

ALLIANCE GIRL'S HIGH SCHOOL
Mathematics 121/2

MARKING SCHEME

SECTION A (50 Marks)

No	Log	
$(2.62 \times 10^5)^{1/2}$	$\frac{3.4185}{2}$	✓ M1 - All logs correct ✓ M1 correct +, -, ÷ ✓ Answer A1
	$= 4 + 1.4185 \div 2$	
	$= 2.7093$	
44.79	$\frac{1.6512 +}{0.3605}$	
3.965	$\frac{0.5982 -}{1.7623}$	
0.5785	\leftarrow	

3 marks

2. a) $5 - - 7 = 12$

B1

b) $2^2 - (-7)^2 = M1$
 $4 - 49 = -45 \quad A1$

3 marks

3. $\frac{y^2}{x^2} = \frac{e^2}{a^2 + x^2}$
 $a^2 y^2 + x^2 y^2 = x^2 e^2$ M1 removal of $\sqrt{\quad}$ sign
 $x^2 y^2 - x^2 e^2 = -a^2 y^2$
 $x^2 (y^2 - e^2) = -a^2 y^2$ M1
 $x^2 = \frac{-a^2 y^2}{y^2 - e^2}$
 $x = \pm \sqrt{\frac{-a^2 y^2}{y^2 - e^2}}$ A1

Alt
 $x^2 = \frac{a^2 y^2}{e^2 - y^2}$
 $x = \pm \sqrt{\frac{-a^2 y^2}{e^2 - y^2}}$

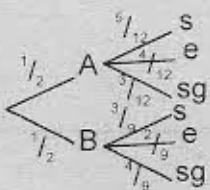
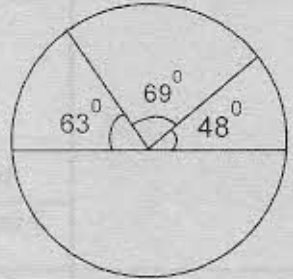
3 marks

4. $P \propto \frac{x^2}{\sqrt{y}}$ | $\text{New P} = \frac{(1.25)^2 kx^2}{\sqrt{0.64} \sqrt{y}}$ M1
 $P = \frac{kx^2}{\sqrt{y}}$ | $= 1.9531P$ M1
 % change in P = 95.31% increase

