MATHS PAPER 2 MARKING SCHEME

1	$\dfrac{(\sqrt{2} + 2\sqrt{5})(\sqrt{5} + \sqrt{2})}{(\sqrt{5} - \sqrt{2})(\sqrt{5} + \sqrt{2})}$ $\dfrac{\sqrt{10} + 4 + 10 + 2\sqrt{10}}{3}$	M1 M1 A1	
2	a) $1 + \frac{-5}{2}x + 10\left(\frac{1}{2}x\right)^2 + 10\left(-\frac{1}{2}x\right)^3 + 5\left(-\frac{1}{2}x\right)^4 + \left(-\frac{1}{2}x\right)^5$ $1 - \frac{5}{2}x + \frac{5}{2}x^2 - \frac{5}{4}x^3 + \frac{5}{16}x^4 - \frac{5}{32}x^5$ $x = 0.04$ b) $1 - \frac{5}{2}(0.04) + \frac{5}{2}(0.04)^2 - \frac{5}{4}(0.04)^3$ $1 - 0.1 + 0.004 - 0.00008$ $= 0.90392$	B1 M1 A1	✓Substitution CAO
		03	
3	Perimeter = 2(l + w) Absolute error for both length and width = 0.5 Max perimeter = 2(80.5 + 60.5) = 282 Actual perimeter = 2(80 + 60) = 280 Percentage error = $\frac{282-280}{280}$ x 100 = 0.714 ≅ 0.7	B1 M1 A1	For either max, actual or min perimeter
		03	
4	$\dfrac{(3x+1)(3x-1)}{(3x-1)(x+1)}$ $= \frac{(3x+1)}{x+1}$	B1 B1 B1	For num For deno
		02	
5	$(x + 3)^2 + (-y - 2)^2 = 3^2$ $x^2 + 6x + 9 + y^2 + 4y + 4 = 9$ $x^2 + y^2 + 6x + 4y + 4 = 0$	M1 M1 A1	
		03	

6	$\log\left(\frac{2x-11}{2}\right) = \log\left(\frac{3}{x}\right)$ $\frac{2x-11}{2} = \frac{3}{x} \Rightarrow 2x^2 - 11x - 6 = 0$ $x = \frac{-(-11) \pm \sqrt{(-11)^2 - (4 \times 2 \times -6)}}{2 \times 2}$ $x = \frac{11 \pm 13}{4}$ $x = \frac{11-13}{4} = -\frac{1}{2}$ (discriminate) $x = \frac{11+13}{4} = 6$ Hence $x = 6$	M1 M1 M1 A1	Forming quadratic equation ✓ attempt to solve the formed equation Square root of discriminant A0 of both values missing
	Total	**3**	
7	$\frac{4}{5} \times \frac{10}{8} \times 3 \times 2 \times \frac{1}{2}$ $= 3$ days	M1, M1 A1	
	Total	**3**	
8	$\left.\begin{array}{r} x = 2 \to x - 2 = 0 \\ x = 4 \to x - 4 = 0 \\ x = -3 \to x + 3 = 0 \end{array}\right\}$ $(x-2)(x-4)(x+3) = 0$ Consider $(x-2)(x-4) = x(x-4) - 2(x-4)$ $x^2 - 4x - 2x + 8 = x^2 - 6x + 8$ $(x+3)(x^2 - 6x + 8) = 0$ $x(x^2 - 6x + 8) + 3(x^2 - 6x + 8) = 0$ $x^3 - 6x^2 + 8x + 3x^2 - 18x + 24 = 0$ $y = x^3 - 3x^2 - 10x + 24$	B1 M1 A1	All three expressions Expansion and simplification
	Total	**3**	
9	$\mathbf{AB} = \begin{pmatrix} 1 & k \\ 3 & 3 \end{pmatrix} \begin{pmatrix} -3 & 5 \\ 1 & -2 \end{pmatrix}$ $\mathbf{AB} = \begin{pmatrix} -3+k & 5-2k \\ -6 & 9 \end{pmatrix}$ $9(-3+k) - \{-6(5-2k)\} = 9$ $-27 + 9k - (-30 + 12k) = 9$ $-27 + 30 + 9k - 12k = 9$ $-3k = 9 + 27 - 30$ $-3k = 6$ $k = 2$	B1 M1 A1	
	Total	**3**	

