Name Marking scheme. Admission No. ________ Class____

Candidate's signature __________

Date __________________

121/1
MATHEMATICS
PAPER 1
JULY/AUGUST 2019
2 ½ HOURS

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INSTRUCTIONS TO DANDIDATES

1. Write your name, index number and class in the spaces provided.
2. Sign and write date of the of the examination in the spaces provided.
3. The paper contains two sections: Section I and II
4. Answer ALL questions in section I and **STRICTLY FIVE** questions from section II.
5. All working and answers must be written on the question paper in the spaces provided below each question.
6. Show all the steps in your calculations, giving you're your answers at each stage in the spaces below each question.
7. Marks may be awarded for correct working even if the answer is wrong.
8. Non-programmable silent electronic calculators and KNEC mathematical tables may be used except where stated otherwise.

FOR EXAMINER'S USE ONLY

SECTION 1

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	25	TOTAL

GRAND TOTAL

This paper consists of 17 printed pages. Candidates should check to ensure that all pages are printed as indicated and no questions are missing.

SECTION I:(50 Marks). Attempt ALL questions in this section

1. Without using a calculator evaluate (3 Marks)

$$\frac{\left(3\frac{1}{3}+1\frac{1}{9}\right)\div 1\frac{1}{3}}{\left(4\frac{2}{9}-2\frac{5}{9}\right)x\,\frac{2}{3}}$$

Num

$\left(\frac{10}{3}+\frac{10}{9}\right)\div\frac{4}{3}$

$\frac{\cancel{40}}{9}\times\frac{\cancel{3}}{\cancel{4}}$

$=\frac{10}{3}$ ✓ M1

Den

$\left(\frac{38}{9}-\frac{23}{9}\right)\times\frac{2}{3}$

$\frac{\cancel{15}}{9}\times\frac{2}{\cancel{3}}$

$=\frac{10}{9}$ ✓ M1

$\Rightarrow \frac{10}{3}\div\frac{10}{9}$

$=\frac{10}{3}\times\frac{9}{10}$

$=\underline{3}$ ✓ A1

2. A basket ball team play 10 matches in a tournament. The following are scores in each match.
9, 15, 17, 16, 7, 20, 21, 15, 10, 12
Determine:
(a) the mode. (1 mark)
(b) the median. (2 marks)

mode = 15 ✓ B1

7, 9, 10, 12, 15, 15, 16, 17, 20, 21 B1

Median $=\frac{15+15}{2}$

$=15$ ✓ B1

3. The gradient of curve at any point is given by 2x – 1. Given that the curve passes through point (1, 5), find the equation of the curve. (3 Marks)

$\frac{dy}{dx}=2x-1$

$y=\frac{2x^2}{2}-x+c$ ✓ B1

$y=x^2-x+c$

at (1, 5)

$x=1$
$y=5$

$5=(1)^2-1+c$

$c=5$ ✓ A1

$\underline{\underline{y=x^2-x+5}}$ B1

4. Simplify: $\frac{9x^2-1}{3x^2+2x-1}$ (3 Marks)

Num $(3x+1)(3x-1)$ ✓ B1

Den

$3x^2+2x-1$

$3x^2+3x-x-1$

$3x(x+1)-1(x+1)$

$(3x-1)(x+1)$ ✓ A1

$=\frac{(3x+1)\cancel{(3x-1)}}{\cancel{(3x-1)}(x+1)}$

$=\underline{\underline{\frac{3x+1}{x+1}}}$ ✓ B1

5. Find the value of $\sqrt{\left(\frac{2x^2+2(p+r)}{p-r} \div \frac{1}{2}\right) + r}$; if $p = r + 2, x = p + 1$ and $r = 2$. (3 Marks)

$r = 2$
$p = 4$
$x = 5$

$= \sqrt{\frac{2(5)^2 + 2(4+2)}{4-2} \div \frac{1}{2} + 2}$ ✓ M1

$= \sqrt{\left(\frac{50+12}{2} \div \frac{1}{2}\right) + 2}$

$= \sqrt{\left(\frac{62}{\cancel{2}} \times \frac{\cancel{2}}{1}\right) + 2}$ ✓

$= \sqrt{64}$ M1

$= \underline{8}$ ✓ A1

6. A car uses 1 litre of petrol for every 8 kilometres. The car was to travel 480 kilometres and had 15 litre of petrol at the beginning of the journey. Each litre of petrol cost sh. 112.00. How much did it cost for the extra petrol added? (3mks)