3 marks

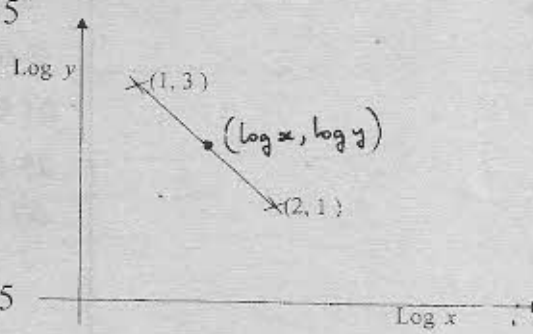
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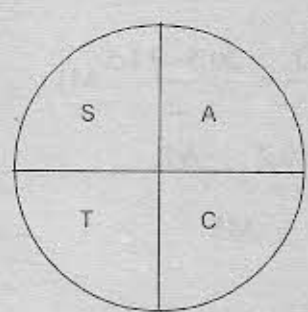
<p>5. Coefficients 1, 5, 10, 10</p> $\left(2x - \frac{y}{2}\right)^5 = 1(2x)^5 + 5(2x)^4\left(-\frac{y}{2}\right) + 10(2x)^3\left(-\frac{y}{2}\right)^2 + 10(2x)^2\left(-\frac{y}{2}\right)^3$ $= 32x^5 - 40x^4y + 20x^3y^2 - 5x^2y^3$ <p>Hence</p> $19.95^5 = \left(20 - \frac{0.1}{2}\right)^5 = \left(2x - \frac{y}{2}\right)^5$ $x = 20, y = 0.1$ $(19.95)^5 = 32(10)^5 - 40(10)^4(0.1) + 20(10)^3(0.1)^2 - 5(10)^2(0.1)^3$ $= 3,160,199.5 \approx 3,160,000$	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>7 marks</p>
<p>6.</p> $= \frac{(1 + \sqrt{2})(\sqrt{5} - \sqrt{3}) + (1 - \sqrt{2})(\sqrt{5} + \sqrt{3})}{((\sqrt{5} + \sqrt{3})(\sqrt{5} - \sqrt{3}))}$ $= \frac{\sqrt{5} - \sqrt{3} + \sqrt{10} - \sqrt{6} + \sqrt{5} + \sqrt{3} - \sqrt{10} - \sqrt{6}}{5 - 3}$ $= \frac{2\sqrt{5} - 2\sqrt{6}}{2} = \sqrt{5} - \sqrt{6}$	<p>M1</p> <p>M1</p> <p>A1</p> <p>3 marks</p>
<p>7. $\underline{OD} = \frac{1}{2}\underline{OA} + \frac{1}{2}\underline{OB}$</p> $\underline{OD} = \frac{1}{2}\begin{pmatrix} 3 \\ 6 \\ 4 \end{pmatrix} + \frac{1}{2}\begin{pmatrix} -1 \\ 4 \\ 2 \end{pmatrix} = \begin{pmatrix} 1 \\ 5 \\ 3 \end{pmatrix}$ $\underline{CD} = \underline{d} - \underline{c} = \begin{pmatrix} 6 \\ -7 \\ 0 \end{pmatrix} + \begin{pmatrix} 1 \\ 5 \\ 3 \end{pmatrix} = \begin{pmatrix} -5 \\ +12 \\ +3 \end{pmatrix}$	<p>M1A1</p> <p>B1</p> <p>3 marks</p>
<p>8. $V = \frac{ds}{dt} = 16t - 6t^2$</p> <p>at $t = 3$</p> $V = 16(3) - 6(3)^2$ $= 48 - 54$ $= -6\text{m/s}$	<p>M1</p> <p>A1</p> <p>2 marks</p>

<p>9. 6^{th} term $a + 5d = 5\frac{1}{2}$</p> <p>12^{th} term $a + 11d = 8\frac{1}{2}$</p> <hr style="width: 20%; margin-left: 0;"/> <p>$-6d = -3$</p> <p>$d = \frac{1}{2}$</p> <p>$a = 3$</p> <p>$540 = \frac{40}{2}(2(3) + 39(0.5)) = 510$</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>3 marks</p>
<p>10. $P = 450,000, n = 4 \quad R = 7.5\%$</p> <p>$A = P\left(1 + \frac{R}{100}\right)^n$</p> <p>$A = 450,000\left(1 + \frac{7.5}{100}\right)^4$</p> <p>$= 600,961.10$</p>	<p>B1</p> <p>M1</p> <p>A1</p> <p>3 marks</p>
<p>11.</p>  <p>$P(A \text{ sg or } B \text{ sg})$</p> <p>$= \frac{1}{2} \times \frac{3}{12} + \frac{1}{2} \times \frac{4}{9}$</p> <p>$= \frac{3}{24} + \frac{4}{18}$</p> <p>$= \frac{25}{72}$</p>	<p>M1</p> <p>M1</p> <p>A1</p> <p>3 marks</p>
<p>12.</p>  <p>Distance = 69×60</p> <p>$= 4140\text{nm}$</p>	<p>M1</p> <p>A1</p> <p>2 marks</p>
<p>13. Water 400ml</p> <p>vol of Ethanol $\frac{40}{100} \times 200 = 80\text{ml}$</p> <p>After removal</p> <p>Ethanol 320ml</p> <p>Water 480ml</p> <p>+ 200 \checkmark M1</p> <p>Adding water 320ml : 680ml</p> <p>Ethanol 600ml</p> <p>$\frac{60}{100} \times 200 = 120\text{ml water}$</p> <p>% of Ethanol</p> <p>$= \frac{320}{1000} \times 100 \checkmark$ M1</p> <p>$= 32\% \checkmark$ A1</p>	<p>3 marks</p>