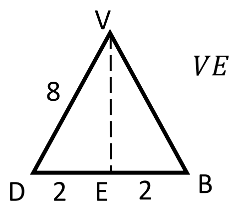
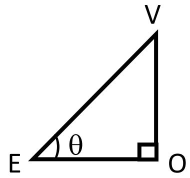
10. $P = \frac{Kt^3}{\sqrt{5}}$ $16 = \frac{K\,2^3}{\sqrt{9}}$ $\frac{16 \times 3}{8} = \frac{8}{8}K \qquad \frac{16 \times -3}{8} = K$ $K = 6 \qquad K = -6$ $P = \frac{6t^3}{\sqrt{5}}$ P $= \frac{6 \times 3^{\,3}}{\sqrt{36}} = \qquad \frac{6 \times 27}{6} = 27$ P $= \frac{-6 \times 3^{\,3}}{\sqrt{36}} = \qquad \frac{-6 \times 27}{6} = -27$	M_1 for $16 = \frac{K\,2^3}{\sqrt{9}}$ M_1 for P $= \frac{6 \times 3^{\,3}}{\sqrt{3}}$ A_1 correct value of P.
11.(a) $TS^{\,2} = 8(8 + x$ $144 = 64 + 8x$ $80 = 8$ $10 = x$ $Vu = 10cm$ $(b) vx = 4cm \left(\frac{2}{\cancel{5}} \times \cancel{10}^2\right)$ $Xu = 10cm - 4 = 6$ $4 \times 6 = 3 \times x \qquad x = \frac{4\ x\ \cancel{6}^2}{\cancel{3}} = 8cm$ $Sx = 8cm$	M_1 for $144 = 64 + 8x$ A_1 for $C.A$ M_1 for $vx\ or\ xu$ A_1 for $8cm$
12. $\frac{r}{p} = \frac{m}{\sqrt{n-1}}$ $\frac{r^2}{p^{\,2}} = \frac{m^{\,2}}{n-1}$ $r^2\,(n-1) = m^2p^2$ r^2n $-r^2 = m^2p^2$ $\frac{r^2n}{r^2} = \frac{m^2p^2 + r^2}{r^{\,2}}$ $n = \frac{m^2p^2+r^2}{r^2}$	M_1 for $squaring$ A_1 for $C.A$

13	(i) $\text{P.A.Y.E} = 5000 - (3944)$ $= \text{Ksh } 1056$ (ii) Gross tax $= 1056 + 1056$ $= \text{Ksh } 2112$ SLABS: $9680 \times \frac{10}{100} = 968$ – $= 1144$ $X \times \frac{15}{100}$ $= 2112$ $X = \frac{1144}{0.15} = 7{,}626.67$ Monthly income $= 9680 + 7{,}626.67$ $= \text{Ksh } 17{,}306.70$	 **B1** **B1** **M1** **M1** **A1**	 CAO CAO Acc. Ksh 17, 306.67
		04	

14.Use logarithms tables to evaluate. (4mks)

$$\sqrt[3]{\frac{36.72\times(0.46)^2}{185.4}}$$

Log	*No*
1.5649 $\bar{1}.3256 +$ 0.8905 $2.2682 -$ $\bar{2}.6223$ $\frac{\bar{2}.6223}{3}$ $\frac{\bar{3}+1.6223}{3}$ $\bar{1}.5408$	*36.72* $(0.46)^2 \Rightarrow 2(\bar{1}.6628)$ 3.474×10^{-1} $= 0.3474$

