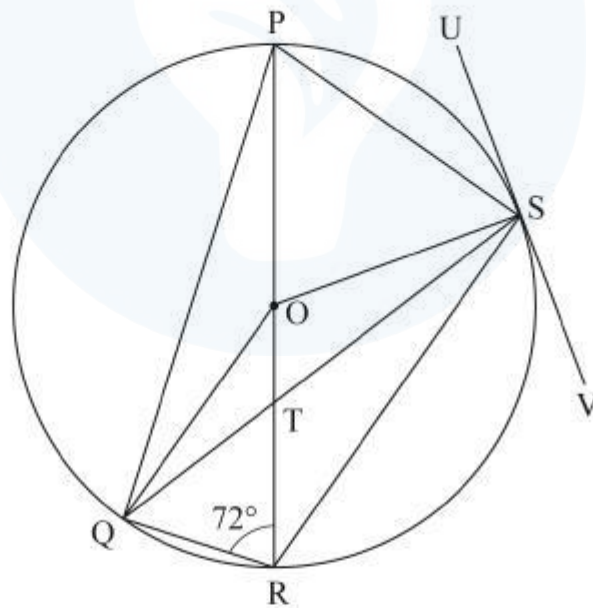

Giving reasons, calculate the size of:

(a)   ∠ QPR;   (2 marks)

(b)   ∠ PQS;   (2 marks)

(c)   ∠ OQS;   (2 marks)

(d)   ∠ RTS;   (2 marks)

(e)   ∠ RSV.   (2 marks)

19 (a) Complete the table below for $y = x^3 + 4x^2 - 5x - 5$. (2 marks)

x	-5	-4	-3	-2	-1	0	1	2
$y = x^3 + 4x^2 - 5x - 5$			19			-5		

(b) On the grid provided, draw the graph of $y = x^3 + 4x^2 - 5x - 5$ for $-5 \leq x \leq 2$. (3 marks)

(c) (i) Use the graph to solve the equation $x^3 + 4x^2 - 5x - 5 = 0$. (2 marks)

(ii) By drawing a suitable straight line on the graph, solve the equation
$x^3 + 4x^2 - 5x - 5 = -4x - 1$. (3 marks)

20 The figure ABCDEF below represents a roof of a house. AB = DC = 12 m, BC = AD = 6 m, AE = BF = CF = DE = 5 m and EF = 8 m.
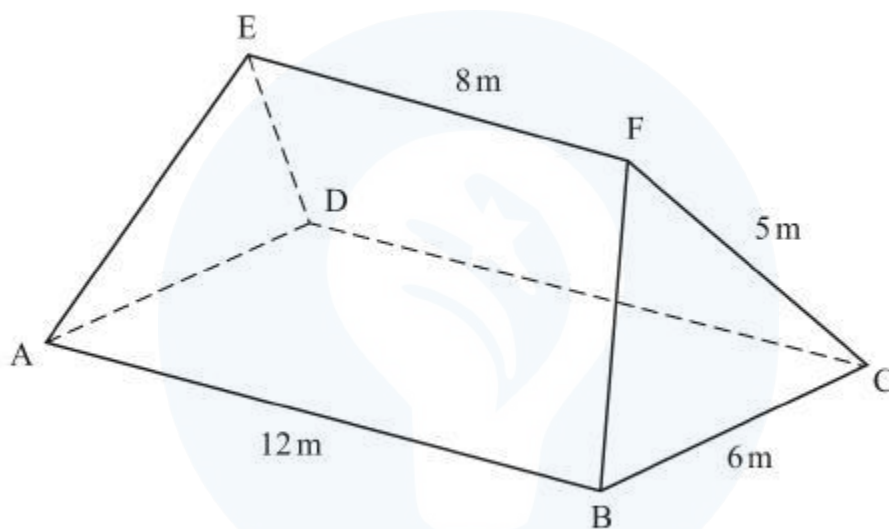
(a) Calculate, correct to 2 decimal places, the perpendicular distance of EF from the plane ABCD. (3 marks)

(b) Calculate the angle between:

(i) the planes ADE and ABCD; (2 marks)

(ii) the line AE and the plane ABCD, correct to 1 decimal place; (2 marks)

(iii) the planes ABFE and DCFE, correct to 1 decimal place. (3 marks)

21 (a) Complete the table below, giving the values correct to 1 decimal place.   (2 marks)

$x°$	0	40	80	120	160	200	240
$2 \sin (x + 20)°$	0.7		2.0		0.0		− 2.0
$\sqrt{3} \cos x$	1.7	1.3		− 0.9		− 1.6	

(b) On the grid provided, using the same scale and axes, draw the graphs of
$y = 2 \sin (x + 20)°$ and $y = \sqrt{3} \cos x$ for $0° \leq x \leq 240°$.   (5 marks)

(c) Use the graphs drawn in (b) above to determine:

(i) the values of x for which $2 \sin (x + 20) = \sqrt{3} \cos x$;   (2 marks)

(ii) the difference in the amplitudes of $y = 2 \sin (x + 20)$ and $y = \sqrt{3} \cos x$.   (1 mark)

22 Three quantities R, S and T are such that R varies directly as S and inversely as the square of T.

(a) Given that R = 480 when S = 150 and T = 5, write an equation connecting R, S and T.   (4 marks)

(b) (i) Find the value of R when S = 360 and T = 1.5.   (2 marks)

(ii) Find the percentage change in R if S increases by 5% and T decreases by 20%.   (4 marks)

23 The equation of a curve is given by $y = 5x - \frac{1}{2}x^2$.

(a) On the grid provided, draw the curve of $y = 5x - \frac{1}{2}x^2$ for $0 \leq x \leq 6$.   (3 marks)

(b) By integration, find the area bounded by the curve, the line $x = 6$ and the x-axis.   (3 marks)

(c) (i) On the same grid as in (a), draw the line $y = 2x$.   (1 mark)

(ii) Determine the area bounded by the curve and the line $y = 2x$.   (3 marks)

24 The table below shows marks scored by 42 students in a test.

35	49	69	57	58	75	48
40	46	86	47	81	67	63
56	80	36	62	49	46	26
41	58	68	73	65	59	72
64	70	64	54	74	33	51
73	25	41	61	56	57	28

(a) Starting with the mark of 25 and using equal class intervals of 10, make a frequency distribution table. (2 marks)

(b) On the grid provided, draw the ogive for the data. (4 marks)

(c) Using the graph in (b) above, estimate:

(i) the median mark; (2 marks)

(ii) the upper quartile mark. (2 marks)