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14.	$AB = \begin{pmatrix} 2 & 1 \\ -3 & 4 \end{pmatrix} \begin{pmatrix} 1 & -2 \\ 3 & 1 \end{pmatrix} = \begin{pmatrix} -3 & -3 \\ -1 & 1 \end{pmatrix}$ $2AB = 2 \begin{pmatrix} 5 & -3 \\ 9 & 10 \end{pmatrix} = \begin{pmatrix} 10 & -6 \\ 18 & 20 \end{pmatrix}$ $C^{-1} = \frac{1}{2} \begin{pmatrix} 1 & 0 \\ 1 & 2 \end{pmatrix} = \begin{pmatrix} \frac{1}{2} & 0 \\ \frac{1}{2} & 1 \end{pmatrix}$ $3C^{-1} = 3 \begin{pmatrix} \frac{1}{2} & 0 \\ \frac{1}{2} & 1 \end{pmatrix} = \begin{pmatrix} 1.5 & 0 \\ 1.5 & 3 \end{pmatrix}$ $M = \begin{pmatrix} 10 & -6 \\ 18 & 20 \end{pmatrix} - \begin{pmatrix} 1.5 & 0 \\ 1.5 & 3 \end{pmatrix}$ $= \begin{pmatrix} 8.5 & -6 \\ 16.5 & 17 \end{pmatrix}$	M1
		M1
		M1
		A1
		3 marks

15.	$\text{Log}_{10} A = 5$ $A = 10^2$ $x^2 y = 10^5$ $y = \frac{10^5}{x^2}$ $y = -2x + 5$		$\frac{\text{Log } y - 1}{\text{Log } x - 1} = -2$ $\text{Log } y - 1 = -2 \text{Log } x + 24$ $\text{Log } y = 2 \text{Log } x + 5$ $\text{Log } y = n \text{Log } x + \text{Log } A$ $\text{Log } y + 2 \text{Log } x = 5$ $\text{Log } y + \text{Log } x^2 = 5$ $\text{Log } (x^2 y) = 5 = \text{Log } A$	
	$n = \text{Gradient of line} = \frac{3-1}{1-2} = -2$ Equation of line in $\text{Log } y = n \text{Log } x - \text{Log } A$ Subst. pt (2,1) $\text{Log } y - 1 = -2(\text{Log } x - 2)$ $\text{Log } y + 2 \text{Log } x = 5$ $\text{Log } (yx^2) = 5 \quad \text{M1}$	$yx^2 = 10^5 \quad \text{M1}$ $y = 10^5 x^{-2}$ $A = 10^5, n = -2 \quad \text{A1}$		
			4 marks	

16.	$\sin^2 x + \cos^2 x = 1$ $\Rightarrow \cos^2 x = 1 - \sin^2 x$ $2 - \sin x = 1 - \sin^2 x + 7 \sin^2 x$ $2 - \sin x = 1 + 6 \sin^2 x$ $6 \sin^2 x - \sin x - 1 = 0 \quad \checkmark \text{ M1}$ Let $\sin x = t$ $6t^2 + t - 1 = 0$		
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$$(3t+1)(2t-1)=0 \quad \checkmark \text{ M1}$$