15	 $VE = \sqrt{60}$  Cos θ = $\frac{1.5}{\sqrt{60}}$ = 0.1936 θ = Cos^{-} 0.1936 θ = 78.84^0	M1 Expression for angle A1	
16	A(50°S, 25°E) B(50°S, 140°E) θ= 140-25 long $\theta, \propto$ $\theta = 115^{o}$ km = $\frac{\theta}{360} 2\pi 2$ $\frac{115^{o}}{360}$x $2x\,\frac{22}{7}$ x 6370 = 12,790.56km	B1 M1 A1	

17	(a) (i) PQ = PO + OQ $= -p + q$ or $q - p$ (ii) OR = OP + PR $= p + \frac{2}{3}(-p + q)$ $= \frac{1}{3}p + \frac{2}{3}q$ (iii) SQ = SO + OQ $= -\frac{3}{4}OP + OQ$ $= -\frac{3}{4}p + q$ or $q - \frac{3}{4}p$ (b) $OT = n(\frac{1}{3}p + \frac{2}{3}q)$ From DOST OT = OS + ST $= \frac{3}{4}p + m(-\frac{3}{4}p + q)$ $\frac{n}{3}p + \frac{2n}{3}q = \left(\frac{3}{4} - \frac{3}{4}m\right)p + mq$ $\frac{n}{3} = \frac{3}{4} - \frac{3m}{4}$ $4n + 9m = 9$…………………. (i) $\frac{2n}{3}= m$, $M = \frac{2n}{3}$ ……………....(ii) $4n + 9\left(\frac{2n}{3}\right) = 9$ $4n + 6n = 9$ $10n = 9$ $n = \frac{9}{10}$ $M = \frac{2}{3} \times \frac{9}{10} = \frac{3}{5}$	B1 M1 A1 B1 B1 M1 M1 M1 M1 Both A1	

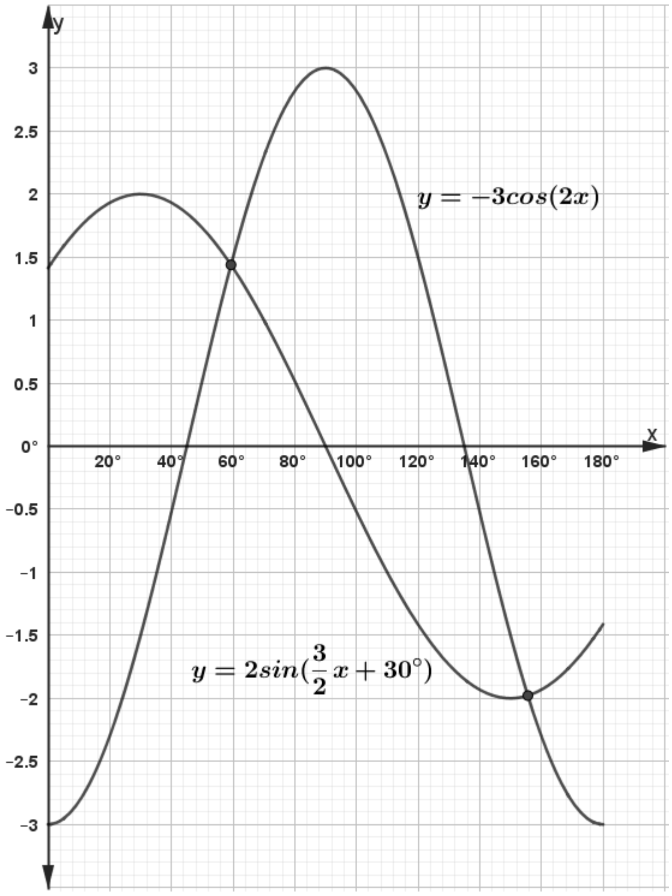
	WORKING	MARKS	REMARKS

18 (a) Table

x^0	20	40	80	120	140	160	180
$-3\cos 2x$	-2.30	-0.52	2.82	1.5	-0.52	-2.30	-3.00
$2\sin\left(\frac{3}{2}x + 30\right)^0$	1.73	2.00	2.00	-1.00	-1.73	-2.00	-1.73

