QUESTION 1

FINAL VERSION 8/11/2002

1.1 1.1.1	$(2x+3)(3-x)=4$		
	$-2x^2+3x+9-4=0$		✓ correct expansion of LHS
	$2x^2-3x-5=0$		✓ std form (-1 if not = 0)
	$(2x-5)(x+1)=0$		✓ both factors
	$x=\frac{5}{2}$ *or* $x=-1$	(4)	✓ both answers, none rejected
1.1.2	$x+2\sqrt{x}-8=0$		
	$(\sqrt{x}+4)(\sqrt{x}-2)=0$		✓✓ factorisation, M/A [if $(\sqrt{x}-4)(\sqrt{x}+2)=0$ ✓]
	$\sqrt{x}=-4$ *or* $\sqrt{x}=2$		✓ both answers
	N/A $\therefore x=4$		
	since $\sqrt{x}\geq 0$	(5)	✓ ✓ rejecting one & accept the other
	OR		
	$(x-8)^2=(-2\sqrt{x})^2$		✓ squaring both sides
	$x^2-16x+64=4x$		
	$x^2-20x+64=0$		✓ std form
	$(x-16)(x-4)=0$		✓ factors
	$x=16$ *or* $x=4$		✓ $x=4$
	N/A	(5)	✓ rejecting $x=16$
	OR		
	$y^2+2y-8=0$		✓ Let $y=\sqrt{x}$
	$(y+4)(y-2)=0$		✓ factorisation
	$y=-4$ *or* $y=2$		✓ 2 y- values
	$16+2\sqrt{16}-8=16\neq 0$ NA		✓ rejecting $x=16$
	$4+2\sqrt{4}-8=0$ $\therefore x=4$	(5)	✓ accepting $x=4$
			If $x^2+2x-64=0$ $\frac{0}{5}$
1.1.3	$(x^2+1)(x-1)=0$		
	$x^2+1=0$ *or* $x-1=0$		✓ interpretation
	$x=1$	(2)	✓ answer

If $x = \pm\sqrt{-1}$ or 1 – (2 marks)

If $x = \sqrt{-1}$ or 1 – (1 mark)

If $x = \pm\sqrt{-1}$ (0 marks)

Answer only: x= 1 (2 marks)

1.1.4 $| 4 - x | \le 20$

$-20 \le 4 - x \le 20$ ✓ removing | |

$-24 \le -x \le 16$ ✓ transposing 4

$x \le 24$ *and* $x \ge -16$ ✓ changing inequality. Sign

✓ correct values

Or $-16 \le x \le 24$ (4) If or / ; -1

ALTERNATIVE

$| 4 - x | \le 20$ ✓ squaring both sides

$| 4 - x |^2 \le 20^2$

$16 - 8x + x^2 \le 400$

$x^2 - 8x - 384 \le 0$ ✓ std form

$(x - 24)(x + 16) \le 0$ ✓ factors

$-16 \le x \le 24$ (4) ✓ answer

ALTERNATIVE

$| 4 - x | \le 20$

$4 - x \le 20$ $\quad -(4 - x) \le 20$ ✓ definition

$-x \le 16$ $\quad x \le 24$ ✓ accuracy

$x \ge -16$ $\quad x \le 24$ ✓ two inequalities

$-16 \le x \le 24$ (4) ✓ answer

1.2 $\frac{3 - x}{x + 7} \ge 0$ ✓ ✓ removing √ & setting inequality

If start with $\sqrt{\frac{3 - x}{x + 7}} \ge 0$ BD max $\frac{3}{5}$

* = 0 1 mark

both 3 and -7 1 mark

If no ≥ 0, but use a number line, x >-7 and x ≤ 3 $\frac{4}{5}$

3 - x >0 & $x + 7$ > 0 [BD: $\frac{3}{5}$

		-7		3	
$3 - x$	+		+	0	−
$x + 7$	−	0	+		+
$\frac{3 - x}{x + 7}$	−	UD	+	0	−

$-7 < x \leq 3,$

$-7 \leq x \leq 3 \quad \left(\frac{4}{5}\, marks\right)$ (5)

✓ critical values (for both)

✓✓ each inequality

1.3 For non-real roots: $\Delta < 0$

$b^2 - 4ac < 0$

$k^2 - 8k < 0$

$k(k-8) < 0$

$0 < k < 8$ (5)

[no mention of $\Delta < 0$ BD : max $\frac{2}{5}$ marks] [25]