$$(3 \sin x + 1)(2 \sin x - 1) = 0$$

$$3 \sin x + 1 = 0 \Rightarrow \sin x = -\frac{1}{3}$$

$$x = 160.33^\circ, 19.47^\circ \quad \text{B1}$$

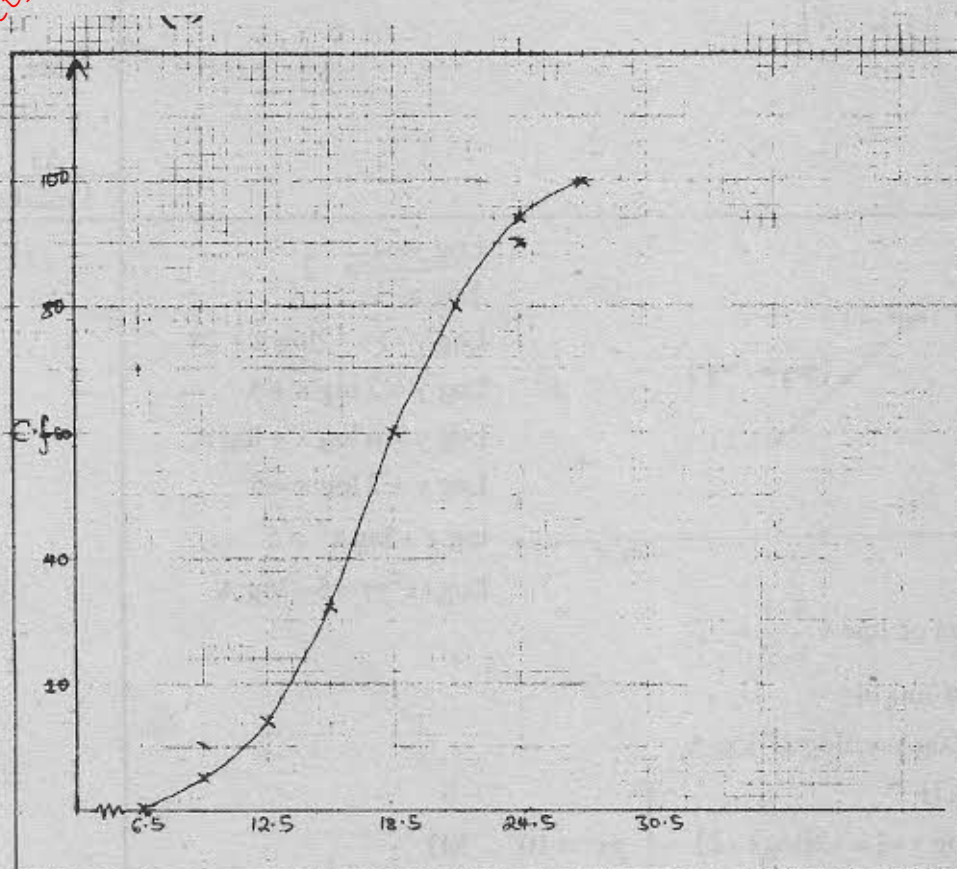
$$2 \sin x - 1 = 0$$

$$\sin x = \frac{1}{2}$$

$$x = 30^\circ, 150^\circ \quad \checkmark \quad \text{B1 (Both values)}$$

4 marks

17a) C.F 5 14 32 60 80 94 100



U.C.L	C.f
6.5	0
9.5	5
12.5	14
15.5	32
18.5	60
21.5	80
24.5	94
27.5	100

b) (i) Median = 17.5

$$\left. \begin{array}{l} \text{ii) } Q_3 = 20.5 \\ Q_1 = 14.5 \end{array} \right\} \text{M1} \quad \frac{Q_3 - Q_1}{2} = \frac{20.5 - 14.5}{2} \text{M1}$$

$$= 3 \pm 0.2 \quad \text{A1}$$

iii) $90 - 60 = 30$ students M1

$$\% = \frac{30}{100} \times 100 \quad \text{M1}$$

$$= 30\% \pm 1 \quad \text{A1}$$

18.a)



Correct sketch

$$AC^2 = 400^2 + 600^2 - 2(400)(600)\cos 65$$

$$AC = 317.143.23$$

$$AC = 563.15\text{km}$$

M1

M1

A1

b)

$$\frac{563.15}{\sin 65^\circ} = \frac{600}{\sin C}$$

$$\therefore \sin C = \frac{600 \sin 65^\circ}{563.15}$$

$$\sin C = 0.9656$$

$$\therefore C = 74.93^\circ$$

$$\therefore 360^\circ - (74.93 - 60)$$

\therefore From C

$$360^\circ - (74.93 - 60)$$

$$= 345^\circ.07$$



c)

