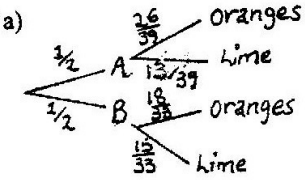
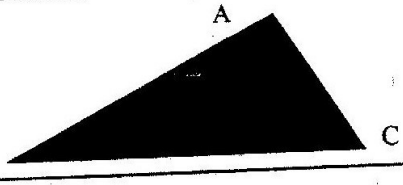
K.C.S.E 1999 MATHEMATICS PAPER 121/1 MARKING SCHEME

SOLUTION	MARKS	ALTERNATIVE METHOD
1. a) $\frac{-8 \div 2 + 12 \times 9 - 4 \times 6}{56 \div 7 \times 2}$ $= \frac{-4 + 108 - 24}{16}$ $= \frac{80}{16}$ $= 5$ b) $5a - 4b - 2\{a-(2b + c)\}$ $= 5a - 4b - 2a + 4b + 2c$ $= 3a + 2c$	m1 m1 m1 A1 4 marks	Divisions and multiplication opperations Removal of brackets
2. $\begin{bmatrix}-5\\4\end{bmatrix} + T\begin{bmatrix}-1\\1\end{bmatrix}$ $T = \begin{bmatrix}-1\\-1\end{bmatrix} - \begin{bmatrix}-5\\4\end{bmatrix}$ $= \begin{bmatrix}4\\-5\end{bmatrix}$ $\begin{bmatrix}-4\\5\end{bmatrix} + \begin{bmatrix}4\\-5\end{bmatrix} = \begin{bmatrix}0\\0\end{bmatrix}$ The image of (-4, 5) is (0.0)	m1 A1 2 Marks	Must be in coordinate form even without the coma Also accept reflection by use of diagram
3. 2n - 4 right angles $2 \times 9 - 4 = 14$ right angles $14 \times 90^\circ = 1260^\circ$	m1 A1 2 marks	Accept use of triangles or quadrilaterals 3 quadrilateral and 1 triangle Reject measurement
4. Area = $3.142 \times 5 \times 13$ $= 204.23\ cm^2$ If base area included M1 A0	m1 A1 2 marks	Logs used with 3.142 204.2 or 204.3 Long used with $\frac{22}{7}$ 204.3 or 204.4 Follow through
5. a) Area = $6 + \frac{22}{2}\ 6 + \frac{22}{7}$ or $\frac{20}{2}$ $= 17\ cm^2$ b) Area in hectares $= \frac{17 \times 50000 \times 50000}{100 \times 100 \times 10000}$ $= 425$ ha	m1 A1 m1 A1 4 marks	Accept $A=6+9=15cm^2$ $A=6+10=16cm^2$ Accept 36 - (20 or 21) 16 or 15 $\frac{15 \times 50000 \times 50000}{100 \times 100 \times 10000} = 375$ ha Accept $36 - \frac{22}{2} = 17$

SOLUTION	MARKS	ALTERNATIVE METHOD
6. $\frac{3 \times 125 + 4 \times 164 + 2 \times 140}{3+4+2}$ $= \frac{1311}{9}$ $= 145\frac{2}{3}$	M1 ml A1 3 marks	Multiplication If log used accept 145.6 Accept 145.7 145.6 145.66 145.67
7 a)  b) P(orange) $= \frac{1}{2} \times \frac{2}{3} + \frac{1}{2} \times \frac{6}{11}$ $= \frac{1}{3} + \frac{3}{11}$ $= \frac{20}{33}$	B1 M1 A1 3 marks	Accept $\frac{26}{39}$ $\frac{13}{39}$ $\frac{18}{33}$ $\frac{15}{33}$ Half must be indicated or equivalent if a half used in calculation recovery of B1 mark
8. a) $y^2 - 2x^2$ cm^2 b) $2x^2 = 14^2$ $x = 7\sqrt{2}$ c) Area of the octagon $y = 14 + 2x = 14 + 2 \times 9.9 = 33.8$ $A = y^2 - 2x^2 = 33.82 - 2 \times 98$ $= 1142.44 - 196$ $= 946.44$ cm^2	B1 B1 M1 M1 A1	$y(14 + 2x) = 2x2$ $14y + 2xy - 2x2$ or Accept - 9.9 -9.8999 - 9.898 or 2 {1 (y+14)x +14y $yx + 14x + 14y$ 1142.1 - 196 = 946.4 cm2
9. a) Maximum possible area $4.11 \times 2.21 = 9.083$ Minimum possible area $4.09 \times 2.19 = 8.9571$ b) Maximum possible wastage $9.0831 - 8.9571 = 0.126$ m^2	M1 A1 B1 3 marks	4.11 x 2.21 and 4.09 x 2.19 9.0531 and 8.9571 9.082 8.956 8.957
10. a) by 30th June, 1996 A = 12000 x 1.09 = Sh. 130050 b) By 30th June 1997 $A = 12000 \times 1.09 + 12000 \times 1.09^2$ = 13080 + 1425[illegible]20 = Sh. 27337.20	B1 M[illegible]	(Use of tables) Accept 27330,27340 1st m[illegible] r 12000 x 1.092 [illegible] 9 = 13[illegible] 13080 [illegible].000=25.080 ml m1 20.080 x 1.09 = [illegible]37 A1