✓ $\Delta < 0$

✓ $b^2 - 4ac$

✓ substitution in Δ

✓✓ critical values & inequali signs

QUESTION 2

2.1 2.1.1 $xy = k$ or $y = \frac{k}{x}$ [but not $y = \frac{x}{k}$ $\frac{0}{3}$]

$\therefore \ (4)(2) = k$

$f(x) = \frac{8}{x}$ *or* $xy = 8$ or $y = \frac{8}{k}$ (3)

✓ formula

✓ substitution in formula

✓ equation

2.1.2 $x^2 + y^2 = r^2$

$r^2 = 16 + 4 = 20$

$g(x) = \sqrt{20 - x^2}$ (3)

✓ formula

✓ substitution

✓ equation

OR

$g(x) = \sqrt{r^2 - x^2}$

$2 = \sqrt{r^2 - 4^2}$

$4 = r^2 - 16$

$r^2 = 20$

$g(x) = \sqrt{20 - x^2}$ (3)

If $y = \sqrt{x^2 - r^2}$

$2 = \sqrt{16 - r^2}$

$r = \sqrt{12}$

$BD : \frac{1}{3}\, marks$

✓ formula

✓ substitution

or $x^2 + y^2 = 20, \quad y \geq 0$

✓ equation

2.2 $y = |x - p|$

(4;2): $2 = |4 - p|$

$4 - p = 2 \quad or \quad -4 + p = 2$

$2 = |4 - p|$

$\therefore 4 - p = 2$

$\therefore p = 2 \quad BD : \frac{2}{4}$

$|4 - p| = 2$

$|4 - 2| = 2$

$\therefore p = 2 \quad \max : \frac{2}{4}$

Starts with $y = x -$ p and then substitutes (4;2): $\frac{4}{4}$

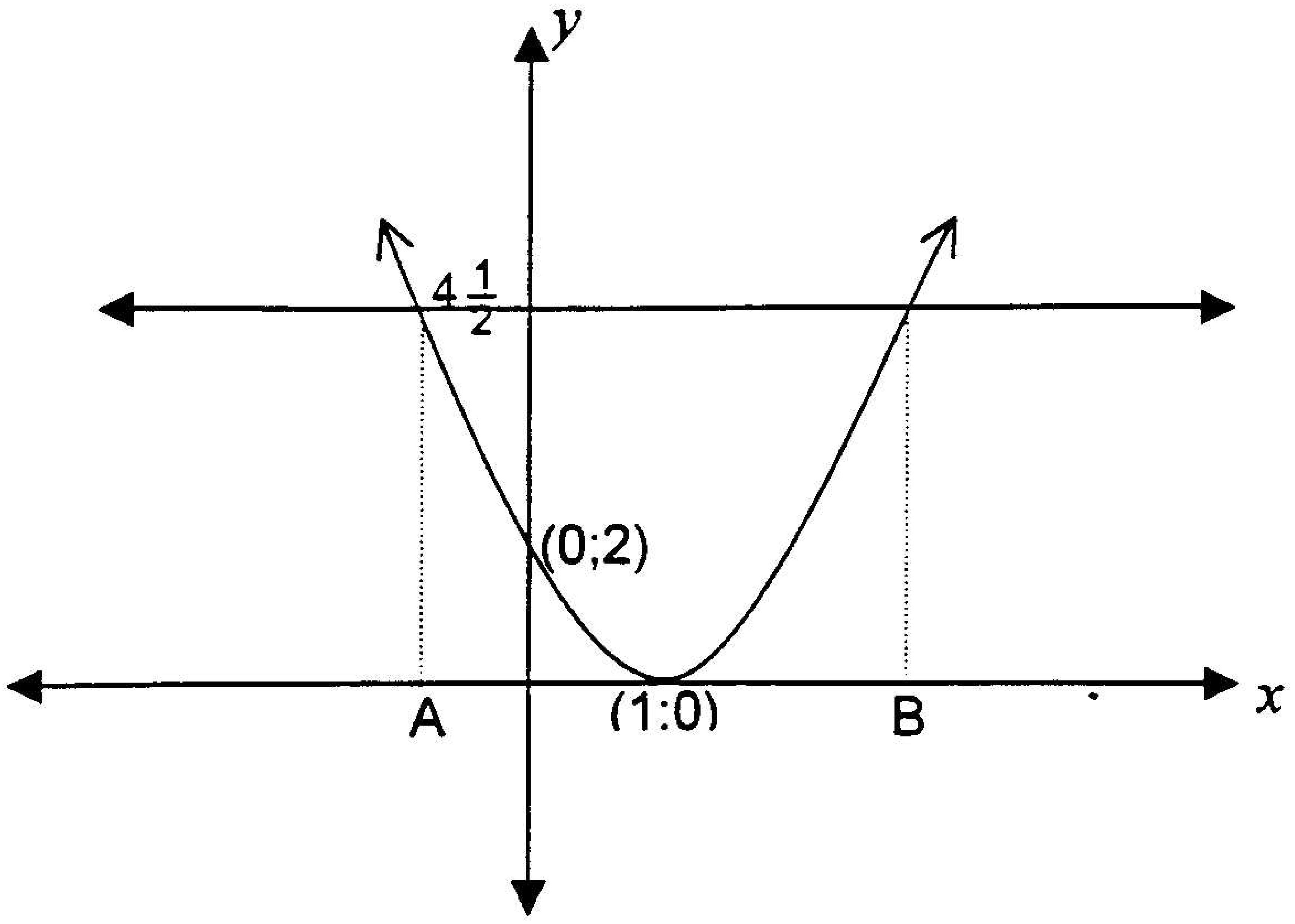
✓ substitution

✓ both equation

