Name........................M|S...............AdmNo...........Class......

Index No............................ Signature.................................

121/1
Mathematics Paper 1
Form 4
2 ½ Hours
Term 2, 2021

KASSU JET EXAMINATIONS
Kenya Certificate of Secondary Education (K.C.S.E)

INSTRUCTIONS TO CANDIDATES

➢ Write your name and Admission number in the spaces provided at the top of this page.
➢ This paper consists of two sections: Section I and Section II.
➢ Answer *ALL* questions from section I and *ANY FIVE* from section II
➢ All answers and workings must be written on the question paper in the spaces provided below each question.
➢ Show all the steps in your calculation, giving your answer at each stage in the spaces below each question.
➢ Non – Programmable silent electronic calculators and KNEC mathematical tables may be used, except where stated otherwise.
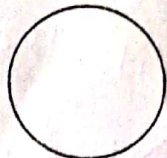
FOR EXAMINERS USE ONLY

SECTION I

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TOTAL

SECTION II

17	18	19	20	21	22	23	24	TOTAL

GRAND TOTAL

1

SECTION A (50 marks)

1. Without using a calculator or tables, evaluate:

$$\left(\frac{2\frac{1}{4}\div\frac{5}{4}+\left(\frac{-2}{3}\right)^3}{\frac{5}{7}-2\frac{2}{3}of\,3+\frac{-3}{8}}\right)^{-2}$$

(3 marks)

$$\left(\frac{9/4\div 5/4+\frac{-8}{27}}{5/7-8/3\,of\,3+\frac{3}{8}}\right)^{-2}$$

$$\left(\frac{9/5+\frac{-8}{27}}{5/7-\frac{67}{8}}\right)^{-2}$$

$$\left(\frac{\frac{203}{135}\div\frac{-429}{56}}{}\right)^{-2}$$

$$\left(\frac{203}{135}\times\frac{56}{-429}\right)^{-2}$$

$$\left(\frac{135\times-429}{203\times56}\right)^{2}$$

∴ Give all marks if a student attempted to this point ③

2. Solve the equation for x. $5^{2x+1}+5^{2x}-750=0$ (3 marks)

$$5^{2x+1}+5^{2x}=750$$

$$5^{2x}\cdot 5^1+5^{2x}=750$$

$$5^{2x}(5+1)=750$$

$$5^{2x}(6)=750$$

$$5^{2x}=125$$

$$5^{2x}=5^3$$

$$2x=3$$

$$x=1.5 \quad ③$$

3. Simplify $\dfrac{8mn-6m+8n^2-6n}{8n-6}$ (3 marks)

$$\frac{2m(4n-3)+2n(4n-3)}{2(4n-3)}$$

$$=\frac{(4n-3)(2m+2n)}{2(4n-3)}$$

$$=\frac{2(m+n)}{2}$$

$$=m+n.$$

③

9

4. Use squares, square roots and reciprocals tables to evaluate the following giving your answer to 2 decimal places. **(4 marks)**

$$\frac{1}{\sqrt{20.52}} + \frac{2}{(6.23)^2}$$

$\sqrt{20.56} = 4.5299$ ✓ $0.2208 + 2 \times 0.02576$ ✓ ¹

$(6.23)^2 = 38.81$ $= 0.2208 + 0.05152$

$1 (\text{rec } 4.530) +$ $= 0.27232$ ✓ ¹

$2 (\text{rec } 38.81)$ ✓ ¹

④

5. Susan made a loss of 20% by selling a blender at sh. 2,400. What profit would she have made had she sold it at sh. 3300? **(3 marks)**

$80\% = 2400$ $3300 - 3000$ ✓ ¹

$100\% = ?$ $= 300$ ✓ ¹

$\dfrac{100\% \times 2400}{80}$ ✓   ③

$= 3,000$

6. Solve for x and y using substitution method:

$\frac{1}{3}(x + y) - 2 = 0$

$\frac{1}{4}(x - y) = 1$ **(3 marks)**

$x + y - 6 = 0$ $y = 1$ ✓ ⎫

$x - y - 4 = 0$ $x = 1 + 4$ ⎬ ¹

$x = y + 4$ ✓ ¹ $= 5$ ✓ ⎭

$\cancel{*} (y + 4) + y = 6$ ✓ ¹   ③

$2y = 2$ ✓ ¹

3

10

7. The number of sides of two regular polygons differs by one. If the sum of the interior angles of these polygons is in the ratio 2:3, calculate the number of sides of each polygon and name them. **(3 marks)**

$$\frac{180(n-2)}{180(n+1-2)} = \frac{2}{3}$$

$$3(n-2) = 2(n-1)$$

$$3n - 6 = 2n - 2$$

$$3n - 2n = 6 - 2$$

$$n = 4 - \text{Quadrilateral}$$

$$n+1 = 5 - \text{Pentagon}$$

③

8. Solve for x in the following equation: $\sin\left(\frac{1}{2}x - 10^0\right) = \cos 2x$ **(3 marks)**

$$\left(\frac{1}{2}x - 10\right) + 2x = 90$$

$$2.5x = 100$$

$$x = 40$$

③

9. A vehicle moves at an initial speed of 20m/s with a constant acceleration of 2m/s² for five seconds before breaks are applied. If the car comes to rest under constant deceleration 4 seconds, determine the total distance travelled during the 9 seconds **(3 marks)**