Total litres used
$= \frac{480}{8}$
$= 60$ litres

Extra petrol ✓ M1
$60 - 15 = 45$

cost for extra petrol
$= 45 \times 112$ ✓ M1
$=$ sh. 5,040 ✓ A1

7. Two pipes **A** and **B** can fill an empty tank in 3hrs and 5hrs respectively. Pipe **C** can empty the full tank in 6 hours. If the three pipes **A, B,** and **C** are opened at the same time, find how long it will take for the tank to be full. (3mks)

In 1hr ~~C~~ empties $= \frac{1}{6}$
In 1hr A fills $= \frac{1}{3}$
B " $= \frac{1}{5}$

In 1hr A+B − C
$= \left(\frac{1}{3} + \frac{1}{5} - \frac{1}{6}\right)$ ✓ M1
$= \frac{10+6-5}{30}$
$= \frac{11}{30}$

If 1hr $= \frac{11}{30}$
∴ ? $= \frac{30}{30}$
$= \frac{30}{30} \times \frac{30}{11} \times 1$ ✓ M1
$= \underline{2\frac{8}{11} \text{ hrs}}$ ✓ A1
(3mks)

8. Without using tables or calculators, find the value of **t** in

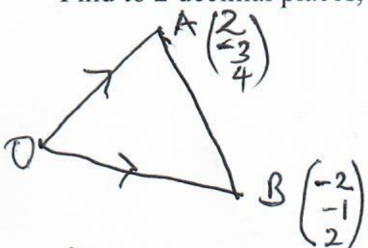
$$log_3(t+5) - log_3(t-3) = -2$$

$\log_3 x = -2$
$3^{-2} = x$
$x = \frac{1}{9}$ ✓ M1
$\log_3(t+5) - \log_3(t-3) = \log_3\left(\frac{1}{9}\right)$

$\log_3\left(\frac{t+5}{t-3}\right) = \log_3\left(\frac{1}{9}\right)$
Comparing logs
$\frac{t+5}{t-3} = \frac{1}{9}$ ✓ M1

$9t + 45 = t - 3$
$\frac{8t}{8} = \frac{-48}{8}$
$t = -6$ ✓ A1

9. The position vectors of A and B are given as **a** = 2**i** – 3**j** + 4**k** and **b** = -2**i** – **j** + 2**k** respectively.
Find to 2 decimal places, the length of vector **AB**. (3 Marks)



$\vec{AB} = AO + OB$

$= -\begin{pmatrix}2\\-3\\4\end{pmatrix} + \begin{pmatrix}-2\\-1\\2\end{pmatrix}$

$= \begin{pmatrix}-2\\3\\-4\end{pmatrix} + \begin{pmatrix}-2\\-1\\2\end{pmatrix} = \begin{pmatrix}-4\\2\\-2\end{pmatrix}$ ✓M1

$|\vec{AB}| = \sqrt{(-4)^2+(2)^2+(-2)^2}$ ✓M1

$= \sqrt{16+4+4}$

$= \sqrt{24}$

$= 4.898979$5

$= \underline{\underline{4.90}}$ ✓A1

10. A regular polygon has internal angle of 150^0 and side of length 10cm.

(a) Find the number of sides of the polygon. (2 Marks)

$n = \frac{360}{ext.}$

$= \frac{360}{30}$ ✓M1

$= 12$ sides ✓A1

(b) Find the perimeter of the polygon. (2 Marks)