Shortest distance is a \perp from B to AC

$$\sin 40.07 = \frac{x}{600}$$

$$x = 600 \sin 40.07 \quad \text{M1}$$

$$= 386.23\text{km}$$

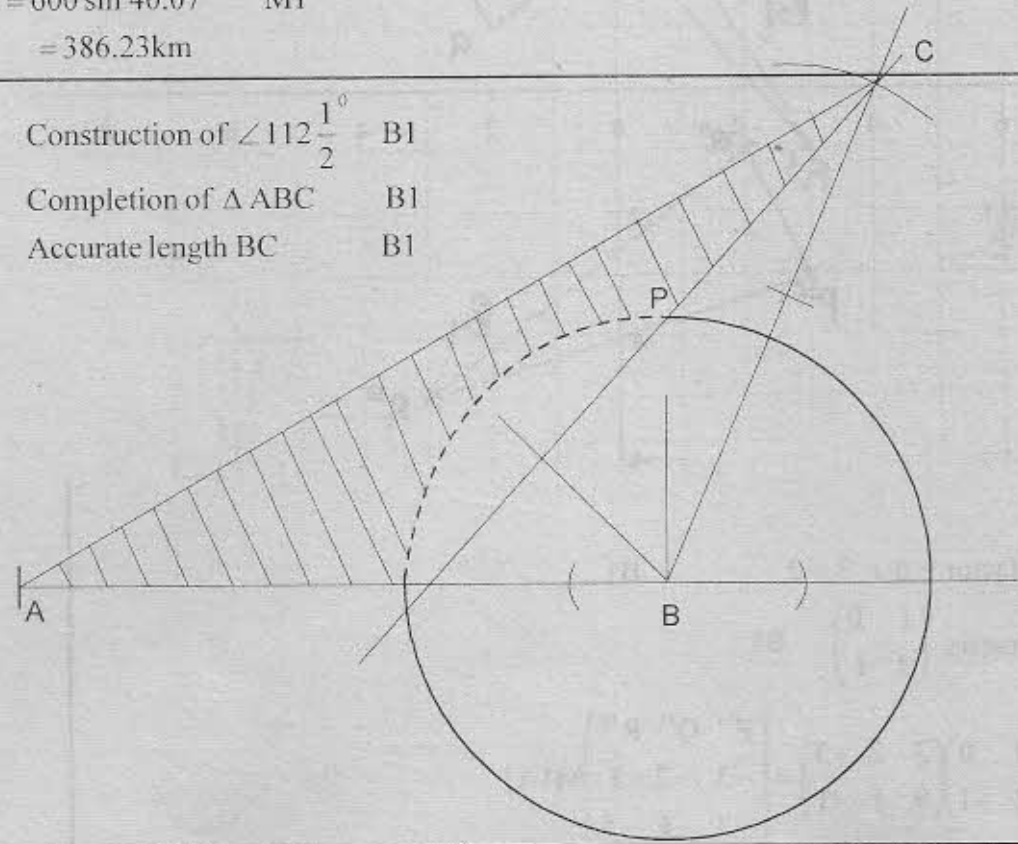
10 marks

19.