$$\frac{v-u}{t} = a$$

$$\frac{v-20}{5} = 2$$
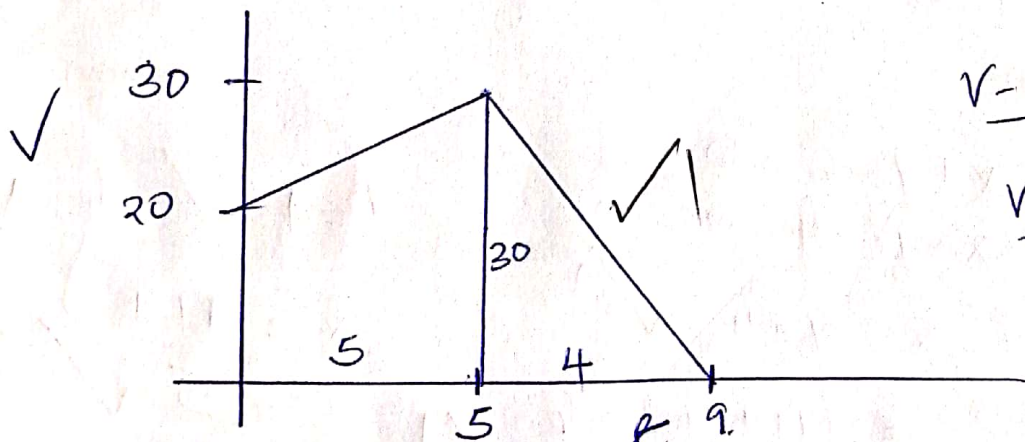
$$v - 20 = 10$$

$$v = 30$$

$$D = \left(\frac{30+20}{2}\right)5 + \frac{1}{2} \times 30 \times 4$$

$$= 125 + 60$$

$$= 185M$$

⑨

10. Simplify completely the expression

$$\frac{\frac{1}{9}x^2 - \frac{1}{25}y^2}{\frac{1}{9}x^2 + \frac{2}{15}xy + \frac{1}{25}y^2}$$

(4 marks)

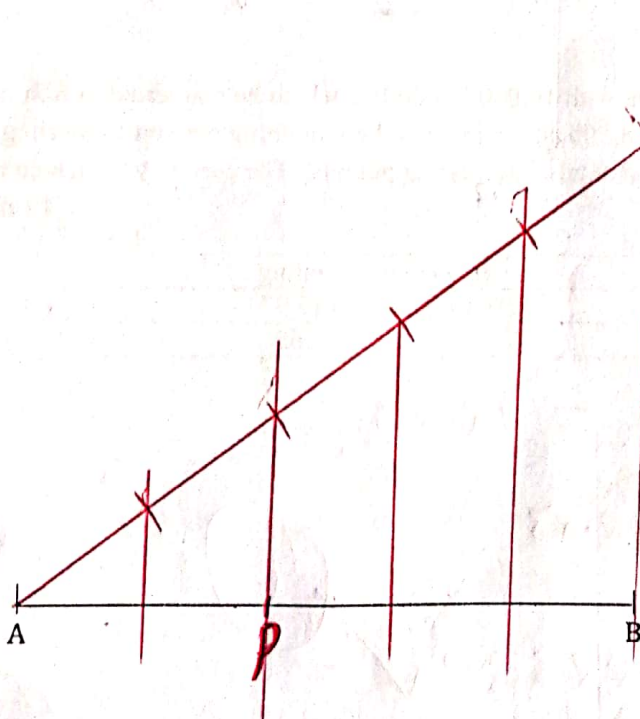$$\frac{\frac{1}{225}\left(25x^2 - 9y^2\right)}{\frac{1}{225}\left(25x^2 + 30xy + 9y^2\right)}$$

$$\frac{(5x-3y)(5x+3y)}{25x^2 + 15xy + 15xy + 9y^2}$$

$$\frac{(5x-3y)(5x+3y)}{5x(5x+3y)+3y(5x+3y)}$$

$$\frac{(5x-3y)(5x+3y)}{(5x+3y)(5x+3y)}$$

$$= \frac{5x-3y}{5x+3y}$$ ④

11. A point P divides the line AB shown below internally in the ratio 2:3. By construction, find the position P and measure AB.
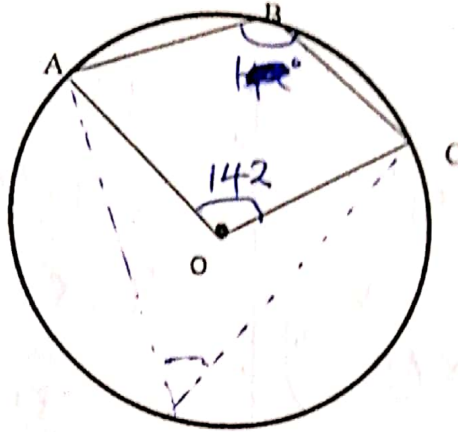

for a line — forming ∠ with AB

— for parallel line

— for point P.