	$p=2$ *or* $p=6$		✓ both values of p
	From sketch: $p=2$	(4)	✓ selecting $p = 2$
	OR		
	$m = \frac{y_A - y_C}{x_A - x_C}$		✓ form
	$C(p;0)$ & $m = 1$		✓✓ point C & value of m
	$\therefore \frac{4-p}{2-0} = 1$		
	$\therefore 4-p=2 \Rightarrow p=2$		✓ simplification
2.3	$y=-x+2$ *and* $y=\sqrt{20-x^2}$		$x-2=\sqrt{2-x^2}$: $\frac{5}{6}$
	$-x+2=\sqrt{20-x^2}$		✓ equating the equations
	$(-x+2)^2=(\sqrt{20-x^2})^2$		✓ squaring both sides
	$x^2-4x+4=20-x^2$		or $\lvert x-2\rvert^2=\left(\sqrt{20-x^2}\right)^2$
	$2x^2-4x-16=0$		✓ std form
	$2(x-4)(x+2)=0$		✓ factors
	$x=4$ *or* $x=-2$		✓ correct values of x
	$x=4$ N/A for B: $\therefore$ $x=-2$		
	$\therefore B(-2;4)$ or $x=-2$ and $y=4$	(6)	✓ answer (answer only: $\frac{1}{6}$)
2.4	$-2 \leq x \leq 4$	(2)	✓ ✓ answer
	$x_B \leq x \leq 4$ (accept) or $x_B \leq x \leq x_A$	**[18]**	$-2<x<4$ (1 mark)
			$x \varepsilon [-2;4]$ (✓ ✓)

QUESTION 3

3.1	$y=2(x-1)^2$	
	Turning point: $(1;0)$	
	x-intercept: $2(x-1)^2=0$	graph not drawn, i.e. only
	$x=1$	calculations : max $\frac{2}{4}$
	y-intercept: $y=2(0-1)^2=2$	
	$\therefore (0;2)$	