$P = 10 \times 12$ ✓M1

$= \underline{\underline{120cm}}$ ✓A1

11. Solve for x in the equation. (3 Marks)

$9^{(2x-1)} \times 3^{(2x+1)} = 243$

$3^{2(2x-1)} \cdot 3^{(2x+1)} = 3^5$ ✓M1

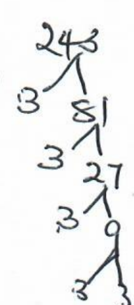
$3^{4x-2+2x+1} = 3^5$

Comparing powers

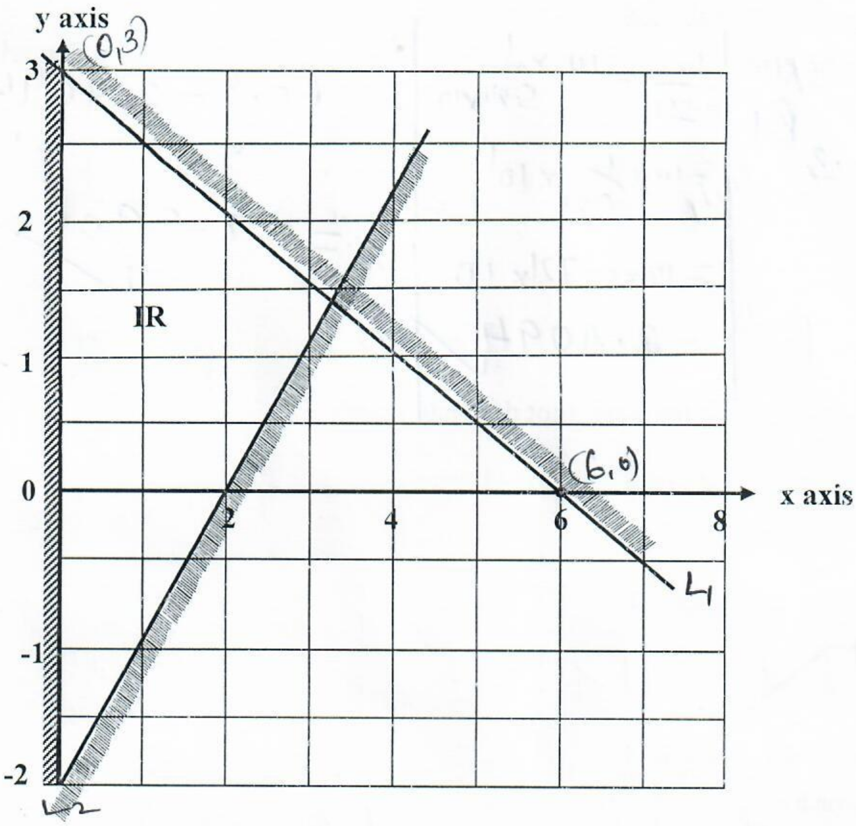
$6x - 1 = 5$ ✓M1

$6x = 6$

$x = 1$ ✓A1



12. The region R in the figure below is defined by the inequalities L1, L2 and L3.



L1 = $y = -\frac{1}{2}x + 3$.

$0 \ngeq 3$

L2: $y = x - 2$

$0 \geq -2$

Find the three inequalities (3 Marks)

(i) $y \leq -\frac{1}{2}x + 3$ or $2y \leq -x + 6$ or $2y + x \leq 6$. ✓ B1

(ii) $y \geq x - 2$ or $y - x \geq -2$. ✓ B1

(iii) $x \geq 0$. ✓ B1

13. Two boys and a girl shared some money. The elder boy got $\frac{4}{9}$ of it, the younger boy got $\frac{2}{5}$ of the remainder and the girl got the rest. Find the percentage share of the younger boy to the girl's share. (3 Marks)

elder boy $= 4/9$

young boy $= 2/5 \times 5/9$

$= 2/9$

girl $= 1 - (4/9 + 2/9)$

$= 1 - 6/9$ ✓ M1

$= 3/9 = 1/3$

$\frac{2/9}{1/3} \times 100\%$ ✓ M1

$\frac{2}{\cancel{9}_3} \times \frac{\cancel{3}^1}{1} \times 100\%$

$= 66.67\%$ ✓ A1

14. Use tables of reciprocals only to find the value of

$\frac{5}{0.0829} - \frac{14}{0.581}$ (3 marks)