A   P   B   **(3 marks)** ③

5

7

12. In the figure below, O is the centre of the circle and reflects angle AOC =142°. Find angle ABC.

(3 marks)

$$\angle ABC = 180° - \frac{1}{2}(142)$$

$$= 180° - 71$$

$$= 109°$$

Alt $\angle ABC = \dfrac{360 - 142}{2}$

$$= \frac{218}{2}$$

$$= 109°$$

13. A tourist arrived in Kenya with 10,000 US dollars which he converted to Ksh on arrival. He spent Kshs.428,500 and converted the remaining amount to Sterling pounds. How much did he receive in Sterling pounds? The currency exchange rate of the day was as follows;

(3 marks)

Currency	Buying	Selling
1 Sterling pound	135.50	135.97
1US dollar	72.23	72.65

1 US dollar = 72.23

(10000×72.23)

sh 722300

Spent 428 500

$(722300 - 428500)$

$= $ Sh. 293,800

1 sterling pound = sh. 135.97

sh 293800

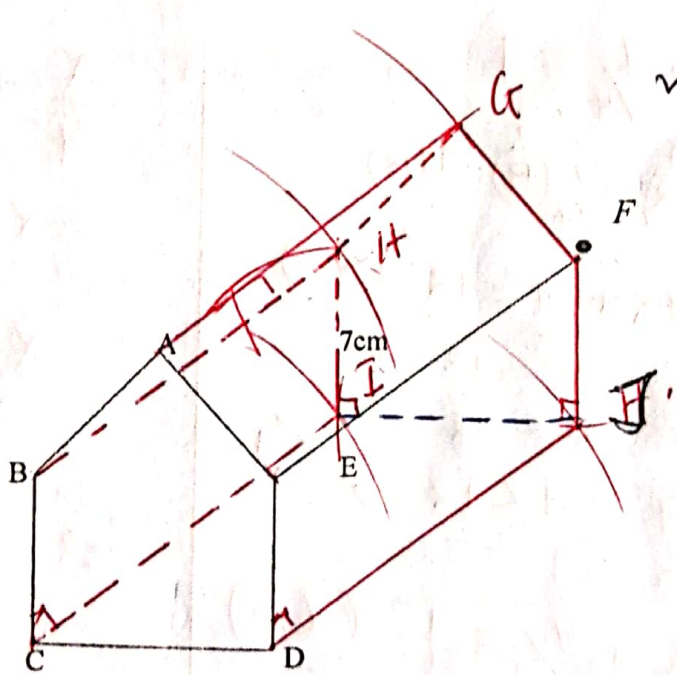$$= \frac{293800}{135.97} = 2160.8 \text{ sterling pounds}$$

14. Adam harvested 200 bags of wheat from 2 ha of his farm. How many bags of wheat would he harvest from 16 ha if he maintained the rate? **(3 marks)**

Bags   Farm.
200   2 ha.
        16 ha.

$$\frac{16}{2} \times \frac{100}{200} = 1600 \text{ bags}$$

③

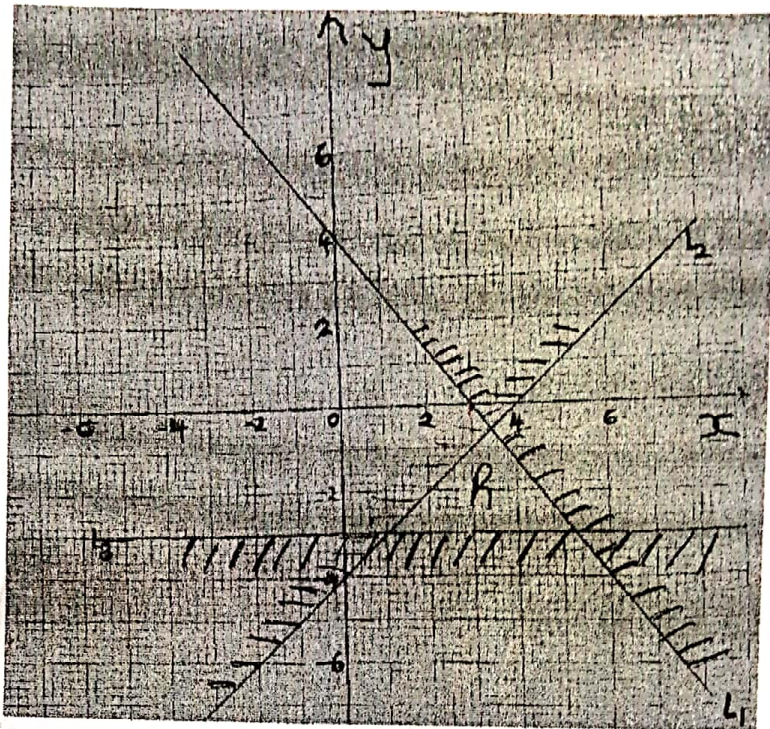15. Complete the solid below whose length is 7cm   **(3 marks)**

✓ 1 showing hidden side

✓ 1 L.

✓ 1 complete solid

③

7

16. Write down three inequalities which fully describe the unshaded region R in the figure below **(3 marks)**

L_1 $\dfrac{X}{3} + \dfrac{Y}{4} = 1$

$\dfrac{X}{3}(12) + \dfrac{Y}{4}(12) = 1(12)$

$4X + 3Y = 12$ $(3,0)$

$8 + 0$ 12

$8 < 12$

$4X + 3Y \le 12$ ✓1

L_2 $\dfrac{X}{4} + \dfrac{Y}{-4} = 1$ $(6,0)$

$\dfrac{6}{4} - \dfrac{1}{4}$

$\dfrac{5}{4} \ge 1$ 8

$\dfrac{X}{4} + \dfrac{Y}{4} \ge 1$

or

$-X + Y \ge -4$ any ✓1

or

$X - Y \ge 4$

L_3 $Y \ge -3$ ✓1

⟋ 3

## SECTION B (50 marks)

17. Three points P, Q and S are on the vertices of a triangular plain field. P is 400m from Q on a bearing of 300^0 and R of 550m directly south of P.