SOLUTION	MARKS	ALTERNATIVE METHOD
11. Construction marks for $37\frac{1}{2}$ $\angle ABC = 37\frac{1}{2}^{\circ} \pm 1^{\circ}$ Subdivision of AB Subdivision of BC (ruler and set square)  	B1 B1 B1 B1 4 marks	* 60°, 30°, 15°, 71/2° * 60°, 150°, 75°, 371/2° * 90°, 45°, 60°, 15°, 71/2°
12. $\angle ABC = 180^{\circ} - 117^{\circ} = 63^{\circ}$ $\angle ACB = 90^{\circ}$ $\angle BAC = 90^{\circ} - 63^{\circ} = 27^{\circ}$	B1 B1 B1 3 marks	Opposite $\angle$S cyclic quadrilateral Angle in semicircle Δ ABC right angled 0w - 1 if at least 1 reason mission or wrong for 90 & 63o only.
13. Length of the pipe $\frac{63}{7000} = (0.15 \times 0.12\ \ 0.12 \times 01)$ $= 0.009 \div 0.006$ $= 1.5$ m	M1 M1 M1 A1 4	For volume (or equivalent) For x - sectional area For the operations Accept cm unit used all through
14. (for tangent) height of ΔABC $= x\sqrt{3}$ $= \tan^{-1}\frac{x}{x\sqrt{3}}$ $= \tan^{-1}\frac{1}{\sqrt{3}}$ $= 30^{\circ}$	M1 ml A1 3 marks	ALT $\sin\theta = \frac{x}{2x} = \frac{1}{2}$ for $\frac{\sin\zeta}{2x}$ $x\sqrt{5}$ ml $= 30^{\circ}$ $\cos\theta = \frac{x\sqrt{3}}{2x} = 30^{\circ}$ For $2x$, $x\sqrt{3} = 30^{\circ}$
15. $(x+y)^2 + (y-x)^2 - 2(x-y)(x+y)$ $= x^2 + 2xy + y^2 + y^2 - 2xy + x^2 + 2x^2 + 2y^2$ $= 2x^2 + 2y^2 - 2x^2 + 2y^2$ $= 4y^2$ $= 22\ (2\text{-}a)^2$	M1 M1 A1 3 marks	Substitution Expansion of the sum Expansion of the difference Expansion of two squares Removal of bracket Accept $4\ (2 - a)^2$
16. $V = 3t^2 - 6t - 8$ $S = \int(3t^2 - 6t - 8)\,dt$ $S = t^3 - 3t^2 - 8t + C$ $10 = 1\text{-}3\text{-}8+C$ $C=20$ $S=t^3 - 3t^2 - St + 20$ $= 8 - 12\text{-}16+20$ $= 0$m	ml ml A1	/t3-3t2-8t2 (8-12-16)-(1-3-8) -20+10=-10 -10+10=0 for integration the constant must be ALT /t3-3t2-8t2