$5 \times \frac{1}{0.0829}$

$5 \times \frac{1}{8.29 \times 10^{-2}}$

$5 \times \frac{1}{8.29} \times 10^{2}$

$5 \times 0.1206 \times 100$ B1

$= 60.3$

$\frac{14}{0.581} = 14 \times \frac{1}{5.81 \times 10^{-1}}$

$= 14 \times \frac{1}{5.81} \times 10^{1}$

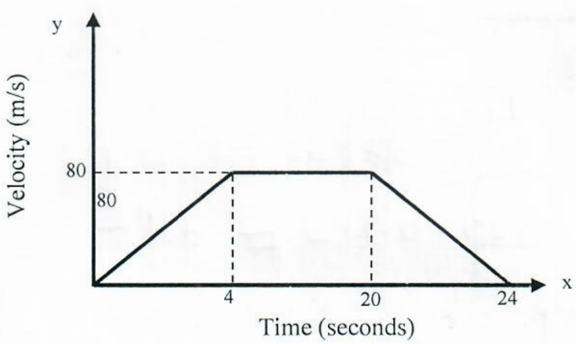
$= 14 \times 0.1721 \times 10$

$= 2.4094$ B1

$60.3 - 2.4094$

$= 57.8906$ A1

15. The figure below is a velocity – time graph for a car. (not drawn to scale).



(a) Find the total distance traveled by the car? (2 Metres)

$= \frac{1}{2}(16+24) \times 80$ M1

$= 20 \times 80$

1600 A1

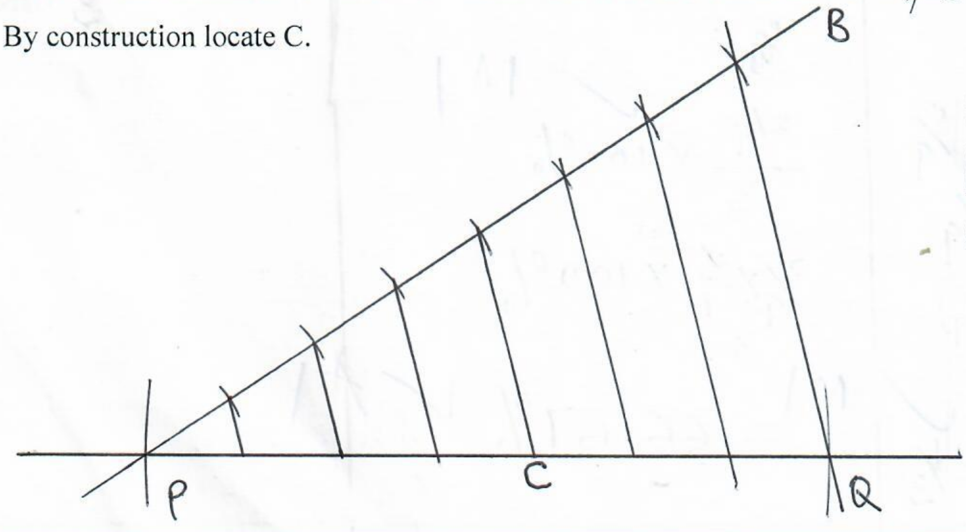
(b) Calculate the deceleration of the car. (2 Marks)

$d = \frac{80-0}{4} = \frac{80}{4}$ M1

$= 20 m/s^2$ A1

16. A point C is on a line PQ where PQ = 9cm. C divides PQ such that $PC = \frac{4}{7} PQ$.

By construction locate C. (3 marks)



PB - Drawn - B_1

PQ - Subdivided - B_1

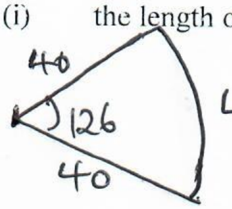
C located - B_1

SECTION II (50 MARKS): Answer any five questions in this section.

17. Arc of a circle of radius 40cm subtends an angle of 126° at the centre of the circle. (use $\pi = 22/7$)

(a) Calculate:

(i) the length of the arc. (2 marks)



$L = \frac{\theta}{360} \times 2\pi r$

$= \frac{126}{360} \times 2 \times \frac{22}{7} \times 40$ M1

$= 88\text{ cm}$ A1

(ii) the area of the sector. (2 marks)

$A = \theta/_{360}\, \pi r^2$

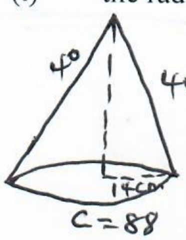
$= \frac{126}{360} \times \frac{22}{7} \times 40^2$ M1

$= 1760\text{ cm}^2$ A1

(b) The sector is folded to form a cone.