B2 — All points ✓ (B1 for at least 6 points ✓)

(b) Graph



S1 — Given scales used and consistent

P1 — Plotting of 1st curve

C1 — Smooth 1st curve drawn

P1 — Plotting 2nd curve

C1 — Smooth 2nd curve drawn

(c) (i) Period of the period of $y = 2\sin\left(\frac{3}{2}x + 30\right)^0$

$$\text{Period} = \frac{360^0}{\frac{3}{2}} = 240^0$$

B1 — 240^0 seen

(ii) Solutions

$x = 56^0 \pm 4^0$ — B1

$x = 56^0 \pm 4^0$ — B1

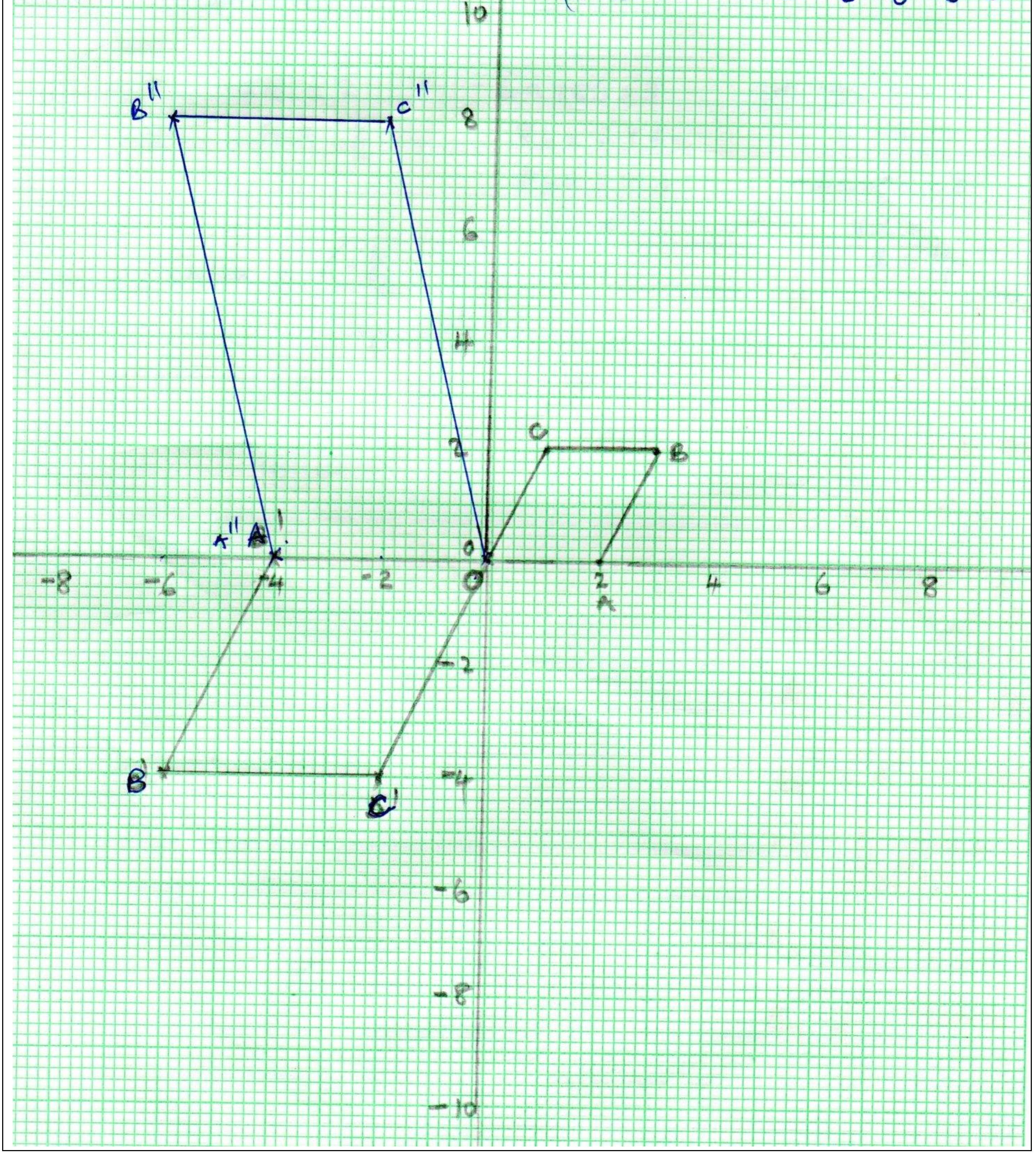
	WORKING	MARKS	REMARKS
19.	(a) (i) Let the annual increment be Ksh. d		
	(ii) $T_{11} = a + 10d \rightarrow 288{,}000 = 180{,}000 + 10d$	M1	✓ attempt to get T_{11}
	$d = \dfrac{288{,}000 - 180{,}000}{10}$		10,800 seen
	$d = \text{Ksh.}\,10{,}800$	A1	
	(iii) Sum after 11 years		✓ attempt to get S_{11}
	$S_{11} = \dfrac{11}{2}\{180{,}000 + (11-1)10{,}800\}$	M1	1,584,000 seen
	$S_{11} = 5.5\{180{,}000 + (10 \times 10{,}800)\}$		
	$S_{11} = \text{Ksh.}\,1{,}584{,}000$	A1	✓ attempt to get T_{10}
	(b) Let the annual salary in the 10th year be T_{10}		
	$T_{10} = ar^9 \rightarrow 150{,}000(1.1)^9$	M1	Attempt for division by 12
	$T_{10} = \text{Ksh.}\,353{,}692.1537$		29,470 seen
	Monthly salary in year 10		
	$\dfrac{353{,}692.1537}{12} = 29{,}474.35$	M1	
	= Ksh29,470 (to the nearest Ksh. 10)	A1	
	(c) Let the years be n		