SOLUTION	MARKS	ALTERNATIVE METHOD
17. a) $950000\left[1-\frac{5}{100}\right]^2$	ml	
$920000\left[1-\frac{5}{100}\right]^2\left[\frac{1-15}{100}\right]^3$	ml A1	
Sh 526400		
b) 526400 x1.25	ml	
= Sh. 658000	A1	
$\left[1-\frac{r}{100}\right]^{60} = \frac{658000}{950000} = 0.6926$	ml	
$1-\frac{r}{100} = \sqrt[60]{0.6926}$		
$\frac{r}{100} = 1-\sqrt[60]{0.6926}$	ml	
$= 1-\sqrt[60]{0.9938}$ $\frac{1}{100} = 1-0.9938$ $= 0.0062$ $r = 0.62\%$	A1 8 marks	Or equivalent Accept 0.60% 0.61%
18. $BC^2 = 34^2 + 66^2 - 2 \times 34 \times 66 \cos 96.7^\circ$	ml	Follow through when logs used
$= 1156 + 4356 - 4488 \times 0.1167$	ml	
$= 5512 + 524$		
$= 6036$	A1	
$= \sqrt{6036} = 77.69m$		
(a) Area of traingle ABC	ml	
$= 1/2 \times 34 \times 66 \sin 96.7^\circ$		
$= 1122 \times 0.9932$	A1	Accept 115 from councils table
$= 1114m^2$		
Area of triangle PB		
$= 1/4 \times 1114$	B1	If any A0 (above is lost)
$= 278.5m^2$		
(c) Height of triangle APB		
$h = \frac{278.5 \times 2}{34} = 16.35m$		
Distance of the pipe from P		
$= \sqrt{\frac{4}{9} \times 16.35}$		
$= \frac{2}{3} \times 16.35$		
$= 10.9m$		

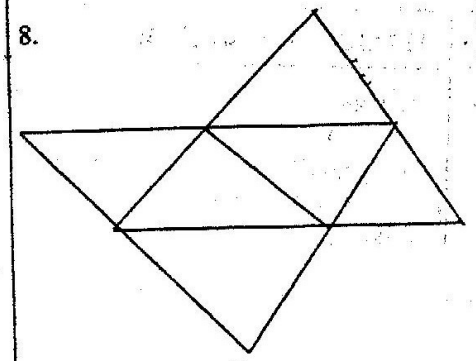
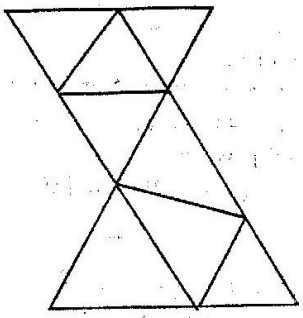
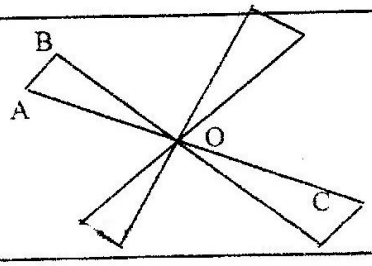
SOLUTION	MARKS	ALTERNATIVE METHOD
19. a) <BAR = 80° b) <STR = 30° c) <BSU = 45° d) <BRS = 45°	B1 B1 B1 B1 B1 B1 B1 B1 8 marks	Cyclic qualdrilateral and supplement of equivalent
20. (a) x: -2, -1.5, -1, 0, 1, 2, 3, 4, 5 x1: -8, -3.4, -1, 0, 1, 8, 27, 64, 175 -5x2: -20, -11.3, -5, 0, -5, -20, -45, -80, -125 2x: -4, -3, -2, 0, 2, 4, 6, 8, 10 9: 9, 9, 9, 9, 9, 9, 9, 9, 9, 99 y: -23, -8.7, 1, 9, 7, 1, -3, 1 19, 109 (b) On the graph: Scale Plotting Curve (c) 2.15 ± 0.1 (d) y = 4- 4x drawn $x = -0.55 \pm 0.1$	B2 S1 P1 C1 B1 B1 L1 B1 8 Marks	For the 10 numerical pints B1 for at least 6 points Accommodates all values and uniform Can score from the graph (Reject coordinate form)
21. (a) (i) AB = b - a (ii) AP = $^3/_8$ (b - a) (iii) BP = $^5/_8$(a-b) (iv) OP = OA + AP or OB + BP $\Rightarrow a = {}^5/_8 (b - a)$ $= {}^5/_8 a + {}^5/_8 b$ (b) $OP = {}^5/_8 a + {}^5/_8 b$ $OQ = a - {}^5/_8 a + {}^9/_{40} b$ $= {}^3/_8 a + {}^9/_{40} b$ $OQ : OP = {}^3/_8 a + {}^9/_{40} b : {}^5/_8 a + {}^3/_8 b$ $= {}^3/_8 (a + {}^3/_5 b) : {}^5/_8 (a + {}^3/_5 b)$ = 3:5 ∴ OQ: Qp =3:2	B1 B1 B1 m1 A1 m1 M1 A1 8 marks	Ow - 1 vector sign missing Direct use of ratio theorem OP = 5/8a + 1/8b m1 A1 OQ or Op or AQ QP = 2/8a + 6/40b OQ: QP = 3/8a + 9/40b: 2/8a + 6/40b =3/8(a+3/5b): 2/8a + 3/5b = 3.2