Calculate:

(i) the radius of the base of the cone. (2 marks)



$c = 2\pi r$ M1

$88 = 2 \times \frac{22}{7} \times r$

$r = \frac{88 \times 7}{2 \times 22}$ A1

$= 14\text{ cm}$

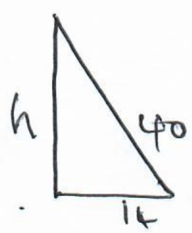
or $CS = \pi r l$

$1760 = \frac{22}{7} \times 40 \times r$

$r = \frac{1760 \times 7}{22 \times 40}$

$= 14\text{ cm}.$

(ii) the height of the cone. (2dp) (2 marks)



$h = \sqrt{40^2 - 14^2}$ M1

$= \sqrt{1600 - 196}$

$= \sqrt{1404}$ A1

$= 37.47\text{ cm}.$

(iii) the capacity of the cone in litres. (2dp.) (2 marks)

$V = \frac{1}{3}\pi r^2 h$ M1

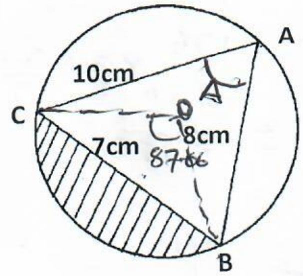
$= \frac{1}{3} \times \frac{22}{7} \times 14 \times 14 \times 37.47$

$= 7693.84\text{ cm}^3$

$= 7.69384\text{ l}$

$= 7.69\text{ l}$ A1

18. The figure below shows a triangle **ABC** inscribed in a circle. **AC** = 10cm, **BC** = 7cm and **AB** = 10cm.



(a) Find the size of angle **BAC**. (3mks) ~~(2mks)~~

$a^2 = b^2 + c^2 - 2bc\cos A$ ✓ M1

$7^2 = 10^2 + 8^2 - (2\times10\times8)\cos A$

$49 = 164 - 160\cos A$

$-116 = -160\cos A$

$\cos A = \frac{116}{160}$ ✓ M1

$\cos A = 0.725$

$\cos^{-1}0.725 = 43.53115.$

$\angle BAC = 43.53$ ✓ A1

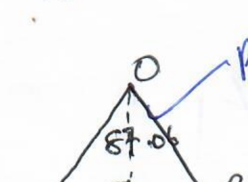
(b) Find the radius of the circle. (2mks)

$\frac{a}{\sin A} = 2R$

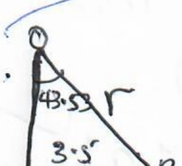
$\frac{7}{\sin 43.53} = 2R$ ✓ M1

$R = 5.082\text{cm}.$ ✓ A1

(c) Hence calculate the area of the shaded region. 5mks ~~(6mks)~~



B1.



NB B1 - for 87.06 seen.

$\sin 43.53 = \frac{3.5}{r}$

$r = \frac{3.5}{\sin 43.53}$

$= 5.082\text{cm}$

Area of $\triangle OCB = \frac{1}{2}ab\sin\theta$

$= \frac{1}{2}\times5.082\times5.082\sin 87.06$

$= 12.896\text{cm}^2$ ✓ M1

Area of sector OCB

$= \frac{\theta}{360}\pi r^2$

$= \frac{87.06}{360}\times\frac{22}{7}\times5.082^2$ M1

$= 19.630$ ✓

Shaded region

$(19.630 - 12.896)$ ✓ M1

$= 6.734\text{cm}^2$ ✓ A1

15
15
150
75

19. A straight line passes through the points (8, -2) and (4,-4).

(a) Write its equation in the form ax + by +c = 0, where a, b and c are integers. (3 Marks)

$G = \frac{-2--4}{8-4}$

$= \frac{2}{4}$ M1

$= \frac{1}{2}$

$\frac{y+4}{x-4} = \frac{1}{2}$ M1

$2y + 8 = x - 4$

$2y - x + 12 = 0$

$-x + 2y + 12 = 0.$ A1

(b) If the line in (a) above cuts the x-axis at point P, determine the coordinates of P. (2 Marks)

at x-axis, $y = 0$

$-x + (2 \times 0) + 12 = 0$ M1

$-x = -12$

$x = 12$

$P(12, 0)$ A1

(c) Another line, which is a perpendicular bisector to the line in (a) above cuts the y axis at the point Q. Determine the coordinates of point Q. (3 Marks)