	$\dfrac{n}{2}\{180{,}000 + (n-1)10{,}800\} = 1{,}022{,}400$		
	$n\{180{,}000 + 10{,}800n - 10{,}800\} = 2{,}044{,}800$		
	$n(169{,}200 + 10{,}800n) - 2{,}044{,}800 = 0$		
	$10800n^2 + 169{,}200n - 2{,}044{,}800 = 0$		
	Divide all through by 400		
	$27n^2 + 423n - 5112 = 0$	M1	Formation and solution of quadratic equation
	$n = \dfrac{-(423) \pm \sqrt{(423^2) - (4 \times 27 \times -5112)}}{2 \times 27}$		
	$n = \dfrac{-423 \pm 855}{54}$		
	$n = \dfrac{-423 - 855}{54} = -23\dfrac{2}{3}$ (discriminate)		
	$n = \dfrac{-423 + 855}{54} = 8$	A1	Both values seen
	Hence $n = 8$	B1	8 seen
	Total	**10**	

20. B and passes and not prefect $\frac{6}{11}\times\frac{5}{8}\times\frac{7}{8}=\frac{105}{352}$ (ii) G and prefect and pass $\frac{5}{11}\times\frac{2}{11}\times\frac{4}{7}=\frac{40}{847}$ (iii) B or G B NP passes or G NP passes $=\frac{6}{11}\times\frac{5}{8}\times\frac{7}{8}+\frac{5}{11}\times\frac{9}{11}\times\frac{4}{7}$ $=\frac{105}{352}+\frac{180}{847}$ $=0.5108$	M_1 for $\frac{7}{8}$ M_1 for $\frac{6}{11}\times\frac{5}{8}\times\frac{7}{8}$ A_1 for $C.A$ M_1 for $\frac{5}{11}\times\frac{2}{11}\times\frac{4}{7}$ A_1 for $C.A$ M_1 for $\frac{6}{11}\times\frac{5}{8}\times\frac{7}{8}+\frac{5}{11}\times\frac{9}{11}\times\frac{4}{7}$ A_1 for $\frac{105}{352}$ A_1 for $\frac{180}{847}$ A_1 for 0.5108