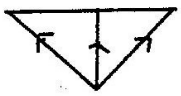
SOLUTION	MARKS	ALTERNATIVE METHOD
b) $OQ = a - {}^{5}/_{8}a + {}^{9}/_{40}b$ $= {}^{3}/_{8}a + {}^{9}/_{40}b$ $OQ + k\,OP = K({}^{5}/_{8}a + {}^{3}/_{8}\,b)$ ${}^{5}/_{8}a + {}^{9}/_{40}b = K({}^{5}/_{8}a + {}^{3}/8b)$ $3({}^{5}/_{40}a + {}^{3}/_{40}b) = 5k\,({}^{5}/_{40}a + {}^{3}/_{40}b)$ $3 = 5k$ $k = 3/5$ $OQ: QP = 3.2$		(b1) $OQ = OP + BP + PQ$ $OP = QA + AP$ $= {}^{5}/_{8}a + {}^{9}/_{40}b$ $OQ: QP = ({}^{5}/_{8}a + {}^{9}/_{40}b) : ({}^{2}/_{8}a + {}^{6}/_{40}b)$ $= 3:2$ (b2) $OA = QA + AO/PQ + PA + AQ$ $OQ = {}^{5}/_{8}a + {}^{9}/_{40}b - a$ $= {}^{3}/_{8}\,(a + {}^{3}/_{5}b)$ $PQ = {}^{3}/_{8}(b - a)\ {}^{5}/_{8}a + {}^{9}/_{40}b)$ $= {}^{-3}/_{8}b + {}^{3}/_{8}a - {}^{5}/_{8}a + {}^{9}/_{40}b$ $= {}^{-1}/_{4}\,a - {}^{6}/_{40}b$ $= {}^{-1}/_{4}\,(a + {}^{3}/_{5}b)$ $OQ:QP = {}^{3}/_{8}(a + {}^{3}/_{5}b): {}^{1}/_{4}(a + {}^{3}/_{5}b)$ $= 3:2$
22. (a) (i) $(x+y)^2 = x^2 + 2xy = y + y^2 = 3^2$ $\therefore x^2 + 2xy + y^2 = 9$ (ii) $2xy = 9 - (x^2 + y^2)$ $= 9 - 29$ $= -20$ (iii) $(x - y)^2 = x^2 + y^2 - 2xy$ $= 29 - 20$ $= 49$ (iv) $x - y = \pm\sqrt{49}$ $= +7$ or -7 (b) $x + y = 3$ $\quad x + y = 3$ $x - y = 7$ $\quad x - y = -7$ $2x = 10$ $\quad 2x = -4$ $x = 5$ $\quad x = -2$ $y = -2$ $\quad y = 5$	B1 B1 B1 B1 B1 B1 B1 B1 8 mark	When x or y is substituted $x^2 + y^2 = 29$ ..... (1) $x = Y = 3$ ..... (2) $y = 3 - x$ or $x = 3$ $x = 5$ when $y = -2$ $x = 5$ when $y = -2$ 22(b) can be done at a (i)