Mid-point $\left(\frac{8+4}{2}, \frac{-2+-4}{2}\right)$

$= (6, -3)$ B1

$G = \frac{-2}{1}$

$\frac{-2}{1} = \frac{y+3}{x-6}$ M1

$y + 3 = -x + 12$

$y = -x + 9$

Point Q $(0, 9)$ A1

(d) Find the length of QP (2 Marks)

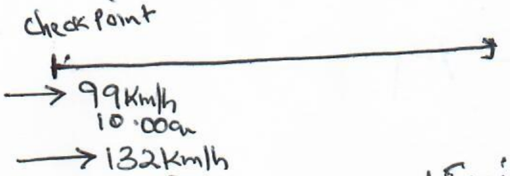
$|QP| = \sqrt{(12-0)^2 + (0-9)^2}$ M1

$= \sqrt{144 + 81}$

$= \sqrt{225}$

$= 15$ units A1

20. (a) A bus travelling at 99km/hr passes a check-point at 10.00a.m. and a matatu travelling at 132km/h in the same direction passes through the check point at 10.15a.m. If the bus and the matatu continue at their uniform speeds, find the time the matatu will overtake the bus. (6mks)



Time bef matatu = 15min

Distance travelled by bus

$= \left(\frac{15}{60} \times 99\right)$ ✓ M1

$= \frac{1}{4} \times 99 = \frac{99}{4}$

$= 24\frac{4}{5}$ km.

Relative speed $= (132 - 99)$ ✓ M1

$= 33$ km/h

Time taken to catch up

$= D/S$

$= \frac{99}{4} \div 33$ ✓ M1

$= \frac{\cancel{99}^{3}}{4} \times \frac{1}{\cancel{33}_{1}}$

$= 3/4$ hr

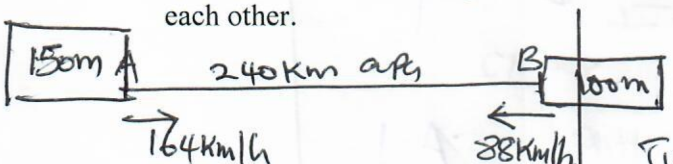
$= 45$min A1

The time it will overtake

$10{:}15 + 45 = 11.00$ ✓ M1

11.00 am ✓ A1

(b) Two passenger trains A and B which are 240m apart and travelling in opposite directions at 164km/h and 88km/h respectively approach one another on a straight railway line. Train A is 150 metres long and train B is 100 metres long. Determine time in seconds that elapses before the two trains completely pass each other. (4mks)



Relative speed $= (164 + 88)$ ✓ M1

$= 252$ km/h

$= \frac{252000}{60 \times 60}$

$= \frac{2520}{36}$ m/s

Total distance

$150 + 240 + 100$ ✓ M1

490m.

390

Time taken to over take

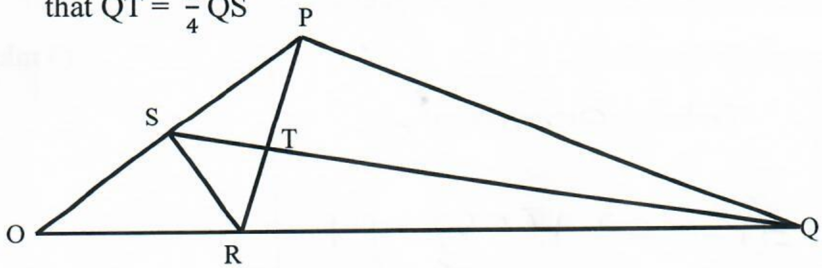
$= D/S$

$= 490 \div \frac{2520}{36}$ ✓ M1

$= \frac{490 \times 36}{2520}$

$= 7$ seconds ✓ A1

21. The figure below shows triangle OPQ in which OS = $\frac{1}{3}$ OP and OR = $\frac{1}{3}$ OQ. T is a point on QS such that QT = $\frac{3}{4}$ QS



(a) Given that OP = p and OQ = q, express the following vectors in terms of p and q.