    (a) Using a scale of 1 cm to represent 100m on the ground, draw a diagram to show the position of the points. **(3 marks)**

    (b) Use the scale drawing to determine;

    (i) The distance and bearing of Q from R. **(2 marks)**

    (ii) The bearing and distance of point S from P given that point S is directly 600m East of R. **(3 marks)**

    (iii) The bearing and distance of Q from S. **(2 marks)**
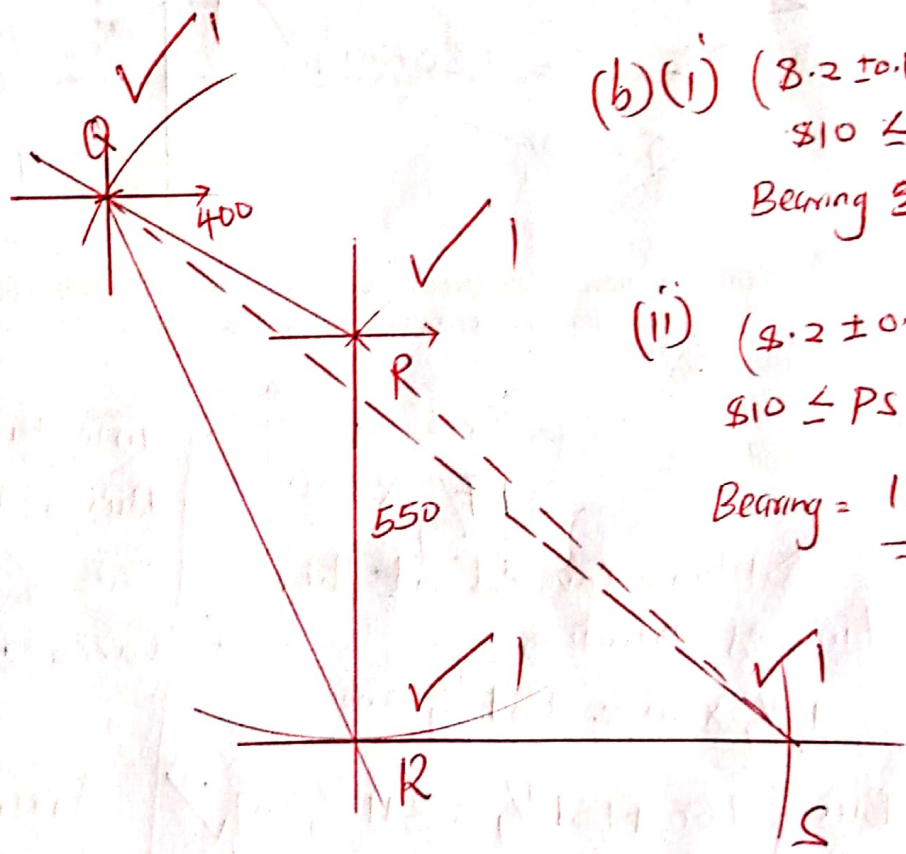
(b)(i) $(8.2 \pm 0.1) \times 100$ ✓
 $810 \leq RQ \leq 830$
    Bearing $335^0 \pm 1^0$ ✓

(ii) $(8.2 \pm 0.1) \times 100$
    $810 \leq PS \leq 830$ ✓
    Bearing $= 133^0 \pm 1^0$ ✓

(iii) $(12 \pm 0.1) \times 100$ ✓
    $1190 \leq QS \leq 1210$
    Bearing $130^0 \pm 1^0$ ✓

18. A bus travelling at a speed of 80km/hr left Mombasa at 8.00am for Nairobi. Two hours later, a car travelling at a speed of 100km/hr left Nairobi for Mombasa.

(a) Given that the distance between both cities is 500km, find the time of the day when the two vehicles met. **(6 marks)**

MBS ——————— 500 Km ——————— NRB

8.00 am
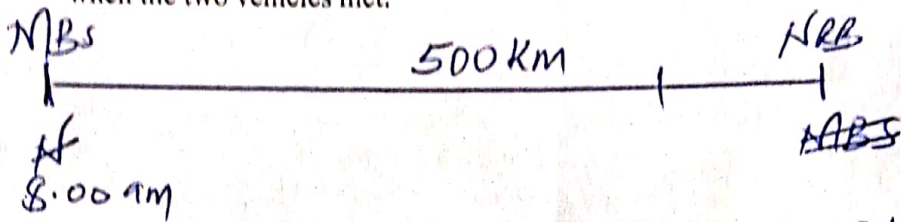
$$D = T \times S$$
$$= 2 \times 80$$
$$= 160 Km$$ ✓

$$500 - 160 = 340 Km$$

$$A \cdot S = 80 + 100$$
$$= 180 Km/h$$ ✓

$$T = D/S$$

$$T = \frac{340}{180}$$
$$= \frac{9}{17} hrs$$
$$= 1\frac{8}{9} hrs \rightarrow 1hr . 53\frac{1}{3}/h$$ ✓

$$10 : 00 : 00$$
$$1 \quad 53 \quad 20$$
$$\overline{11 : 53 : 20} \; am$$ ✓

(b) After meeting, the speed of both vehicles dropped to 60km/hr due to traffic jam. At what time did each vehicle arrive at its destination? **(4 marks)**