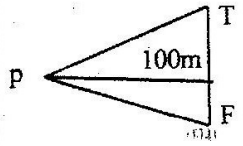
SOLUTION		
23. (a) Volume of hemishere $\frac{1}{2} \times \frac{4}{3} \times \frac{22}{7} \times 5.2^3$ 10.4 : 10:4 : :11: h -H = 3h Big cone V1 = $\frac{1}{3} \times \frac{22}{7} \times \frac{5.2}{3}^2 \times h$ Small cone $V_2 = \frac{1}{3} \times \frac{22}{7} \times \left(\frac{5.2}{3}\right) \times h$ V1 - V2 - $\frac{1}{3} \times \frac{22}{7} \times 5.2^2 \times \left(3 - \frac{1}{9}\right)h$ $\therefore \frac{1}{2} \times \frac{4}{3} \times \frac{22}{7} \times 5.2^2 \times \frac{26}{9} h$ $\frac{26}{9} h = 10.4$ $h = \frac{10.4 \times 9}{26} = 3.6$ Therefore height of the frustum = 2h = 7.2 cm (b) $L = \sqrt{3.62 + \left(\frac{5.2}{3}\right)^2} = 3.995$ $L = \sqrt{10.8^2 + 5.2^2} = 11.98$ Area = $\pi r^2 + \pi RL - \pi rl$ $= \frac{22}{7} \times 3 + \frac{22}{7} \times 5.2 \times 11.98 - \frac{22}{7} \times \frac{5.2}{3} \times 3.995$ = 9.429 + 195.8 - 21.76 = 183.469 = 183.5 cm^2	m1 m1 m1 A1 m1 m1 A1 8 marks	
24. (a) x 2 3 4 5 6 7 8 y 3 5 9 15 23 33 45 (b) A = 1 x 1 x {(3 + 45) + 2(5+9+15+23+33)} $= \frac{1}{2}(48 + 170)$ = 109 (109.25) (c) $\int_2^8 (x^2 - 3x + 5)dx$ $= \frac{x^3}{3} - \frac{3x^2}{2} + 5x \Big|_2^8$ $= \left(\frac{8^3}{3} - \frac{3 \times 8^2}{2} + 5 \times 5\right) - \left(\frac{2^3}{3} - \frac{3 \times 2^2}{2} + 5 \times 2\right)$ = 108 (d) it would given an underestimate because the line for the trapezia run below the curve in the region	B1 m1 m1 A1 m1 m1 A1 B1 8 marks	Accept 23,75, 33, 25 (graph)

K.C.S.E 1999 MATHEMATICS PAPER 121/2 MARKING SCHEME

SOLUTION	MARKS	ALTERNATIVE METHOD
1. NO | LOG 0.97 | 0.8319 0.3911 | $\bar{1}$.5923 + | 0.4242 Log 5 = 0.6990 | 1.8445 0.5797 | (0.5797÷4) x 3 | 0.1449 1.7391 : 4 | x 3 2.721 ⇐ (0.4347) | 0.4347	M1 M1 A1	Logs of numbers in numerator for 1.8445 and operators inside brackets M1 Power used
2. $2 \leq 3 - x$ $\quad 3 - x < 5$ $-1 \leq -x$ $\quad -x < 2$ $1 \geqslant x$ $\quad x > -2$ $-2 < x \leqslant 1$ or $1 \geqslant x > -2$	 B1 2	B1 for inequlities rightly solved
3. a) Mass of maize in 5/8 x 72 = 45 kg (b) Beans in A and B = 8/17 x 170 or maize = 9/17 x 170 = 80 kg = 90 kg mixture B Beans 80 - 27 = 53 kg Maize 90 -45 = 45 kg Ratio 53 : 45 1.1778:1	B1 M1 M1 A1 4	ALT METHOD Let kg of maize in B be y $\frac{45+y}{170} = \frac{9}{17}$ $\Rightarrow y = 45$ Beans in B 98 - 45 = 53 M1
4. $2^{2x} \times 5^{2x}$ or $(2^{2x} \times 5^{2x})$ $(2 \times 5)^{2x \times \frac{1}{2}} = 10^{x}$	M1 A1	Ratio 53:45
5. Premium = sh. 6750 x $\frac{100}{4.5}$ = 150000 (b) Amount earned = 1/3 x 4.5 x 150000 M1 or 6750 x 2.3 x 90.100 100 x 100 = Sh. 2025	 B1 A1	or $6750 \times \frac{1}{3} \times \frac{90}{100}$
6. Let $\log_3 x = y$ $y^2 - \frac{1}{2}y = 3/2$ $2y^2 - y - 3 = 0$ $(2y - 3)(y + 1) = 0$ $y = 3.2$ or $y = -1$ $\text{Log } x = \frac{3}{2}$ or $\log x = -1$ $x = 3^{\frac{3}{2}}$ or $x = 3^{-1}$ $x = 5.196\ (3\sqrt{3})$ or $x = 1$	 M1 A1 M1 A1 4	For correct factorization correct sub equivalent Correctly interpreting at least one ans. (✓) for both
7. a) $y = \frac{1}{5}x + 2$ gradient = $\frac{1}{5}$ (b) $m \times \frac{1}{2} = -1 \Rightarrow m = -3$ Equation $\frac{y-2}{x-1} = -5$	B1 M1 M1	