Construction of $\angle 112 \frac{1}{2}^\circ$ B1

Completion of ΔABC B1

Accurate length BC B1



10 marks

19. (i) 13.1 cm + 0.1 B1

(ii) a) Circle centre B radius 3.5cm B1

b) Bisector of $\angle ACB$ B1

(iii) Correct position P B1

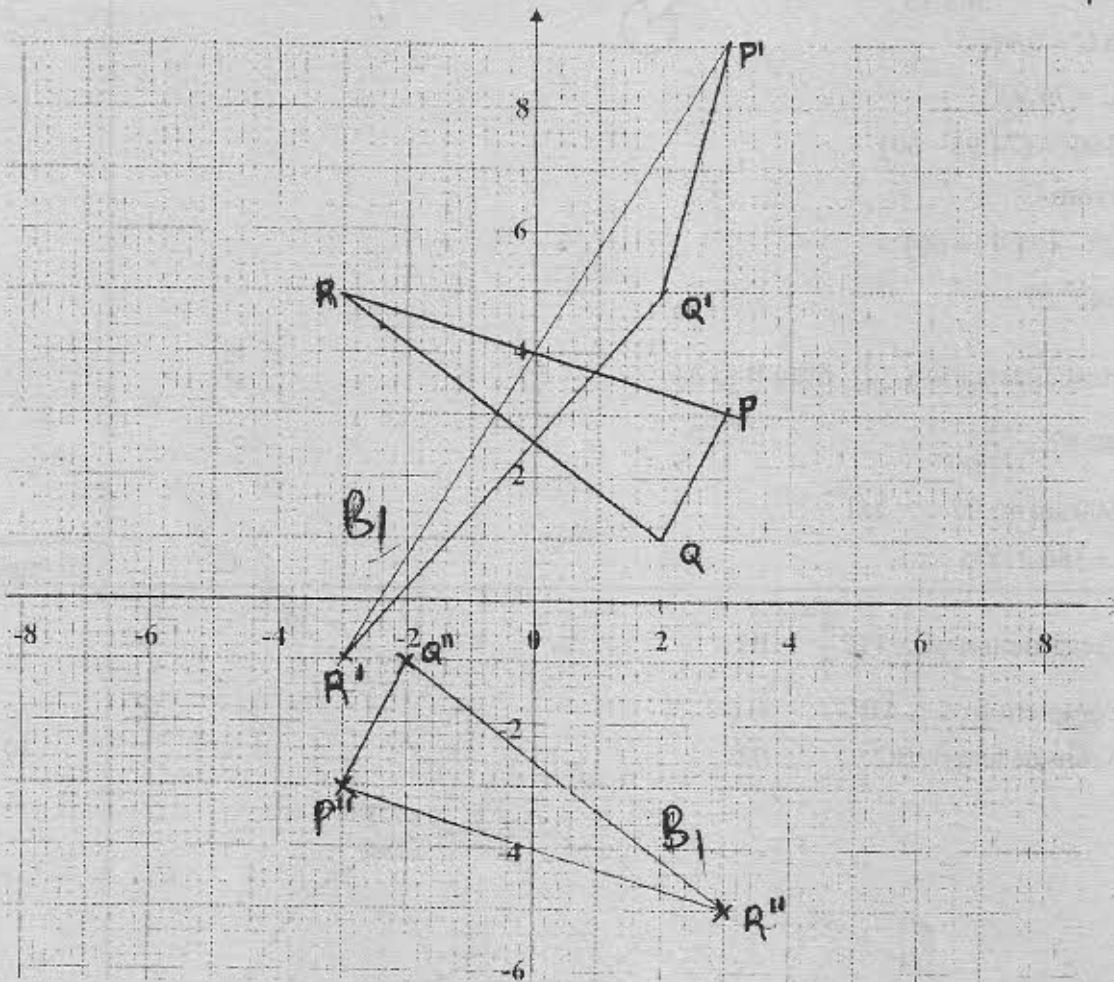
9.2cm + 0.1 B1

(iv) Circular part of circle dotted B1

Correct shaded part B1

10 marks

20. (i)



(ii) Shear factor = $6 \div 3 = 2$ B1

Shear matrix $\begin{pmatrix} 1 & 0 \\ 2 & 1 \end{pmatrix}$ B1

b) $\begin{pmatrix} -1 & 0 \\ 2 & -1 \end{pmatrix} \begin{pmatrix} 3 & 2 & -3 \\ 9 & 1 & -1 \end{pmatrix} = \begin{pmatrix} P'' & Q'' & R'' \\ -3 & -2 & 3 \\ -3 & -1 & -5 \end{pmatrix}$ M1A1

(iii) Rotation B1 of $+180^\circ$ about $(0,0)$ B1

(c) Combined matrix $\begin{pmatrix} -1 & 0 \\ 2 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ 2 & 1 \end{pmatrix} = \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$ M1