$$D = T \times S$$
$$= \frac{17}{9} \times 100$$

Distance Covered at the time of meeting

$$\frac{18}{9} \times 80 = 151\frac{1}{9} km$$

Bus = $160 + 151\frac{1}{9} = 311\frac{1}{9} km$ ✓

Car = $151\frac{1}{9} km$

Remaining distance

Bus = $500 - 311\frac{1}{9} = 188\frac{8}{9} km$ ✓

Car = $500 - 151\frac{1}{9} = 348\frac{8}{9} km$ ✓

Time taken by

Bus = $\dfrac{188\frac{8}{9}}{60} = 3hr \; 9min$ ✓

Car = $\dfrac{348\frac{8}{9}}{60} = 5hrs \; 49min$ ✓

Arrival time

Bus $\quad 11:53$
$\quad\quad 3 \quad 09$
$\quad\quad \overline{1502} hrs$ ✓

Car $\quad 11 \; 53$
$\quad\quad 5 \; 49$
$\quad\quad \overline{17 \; 42} hrs$ ✓

10

19. The figure below represents an histogram of heights against age brackets of members of a village.

Age(yrs)
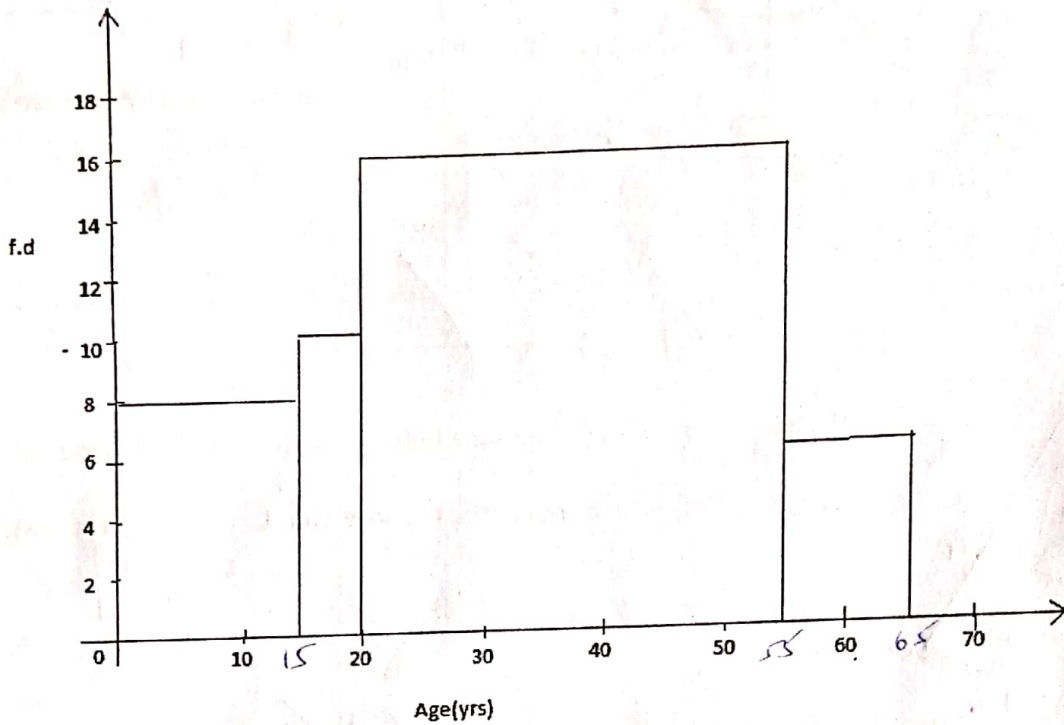
Using the figure above,

a) Develop a frequency distribution table   (3marks)

b) Using the table in (a) above find;
  i. The mean.   (3marks)
  ii. The median class   (1mark)
  iii. The median   (3marks)

(a)

X	f	X	Xf	cf
0 – 15	120	7·5	900	120
15 – 20.	50	17·5	875	170
20 – 55	560	47·5	26600	730
55 – 65	60	60	3600	790
	850		31,975	

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(b)

(i) $\bar{X} = \dfrac{31975}{790}$

$\Rightarrow \dfrac{37·6176}{40·475}$ ①

(ii)

$\dfrac{790}{2} = 395^{th}$

$20 - 55$

(iii) $= 20 + \left(\dfrac{395 - 170}{730}\right) 35$

$= 30·788$

10

20. The diagram below shows a container base made of a frustum of a square pyramid. The top is a solid frustum of a cone.
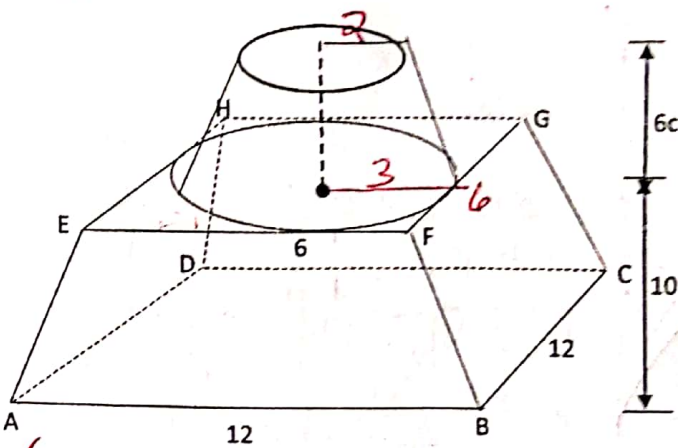
AB = BC = 12 cm

EF = 6

Height of 10 and 6 cm respectively.