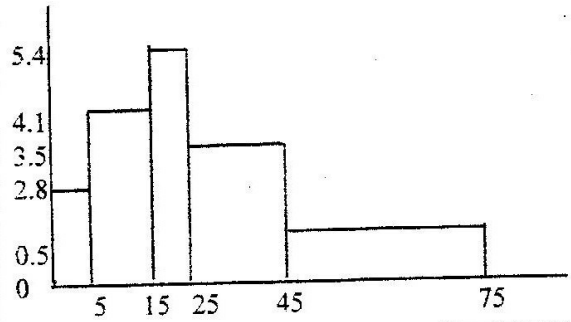
SOLUTION	MARKS	ALTERNATIVE METHOD
8. 		
Area one = $^1/_2$ x 5 x 5 sin 60° Area of 6 = 6 x $^1/_2$ x 5 x 5 x 0.8660 or $^1/_2$ x 5 x 4.33 x 6 x $^1/_2$ x 5 x 5 3 x 6 = 64.95 or $\frac{\sqrt{75}}{2}$	M1 A1 3	6 $\sqrt{7.5(7.5.5)(7.5-5)9-5}$ $\sqrt{8.75}$ = 4.330
9. Let dist. covered by bus be x km $\frac{x}{60} = \frac{220 - X + {}^3/_4}{80}$ m1 4x = 3(220 - x) + 3 x 60 4x = 660 - 3x + 180 4x = 660 - 3x + 180 m1 7x = 840 x = 120 Dist. bus covered 1.25 x 60 + 45	m1 M1 M1 A1	ALT. METHODS Let time taken when both are moving to be 1 hour 1. 60(t + 3/4) = 220 - 809t M1 = t = 11/4h M1 time bus moving = 11.4 - 3.4 = 21 Dist bus covered = 2 x 60 M1 = 120 2. Relative velocity = 140 .: time taken $\frac{220 - {}^3/_4 \times 60}{140}$ M1 = 1.25 h M1 = 120 A1
10. $(0.96)^5 = (1-0.04)^5$ = 1 + 5(-0.04) + 10(-0.04)^2 + 10(-0.04)^3+ = 1-0.2 + 0.016 - 0.0000001024) = 0.81536 (0.8153728 or 0.8153726976) = 0.8154 (to 4 s.f.)	M1 M1 A1 B1 4	Accept for up to all terms For this binomial up to 4 terms correctly (✓) at least one M1 earned.
11. 	B1 B1 B1 3	For line thro') ⊥ BC or ⊥ O0A Any second part drawn Completing the figure

SOLUTION	MARKS	ALTERNATIVE METHOD
12. $8^2 + 2S - 3 = (4s + 3)(2S - 1) = 0$ $S = -3/4$ OR $s = 1/2$ sINE $= 1/2 = \theta = 30^o$ OR 150^o For all θ + ve no ow -1	M1 A1 4	for both ✓| apply ✓| for ✓ us of his values S 2. OW - 1 if values of btw 180o & 360o inclusive
13. No of people $= {}^{360}/_{144} \times 1080 = 2700$ No of children $= 2700 - (510 + 1080)$ 1110 L of children $\frac{1110 \times 360}{2700}$ 148^o	M1 M1 A1	ALT METHOD 1. let x be no of children $\frac{510 + x}{1590 + x} = \frac{216}{360}$ M1 $x = 1110$ 2. L for me $= \frac{510 \times 144}{1080}$ M1 $= 68$ 2 Q 1 R For children 216 - 68 M1 $= 148o$
14. $OQ = {}^1/_3(2i + 3j + 13k) + {}^2/_3(5i - 3j + 4k)$ or $(2i + 3j + 13k) + {}^2/_3(3i - 6j - 9k)$ $= 4j - j + 7k$ $OQ = \sqrt{4^2 + (-1)^2 + 7^2} = \sqrt{66}$ $= 8.124$	M1 A1 B1✓	 $PR = (5i - 3j + 4k) - (2i + 3j + 3k)$ $= 3i - 6j - 9k$ accept $\begin{pmatrix} 4 \\ -1 \\ 7 \end{pmatrix}$
15. Ratio of work $= T_2 = {}^1/_6 - {}^1/_{15}$ $= {}^1/_{10}$ Time needed by $T_2 = {}^1/_3 \div {}^1/_{10}$ $3{}^1/_3$ days	M1 M1 A1	
16. $(x^2 + 1)(x - 2) = x^3 - 2x^2 + x - 2$ $dy/dx = 3x^2 - 4x + 1$ When $x = 2$ ${}^{dy}/_{dx} = 5$ $y = 0$ $\frac{y - 0}{x - 2} = 5$ $y = 5x - 10$	M1 M1 A1	