Inverse matrix $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$ A1

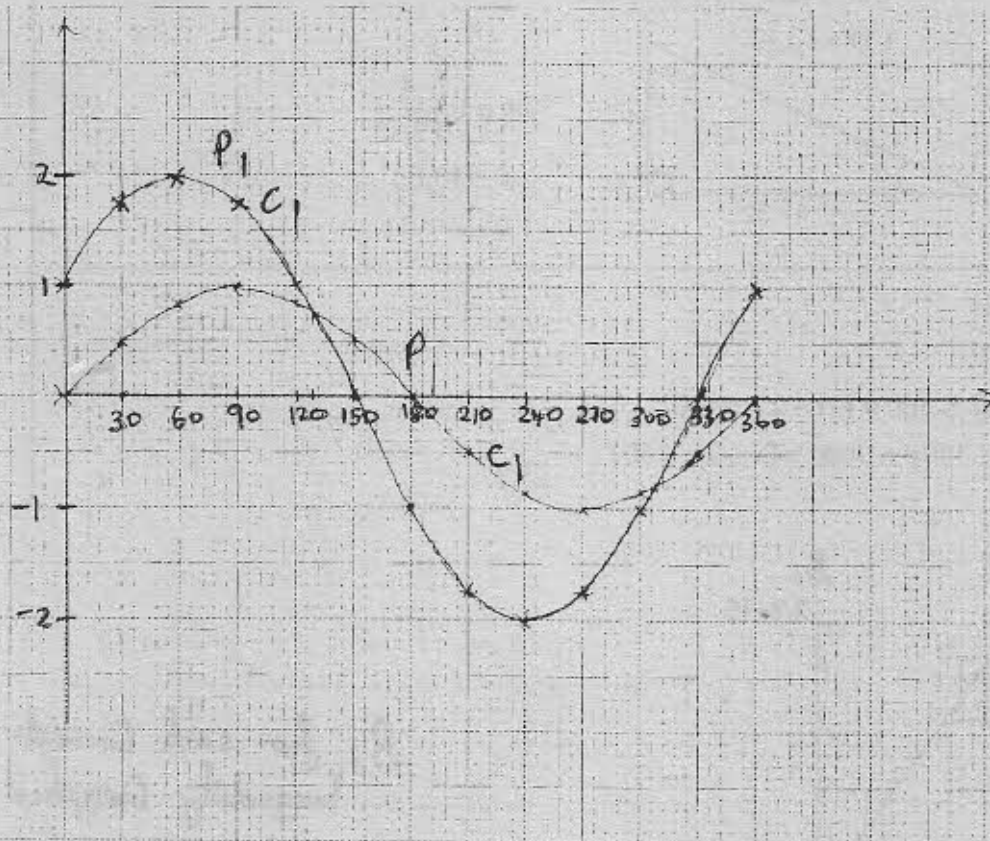
10 marks

21. a)

X	0	30	60	90	120	150	180	210	240	270	300	330	360°
$\sin x$	0	0.5	0.87	1	0.87	0.5	0	-0.5	-0.87	-1	-0.87	-0.5	0
$2\sin(x+30)$	1	1.73	2	1.73	1	0	-1	-1.73	-2	-1.73	-1	0	1

B2

b)



c) $2 \sin(x + 30) = \sin x$
 $x = 129^\circ \pm 3^\circ$ B1 and $309 \pm 3^\circ$
 B1

d) Stretch along y-axis $\times 2$ ✓ B1
 and a translation vector $\begin{pmatrix} -30 \\ 0 \end{pmatrix}$ ✓ B1

10 marks

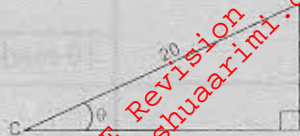
22. a) $CF = AE = 20\text{cm}$

(Diagonal of a rectangle)

OR (Alt methods)

b)