21 (d)$\begin{pmatrix} a & b \\ c & d \end{pmatrix}\begin{pmatrix} 0^{11} & A^{11} & B^{11} & C^{11} \\ 0 & -4 & -6 & -2 \\ 0 & 0 & 8 & 8 \end{pmatrix}=\begin{pmatrix} 0 & A & B & C \\ 0 & 2 & 3 & 1 \\ 0 & 0 & 2 & 2 \end{pmatrix}$ $-4a=2$ $a=-\frac{1}{2}$ $-6a+8b=3$ $8b=3+6a$ $8b=3-3$ $b=0$ $-4c=0$ $c=0$ $-2c+8d=2$ $8d=2$ $d=\frac{1}{4}$ $matrix=\begin{pmatrix} -\frac{1}{2} & 0 \\ 0 & \frac{1}{4} \end{pmatrix}$	M_1 for $finding\ cordinates$ A_1 for $cordinates$ B_1 for $OABC\ drawn$ B_1 for $O^1A^1B^1C^1drawn$ M_1 for $Attempting\ to\ find\ cordinates\ of\ O^{11}A^{11}B^{11}C^{11}$ A_1 coordinates of $O^{11}A^{11}B^{11}C^{11}$ B_1 for $O^{11}A^{11}B^{11}C^{11}drawn$ M_1 for $Attempting\ to\ find\ matrix$ A_1 for $a=-\frac{1}{2}$ A_1 for $matrix$

(a) $\begin{pmatrix} -2 & 0 \\ 0 & -2 \end{pmatrix} \begin{array}{c} \begin{array}{cccc} O & A & B & C \end{array} \\ \begin{pmatrix} 0 & 2 & 3 & 1 \\ 0 & 0 & 2 & 2 \end{pmatrix} \end{array} = \begin{array}{c} \begin{array}{ccc} O' & A' & B' \end{array} \\ \begin{pmatrix} 0 & -4 & -6 \\ 0 & 0 & -4 \end{pmatrix} \end{array}$

(b) $\begin{pmatrix} 1 & 0 \\ 0 & -2 \end{pmatrix} \begin{array}{c} \begin{array}{cccc} O' & A' & B' & C' \end{array} \\ \begin{pmatrix} 0 & -4 & -6 & -2 \\ 0 & 0 & -4 & -4 \end{pmatrix} \end{array} = \begin{array}{c} \begin{array}{cccc} O'' & A'' & B'' & C'' \end{array} \\ \begin{pmatrix} 0 & -4 & -6 & -2 \\ 0 & 0 & 8 & 8 \end{pmatrix} \end{array}$