SOLUTION	MARKS	ALTERNATIVE METHOD
17. (a) B.P. per Kg = $\frac{40 \times 65 + 60 \times 27.50}{100}$ = Sh. 42.50	M1 A1	
(b) S.P. = $\frac{85 \times 120}{100}$ Sh. 102 per pkt	M1 A1	(✓)
(ii) New S.P = $102 \times {}^{90}/_{100}$ = Sh. 91.80	B1	Depends on the 1st M or 2nd M or 2nd M mark earned
(iii) Total realised so far 8x 102 ÷ 1285.20 - 2101.20 816 ÷ 1285.20 - 2101.20 Original total S.P. 102 x 50 = 5100	M1	or 42.50 x 1.2 x 100
New price per packet = $\frac{5100 - 2101.20}{28}$		18 in 1 sin PQT = $\frac{1005 \text{ in } 60°}{88.88}$ = 100 x 0.866 = $\frac{0.9743}{88.88}$ <PQT = 76.59°
Sh. 107.10	A1	p=360 - (76.5 + 30) Or equivalent
	8	
18. (a) 100 tan 15° or 100 tan 1° Height = 100 x 0.2679 : 100 x 0.0175 = 28.54 m	M1 M1 A1	
b) $PQ^2 = 100^2 + 70^2 - 2 \times 100 \times \cos 60°$ $= 100^2 + 70^2 - 2 \times 100 \times 70 \times 0.5$ $PQ = \sqrt{7900} = 88.88$ m	M1 A1	
19.		

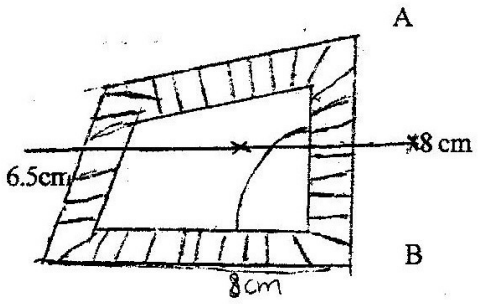
Class	x<5	x<15	x<25	x<45	x<75
5	14	20.5	29.5	17.5	2.5
10	28	41	29	35	5
H.f.w	2.8	4.1	5.9	3.5	0.5

mean of x = $\frac{4975}{199}$ M1



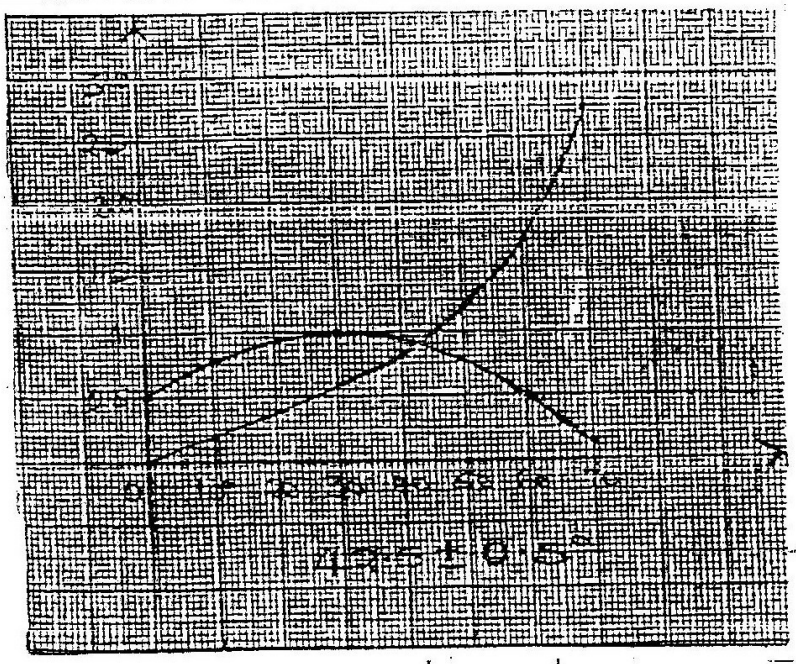
S1 ✓ use of scale
B1 for appropriate height