(i) SR (1 Mark)

$\vec{SR} = SO + OR$

$= -\frac{1}{3}p + \frac{1}{3}q$ B1

(ii) QS (2 Marks)

$\vec{QS} = QO + OS$

$= -q + \frac{1}{3}p$ B1 B1

(iii) PT (2 Marks)

$PT = PO + OQ + QT$

$= -p + q + \frac{3}{4}(-q + \frac{1}{3}p)$ M1

$= -p + q - \frac{3}{4}q + \frac{1}{4}p$

$= -\frac{3}{4}p + \frac{1}{4}q$ A1

(iv) TR (2 Marks)

$TR = TS + SR$

$= \frac{1}{4}(-q + \frac{1}{3}p) + (-\frac{1}{3}p + \frac{1}{3}q)$ M1

$= \frac{1}{12}q - \frac{1}{4}q$. A1

(b) Hence or otherwise show that the points P, T and R are collinear. (3 Marks)

$PT = -\frac{3}{4}p + \frac{1}{4}q$

$PR = -p + \frac{1}{3}q$.

$PT = k\,PR$

$\frac{1}{4}(q - 3p) = 3k(q - 3p)$

$3k = \frac{1}{4}$

$k = \frac{1}{12}$ B1

$\therefore PT = \frac{1}{12}PR$

Hence parallel B1

and P is a common Point

Therefore P, T, R are B1

Collinear

22. A saleswoman is paid a commission of 2% on goods sold worth over ksh. 100,000. She also paid a monthly salary of ksh. 12,000. In a certain month, she sold 360 handbags at ksh. 500 each.

a) Calculate the saleswoman's earnings that month. (3 mks)

Total sale of bags
$=(500 \times 360)$ M1
$= 180,000$

Commission.
$(180\,000 - 100{,}000) \times \frac{2}{100}$ M1
$= 1,600$

Total earnings
$=(12000 + 1600)$
$= \underline{13600}$ A1

b) The following month the sales woman's monthly salary was increased by 10%. Her total earnings that month were ksh. 17600. Calculate:

(i) The total amount of money received from the sales of hand bags that month. (5 mks)

New monthly salary M1
$=\left(\frac{10}{100} \times 12000\right) + 12000$
$= 1200 + 12000$
$= 13\,200.$

Commission earned
$(17600 - 13200)$ M1
$= 4,400.$

Value of sale under Commision
$2\% = 4400$
$100\% = ?$

$\frac{100}{2} \times 4400$ M1
$= 220,000$

Total sale M1
$(220,000 + 100\,000)$
$= \text{Ksh. } 320,000$ A1

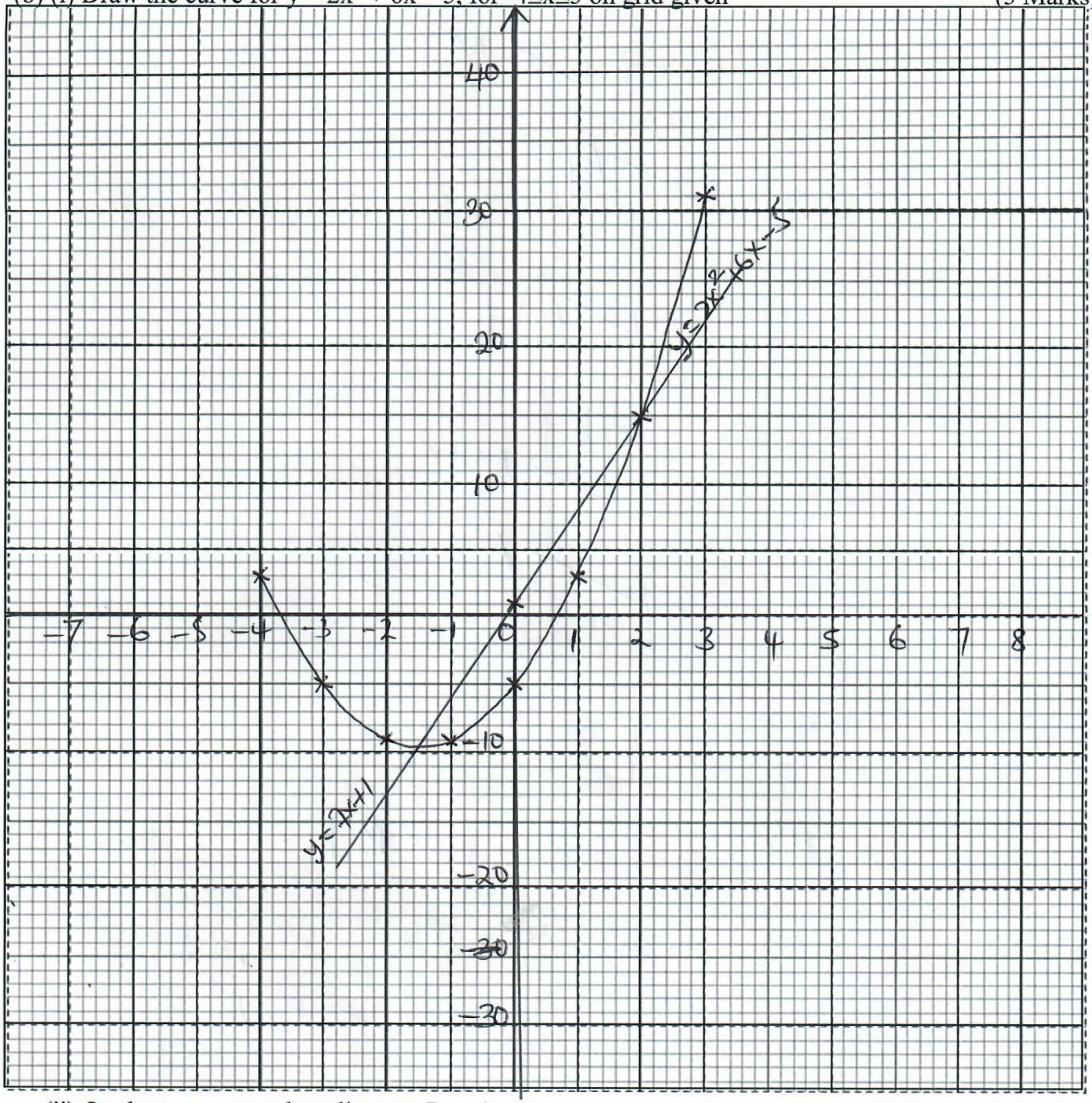
ii) The number of handbags sold that month. (2 mks)