22	$V = 10t - \frac{1}{2}t^2 - \frac{15}{2}$ (a) $V = 10(0) - \frac{1}{2}(3)^2 - \frac{15}{2}$ $= -7.5$ mls	B1	✓velocity (award B0 for wrong units)
	(b) $V = 10t - \frac{1}{2}t^2 - \frac{15}{2}\ \Big\vert_{t=3}$ $V = 10(3) - \frac{1}{2}(3)^2 - \frac{15}{2}$	M1	✓substitution
	$= 18$ mls	A1	✓velocity (award A0 for wrong units)
	(c) $s = \int_4^5 \left(10t - \frac{1}{2}t^2 - \frac{15}{2}\right) dt$	M1	✓limits
	$S = \left[\frac{10t^2}{2} - \frac{t^3}{6} - \frac{15}{2}t + c\right]_4^5$	M1	✓integral
	$S = \left[5t^2 - \frac{t^3}{6} - \frac{15}{2}t + c\right]_4^5$		
	$S = \left[\left(5(5)^2 - \frac{(5)^3}{6} - \frac{15}{2}(5)\right) - \left(5(4)^2 - \frac{(4)^3}{6} - \frac{15}{2}(4)\right)\right]$	M1	attempt to subst. & subtr.
	$= \left[\left(66\frac{2}{3}\right) - \left(30\frac{1}{3}\right)\right]$		
	$= 27\frac{1}{3}$ m	A1	
	(d) $a = \frac{dV}{dt} = 10 - t$ $10 - t = 0 \Rightarrow t = 10$	B1	for t = 10s
	$V = 10(10) - \frac{1}{2}(10)^2 - \frac{15}{2}$	M1	✓subst.
	$= 42.5$ mls	A1	✓velocity (award A0 for wrong units)
		10	

23.(a) The 1st term and the common difference. (3mks

$a + d = 8$
$a + 4d = 17$
$3d = a$
$d = 3$
$a = 5$

(b) The first three terms of the G.P and the 10th term of the G.P. (4mks)

$2^{nd} = 8$
$10^{th} = 5 + 9 \times 3 = 32$
$42^{nd} = 5 + 41 \times 3 = 128$
$\therefore$GP is 8, 32, 128, - - - -
$a = 8$

$r = 4$

n^{th} term of G.P $= ar^{n-1}$

$\therefore 10^{th}$ term$= 8(4)^9$

$= 2097152$

(c) The sum of the first 10 terms of the G.P. (3mks)

$$S_n = \frac{a(r^n - 1)}{r - 1}$$

$$S_{10} = \frac{8(4^{10} - 1)}{4 - 1}$$

$$= \frac{8}{3} \times 1048575$$

$= 2796200$

24	(a) Det = 32 – 35 = - 3 P-1 = $-\frac{1}{3}\begin{pmatrix} 8 & -7 \\ -5 & 4 \end{pmatrix}$ (b) (i) 8b + 14m = 47600 10b + 16m = 57400	B1 B1 M1	✓ Accept $\begin{pmatrix} -\frac{8}{3} & \frac{7}{3} \\ \frac{5}{3} & -\frac{4}{3} \end{pmatrix}$

	$\begin{pmatrix} 8 & 14 \\ 10 & 16 \end{pmatrix}\begin{pmatrix} b \\ m, \end{pmatrix} = \begin{pmatrix} 47600 \\ 57400 \end{pmatrix}$ or $\begin{pmatrix} 4 & 7 \\ 5 & 8 \end{pmatrix}\begin{pmatrix} b \\ m \end{pmatrix} = \begin{pmatrix} 23800 \\ 28700 \end{pmatrix}$ (ii) $\begin{pmatrix} b \\ m \end{pmatrix} = \begin{pmatrix} \frac{-8}{2} & \frac{7}{3} \\ \frac{5}{3} & -\frac{4}{3} \end{pmatrix}\begin{pmatrix} 23800 \\ 28700 \end{pmatrix}$ $\begin{pmatrix} b \\ m \end{pmatrix} = \begin{pmatrix} -\frac{8}{3}x23800 + 28700x\frac{7}{3} \\ \frac{5}{3}x23800 + -\frac{4}{3}\ x\ 28700 \end{pmatrix}$ $\begin{pmatrix} b \\ m \end{pmatrix} = \begin{pmatrix} 3500 \\ 1400 \end{pmatrix}$ Bag of beans cost Sh. 3500 Bag of maie cost Sh. 1400 (c) $\frac{115}{100}$ x 3500 = 4025 8 x 4025 = 32400 47600 – 32400 = 15400 ∴1400m = 15400 m = 11 bags Ratio 8:11	A1 M1 M1 A1 B1 B1 B1	 Both