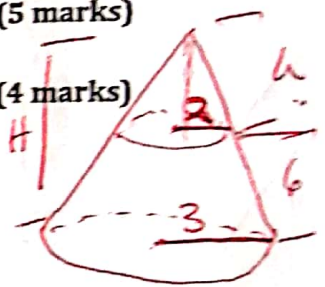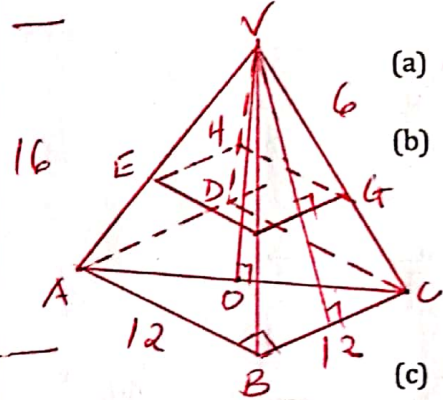(a) Calculate the surface area of the bottom solid. (5 marks)

(b) Calculate the surface area of the top side. Solid (4 marks)

(c) Calculate the total area. (1 mark)

(a)
$$AC^2 = 144 + 144$$
$$AC^2 = 288$$
$$AC = \sqrt{288}$$
$$OC = \frac{\sqrt{288}}{2}$$ ✓
$$(VC)^2 = 16^2 + \left(\frac{\sqrt{288}}{2}\right)^2$$
$$= 256 + 72$$
$$VC = \sqrt{328}$$
$$H'^2 = \left(\sqrt{328}\right)^2 - 6^2$$
$$= 328 - 36$$
$$(H') = \sqrt{292}$$ ✓
$$\frac{h'}{H'} = \frac{4}{4}$$
$$\frac{h'}{\sqrt{292}} = \frac{6}{16}$$

$$h' = \frac{3}{8}\left(\sqrt{292}\right)$$ ✓

$$2A = \left[\frac{1}{2} \times 12 \times \sqrt{292} - \frac{1}{2} \times 6 \times \frac{3}{8}\sqrt{292}\right]4$$

$$= \left[\sqrt{292}\left(6 - \frac{9}{8}\right)\right]4$$

$$= [83.304 \text{ cm}^2]4$$

$$= 333.216 \text{ cm}^2$$ ✓

$$A_2 = 12 \times 12 = 144 \text{ cm}^2$$

$$A_3 = (6 \times 6) - \frac{22}{7} \times 3 \times 3$$
$$= 36 - 28\frac{2}{7}$$
$$= 7.7142 \text{ cm}^2$$ ✓

$$TOTAL = 333.216 + 144 + 7.7142$$

$$= 484.93 \text{ cm}^2$$

(b) $$A_1 = \frac{22}{7} \times 2 \times 2$$
$$= 12.5714 \text{ cm}^2$$

$$\frac{h}{H} = \frac{r}{R}$$
$$\frac{h}{6 + h} = \frac{2}{3}$$
$$3h = 12 + 2h$$
$$h = 12$$ ✓

$$l^2 = 12^2 + 2^2$$
$$l = 12.166$$
$$\frac{12.166}{L} = \frac{2}{3}$$
$$2L = 36.4966$$
$$L = 18.248$$

$$A_2 = \pi R L - \pi r L$$
$$= \pi(3 \times 18.248 - 2 \times 12.166)$$
$$= \pi \times 30.412$$
$$= 95.581$$ ✓