No. of bags $= \frac{320\,000}{500}$ M1
$= 640$ bags A1

23.(a) Fill the table below for the function $y = 2x^2 + 6x - 5$, for $-4 \le x \le 3$ (2 Marks)

X	-4	-3	-2	-1	0	1	2	3
Y	3	-5	-9	-9	-5	3	15	31

(b) (i) Draw the curve for $y = 2x^2 + 6x - 5$, for $-4 \le x \le 3$ on grid given (3 Marks) B2



S1
P1
C1
L1

(ii) On the same axes, draw line $y = 7x + 1$ (1Mark)

x	0	2	-1
y	1	15	-6

(c) Determine the values of x at the points of intersection of the curve $y = 2x^2 + 6x - 5$ and line $y = 7x + 1$ (2 Marks)

$x = 1.5$ ✓ B1

$x = 2$ ✓ B1

(d) Use your graph to estimate the value of $2x^2 + 6x = 5$ (2 Marks) ✓ B1

$2x^2+6x-5=0$ | $y=0$ B1 | $x = -3.7$ or 0.7

$2x^2+6x-5=$ [illegible]

24. The displacement S metres of a moving particle after t seconds is given by

$S = 2t^3 - 5t^2 + 4t + 2$

Determine

(a) the velocity of the particle when $t = 2$. (3 marks)

$V = 6t^2 - 5t^2 + 4t + 2$ ✓ M1

$= 6(2)^2 - 10(2) + 4$ ✓ M1

$= 24 - 20 + 4$

$= 8 m/s$ ✓ A1

(b) the value(s) of t when the particle is momentarily at rest. (3 marks)

$6t^2 - 10t + 4 = 0$ ✓ M1

$3t^2 - 5t + 2 = 0$

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

$(3t-2)(t-1) = 0$ ✓ M1

$t = 1$ or $2/3$ ✓ A1

(c) the displacement when the particle is momentarily at rest. (2 marks)

when $t = 1$; $S = 2(1)^3 - 5(1)^2 + 4(1) + 2$

$= 3m.$ ✓ B1

when $t = 2/3$; $S = 2(2/3)^3 - 5(2/3)^2 + 4(2/3) + 2$

$= 3\frac{1}{27} m.$ ✓ B1

(d) the acceleration of the particle when $t = 5$. (2 marks)

$a = \frac{dv}{dt} = 12t - 10$ ✓ M1

$= 12(5) - 10$

$= 50 m/s^2.$ ✓ A1