Vertical height of isosceles $\Delta = 8\text{cm}$



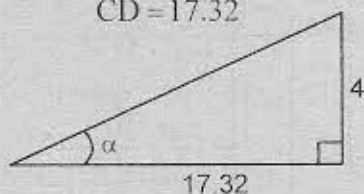
$$\sin \theta = \frac{8}{20}$$

$$\theta = 23.58^\circ$$

$$AC = \sqrt{8^2 + 6^2} = 10$$

$$CD = \sqrt{20^2 - 10^2} = \sqrt{300}$$

$$CD = 17.32$$



$$\tan \alpha = \frac{4}{17.32}$$

$$\alpha = 13.00^\circ$$

B1

B1

M1

A1

M1

M1

A1

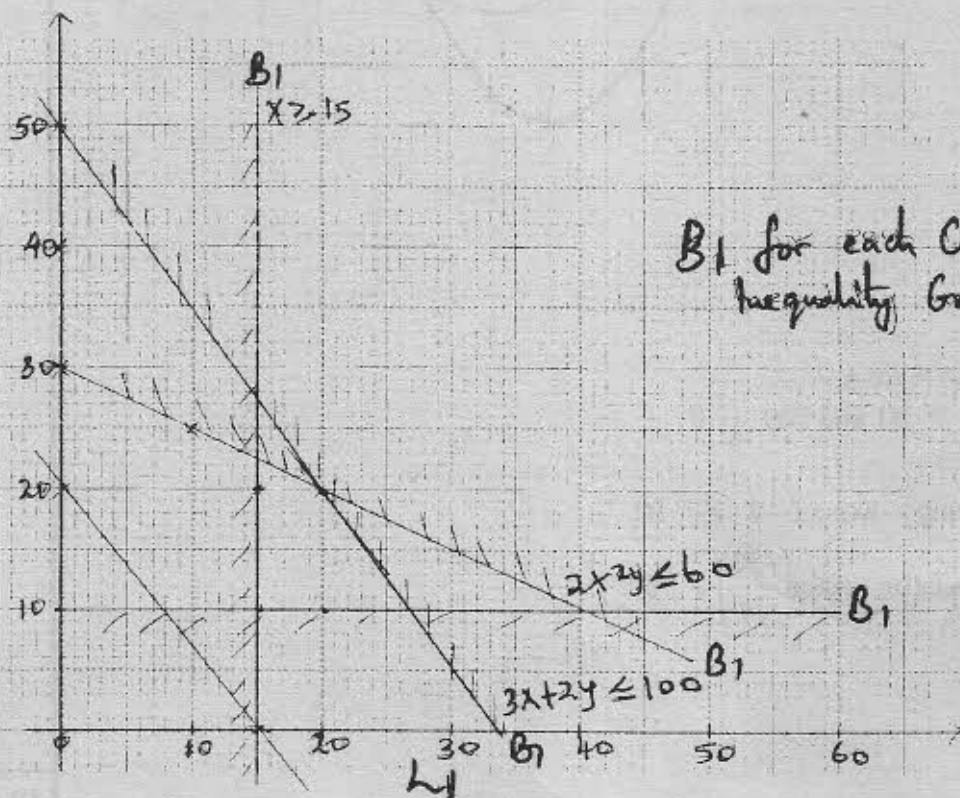
10 marks

23. a) $x \geq 15$
 $y \geq 10$

$$9x + 6y \leq 300 \Rightarrow (3x + 2y \leq 100)$$

$$150x + 300y \leq 9000 \Rightarrow (x + 2y \leq 60)$$

b)



B1 for each correct inequality Graphed

Search line

B1

B1

B1

<p>c) Objective function $80x + 60y = \max P$ Search line $4x + 3y = 60$ Max. point (20,20)</p>	<p>M1 A1 10 marks</p>
<p>24. a) $y = (x-2)^2 - 4x^2 + 4x$ $\frac{dy}{dx} = 3x^2 - 8 + 4$ M1 At point (1,1) Grad = $3 - 8 + 4 = -1$ M1</p> <p>b) $A = \int_0^2 (x^3 - 4x^2 + 4x) dx - \int_0^1 (x^3 - 4x^2 + 4x - x) dx$ M1 M1</p> <p>$\left[\frac{x^4}{4} - \frac{4x^3}{3} + 2x^2 \right]_0^2 - \left[\frac{x^4}{4} - \frac{4x^3}{3} + \frac{3x^2}{2} \right]_0^1$ M1 M1</p> <p>$-1 \frac{1}{3} - \frac{5}{12} = \frac{11}{12}$ M1 A1</p>	<p>$\frac{y-1}{x-1} = -1$ M1 $y = -x + 2$ or $y + x = 2$ } A1</p> <p>10 marks</p>