Total Area = 12.57 + 95.581
$$= 108.15$$ ✓

(c) $$484.93 + 108.15$$
$$= 593.082 \text{ cm}^2$$

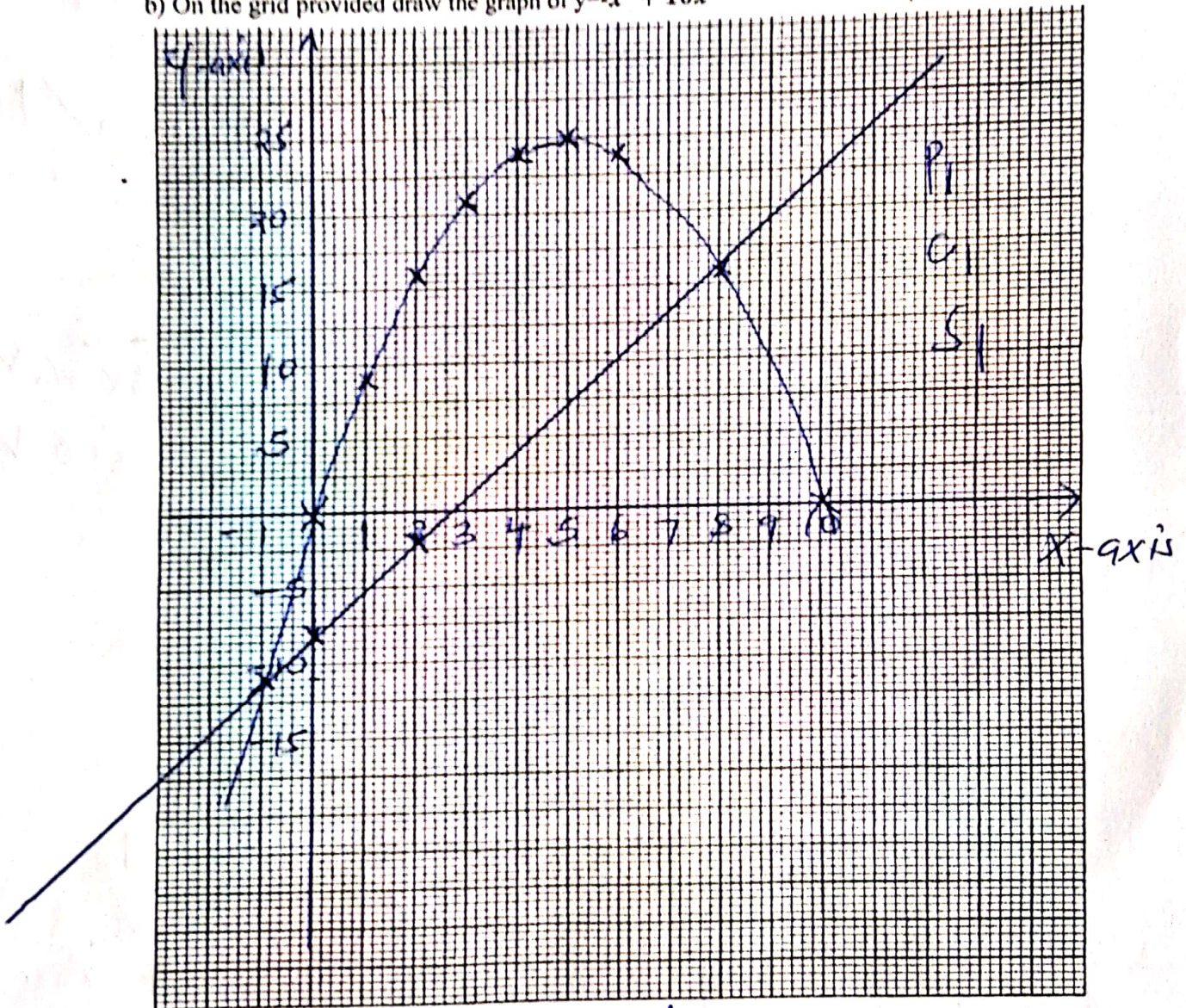21. a).Complete the table below for the function
    $y = -x^2 + 10x$ (2marks)

X	-1	0	1	2	3	4	5	6	8	10
Y	-11	0	9	16	21	24	25	24	16	0

✓ 2

b) On the grid provided draw the graph of $y = -x^2 + 10x$ (3marks)

c) Using the graph above solves the equations.

i) $10x - x^2 = 0$ $X = 0$ or $X = 10$ (2marks)

ii) $x^2 - 7x - 8 = 0$ (3marks)

$$y = -x^2 + 10x + 0$$
$$0 = x^2 - 7x - 8$$
_____
$$y = 3x + 8$$ M1

$X = 0, Y = -8, (0, -8)$
$X = 2, Y = -2, (2, -2)$

$X = -1$ or $X = 8$

10

22. Two lines $L_1=2y-3x-6$ and $L_2=3y+x-20=0$ intersect at point A.

i. Find the coordinates of A **(3marks)**

$$(2y-3x=6)3$$
$$(3y+x=20)2$$

$$6y-9x=18$$
$$6y+2x=40$$
$$\overline{\quad\quad\quad}$$
$$-11x=-22$$
$$x=2 ✓$$

$$2y-3(2)=6$$
$$2y=12$$
$$y=6 ✓1$$

$$A(2,6) ✓1$$

ii. A third line L_3 is perpendicular to L_2 at point A. Find the equation of L_3 in form of $y=mx+c$, where m and c are constants. **(3marks)**

$$3y=-x+20$$
$$y=-\tfrac{1}{3}x+\tfrac{20}{3}$$
$$M=3 ✓1$$
$$\frac{y-6}{x-2}=\tfrac{3}{1} ✓1$$

$$y-6=3x-6 ✓$$
$$y=3x+0 ✓1$$
$$\overline{\qquad}$$
$$2$$

iii. Another line L_4 is parallel to L_1 and passes through (-1,3). Find the x-intercept and the y-intercept of L_4. **(4marks)**