For complete ✓ histogram
Allow B1 for 3 bars
Apply ✓ if at least 3 heights

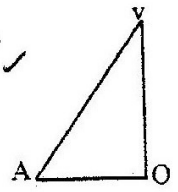
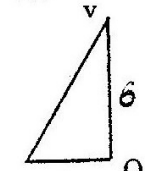
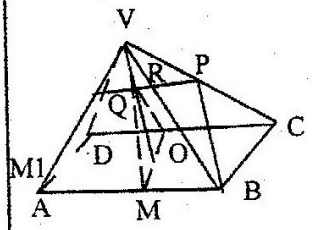
SOLUTION	MARKS	ALTERNATIVE METHOD
20.(a) $n/2\ (4 + 20) = 252$ $n = 504/24 = 21$ $21/2\{2\times4 + (21-1)d\} = 252$ $21(8 + 20d) = 504$ $d = 16/20 = 4/5$ b) $50 \times 1.8^n = \frac{12000\ 000}{50}$ $n \times 0.2553 = 4.3802$ $n = \frac{4.3802}{0.2553}$ $= 17.16$ Time taken 17.16×20 $= 343.2$ minutes (5.72h)	M1 A1 M1 A1 M1 M1 A1 B1	 ✓ Allow $50 \times 1.8 = 1200000$ $(n-1) \times 0.2553 = 4.3802$ Allow if sum of GP used $n - 1 = 17.16$ (✓)
21. Bisector of AB drawn interpretation of the scale path 1-0.1 cm wide all round There are 3.5 0.1 cm from B d n five points 1 cm apart on bisector of AB  	B1 B1 B2 B1 B2	 may be implied (✓) allow B1 2 Allow B1 for 3 points shown Apply all-1 for p tree in wrong region.

SOLUTION	MARKS	ALTERNATIVE METHOD
22.	B1 B1 S1 P1 C1 B1 8	Apply all -1 if not given to 2 dp ✓ scale used (✓) for sine curve (✓)

x	0	10	20	30	40	50	60	70
10mx	0	0.8	0.36	0.58	0.84	1.19	1.73	2.75
2x+30	30	50	70	90	110	130	150	170
0.50	0.77	0.94	1	0.94	0.77	0.50	0.17	



23. a = 15, 17c = 8, 17b = -8, 17d = 15 $A = \begin{bmatrix} {}^{15}/_{17} & {}^{8}/_{17} \\ {}^{8}/_{17} & {}^{15}/_{17} \end{bmatrix}$ (b) cos = $^{15}/_{17}$ = 0.8824 (or Sin = $^{8}/_{17}$ or tan = $^{8}/_{15}$ ∴ = 28° 4 (28.07°)	M1 A1 M1	Multiplication and equating Allow for image and scale drawing (28+ 1°) General matrix for rotation cose -sine sine cose
c) S(O) = $\begin{pmatrix} 3 \\ 6 \end{pmatrix}$ $\begin{bmatrix} {}^{15}/_{17} & {}^{-8}/_{17} \\ {}^{8}/_{17} & {}^{15}/_{17} \end{bmatrix} \begin{pmatrix} 3 \\ 6 \end{pmatrix} = \begin{bmatrix} {}^{83}/_{13} \\ {}^{114}/_{12} \end{bmatrix}$ Image of (1,0) - ($^{3}/_{17}$ $^{114}/_{12}$)	B1 M1 A1 8	

SOLUTION	MARKS	ALTERNATIVE METHOD
24.(a) OA = $\frac{1}{2}\sqrt{(3^2 + 4^2)}$ ✓ 	M1	Identification or calcution to obtain θA
2.5 ✓		
(ii)  M 1.5		
$\tan \alpha = 6/12 = 4$ $\alpha = 75° 58 (75\ 96)$	M1 A1	
Identification of < VMR Tan β = 3 / $2^1/_4$ = 1.333 β = 53°7	A1	
θ = 75° 58 - 53° 7		53 ($^3/_2$)
= 22° 51'	B1	(22 $\sqrt{(3)}$ /4 }