$$2y=3x+6$$
$$y=\tfrac{3}{2}x+3 ✓$$

$$\frac{y-3}{x+1}=\tfrac{3}{2}$$

$$2(y-3)=3(x+1) ✓$$

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$$2y-6=3x+3$$

$$2y=3x+9$$
$$y=\tfrac{3}{2}x+\tfrac{9}{2}$$

X-intercept $y=0$

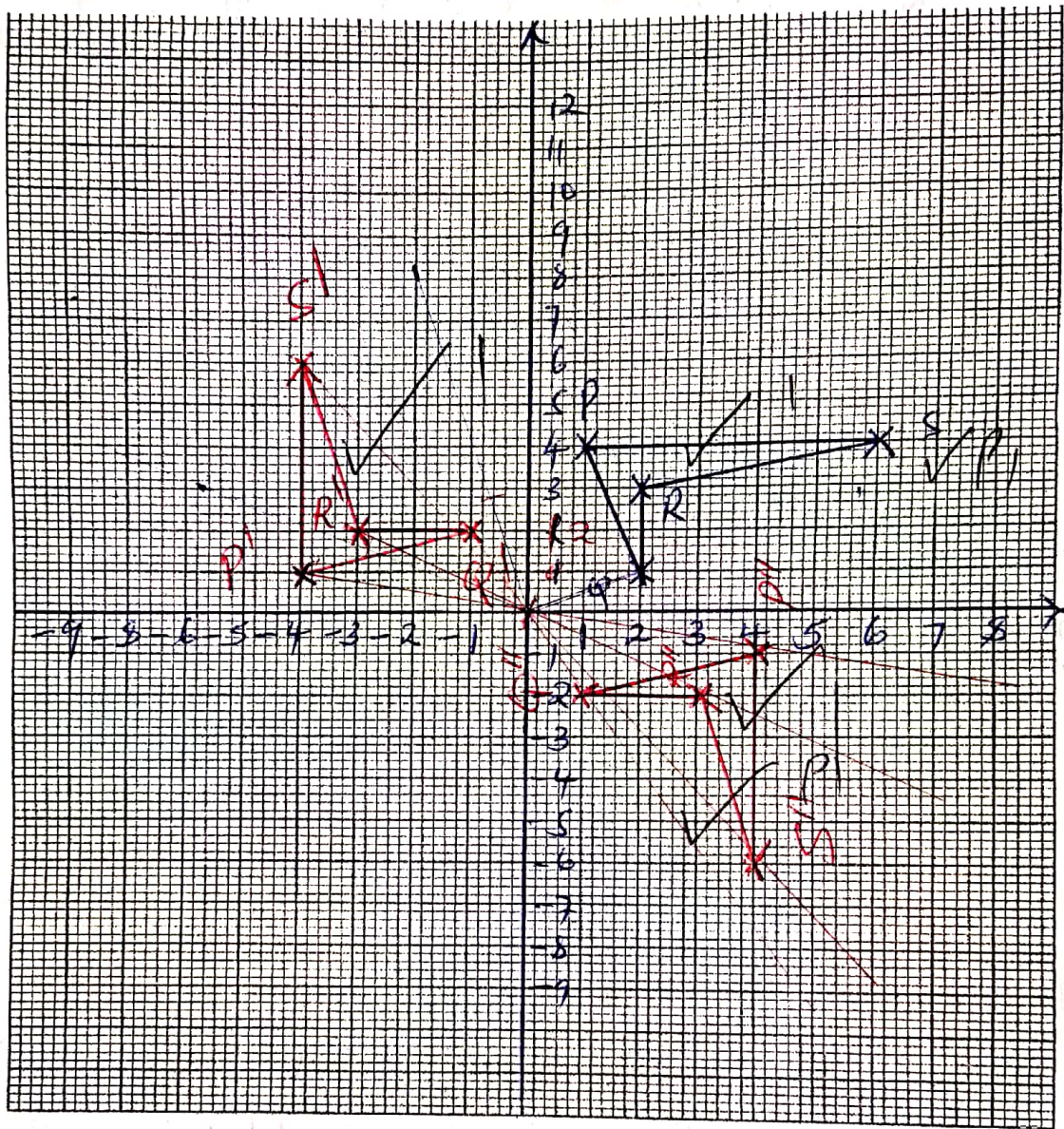$$\tfrac{2}{3}\times\tfrac{3}{2}x=-\tfrac{9}{2}\times\tfrac{2}{3}$$
$$x=-3 ✓1$$

Y-intercept $x=0$

$$y=\tfrac{9}{2}, \; 4.5$$
$$y=4.5 ✓1$$

$$\overline{\qquad}$$
$$10$$

23. (a) PQRS is a quadrilateral with vertices P(1,4), Q(2,1), R(2,3) and S(6,4). On the
         grid provided, plot the quadrilateral.   **(1 mark)**

(b) Draw P'Q'R'S' the image of PQRS under a positive quarter turn about the
     origin and write down its co-ordinates.   **(3 marks)**

     $P'(-4,1)$ $Q'(-1,2)$ $R'(-3,2)$ $S'(-4,6)$

(c) Draw P"Q"R"S" the image of P'Q'R'S' under an enlargement scale factor -1
     and center (0,0) and write down its co-ordinates.   **(3 marks)**

     $P''(4,-1)$ $Q''(1,-2)$ $R''(3,-2)$ & $S''(4,-2)$

(d) Determine the matrix of a single transformation that maps PQRS onto
     P"Q"R"S   **(3 marks)**

     The transformation of +90°
     about the origin;
     ⅃ for constructions
     10

24. A curve whose equation is $3y = 9 - 18x + \frac{27}{2}x^2 - 3x^3$ turns at points P and R.

a) Find the coordinates of P and R (5 marks)

$$\left[3y = 9 - 18x + \frac{27}{2}x^2 - 3x^3\right] \times \frac{1}{3}$$

$$y = 3 - 6x + 4.5x^2 - x^3$$

$$\frac{dy}{dx} = -6 + 9x - 3x^2$$

at st. p. $\frac{dy}{dx} = 0$

$-6 + 9x - 3x^2 = 0$

$x^2 - 3x + 2 = 0$

$x(x-1) - 2(x-1) = 0$

$x = 1$ or $x = 2$

when $x = 1$, $y = 3 - 6 + 4.5 + 1$

$y = \frac{1}{2}$

when $x = 2$ $y = 3 - 12 + 18 - 8$

$y = 1$

$P_1\left(1, \frac{1}{2}\right)$ $P_2(2, 1)$

b) Determine the nature of points P and R (3 marks)

$y'' = 9 - 6x$

at $x = 1$.

$y = 9 - 6 = 3$

$P_1\left(1, \frac{1}{2}\right)$ min point

$y'' = 9 - 6x$ at $x = 2$

$y'' = 9 - 6(2) = -3$

$P_2(2, 1)$ max point.

c) Sketch the curve (2 marks)

At, $x = 0$

$y = 3$

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