✓ y-intercept

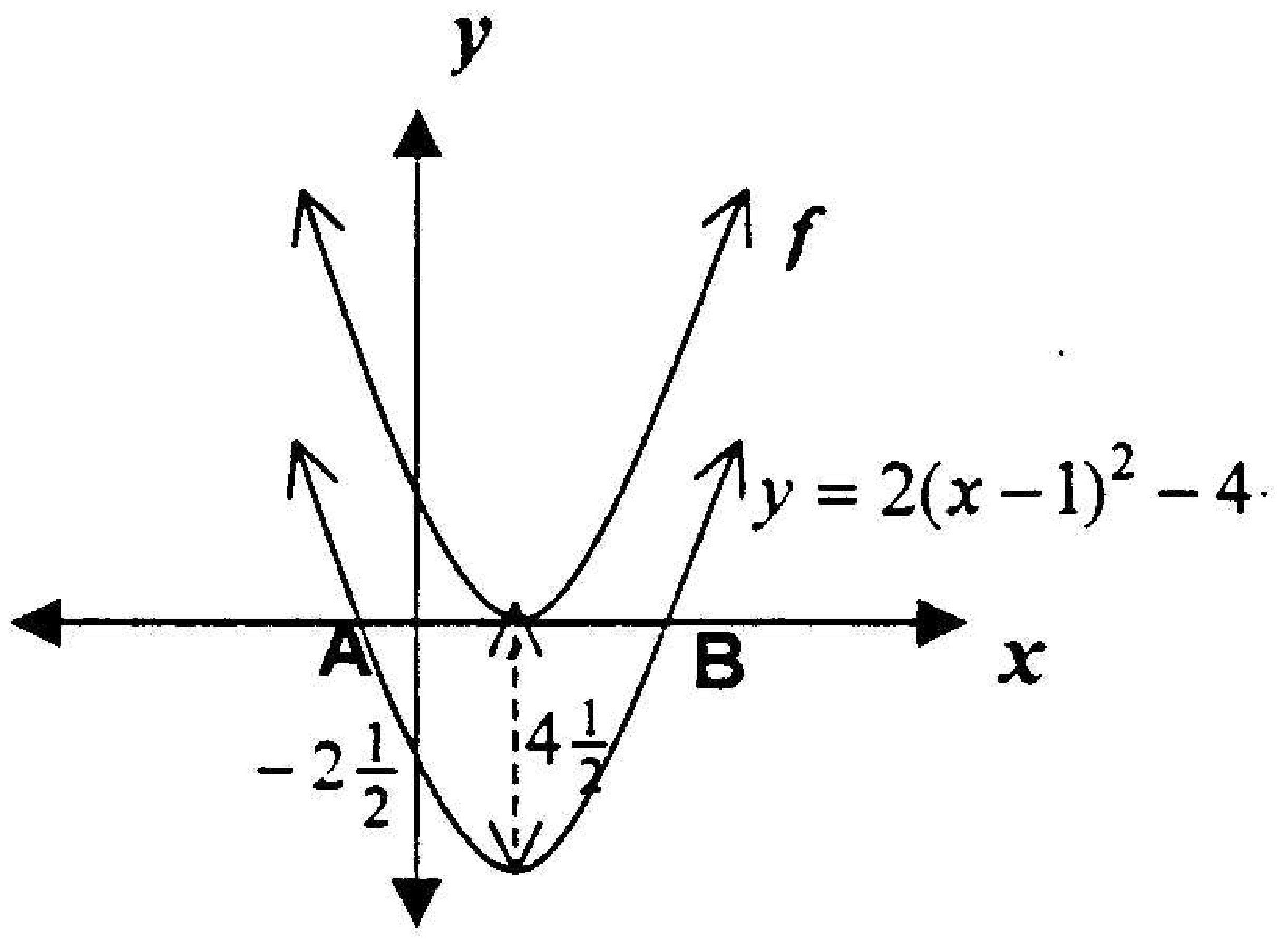
✓✓ turning point
(1 mark: x value; 1 mark: equal roots)

✓ shape

(4)

OR

3.1



For correct answer non-graphical techniques $\frac{1}{2}$

3.2 is C/A marked from 3.1

3.2 3.2.1 $k \geq 0$. (2) ✓ ✓ answer ; $k > 0$ ✓

3.2 3.2.2 $k < -2$. / accept $k \leq -2$ (2) ✓ ✓ answer

3.3 Read off at A and B. (2) ✓ ✓ on graph

[Calculation; i.e. not using graph: max $\frac{1}{2}$ [10] at points of intersection max $\frac{1}{2}$

Draw line $y = 4\frac{1}{2}$ only: ✓

Calculate x values and show A and B on x –axis ✓✓

QUESTION 4

4.1 $f(x) = 2x^3 + ax^2 + ax - 2$

$f(-\frac{1}{2})$ ✓ $= \text{b}$ ✓ — ✓$x = -\frac{1}{2}$ & knowing rem. thm✓

$2(-\frac{1}{2})^3 + a(-\frac{1}{2})^2 + a(-\frac{1}{2}) - 2 = b$ — ✓ substitution

$-\frac{1}{4} + \frac{1}{4}a - \frac{1}{2}a - 2 = b$ — ✓ simplification

$-1 + a - 2a - 8 = 4b$ (× by LCD = 4)

$a = -4b - 9$ (5) — ✓ answer

4.2 $f(x) = (x-8)p(x) + k$

$f(2) = 0$✓ — ✓ knowing factor theorem

$\therefore (2-8)p(2) + k = 0$✓ — ✓ substitution

$k = 6p(2)$

but $p(2) = 5$✓ — ✓ knowing remainder theoren

$(2-8)(5) + k = 0$✓ — ✓ substitution

$\therefore k = 6(5)$

$= 30$✓ (5) — ✓ answer

If $p(2) = 5$
then $p(x) = x + 3$
$\therefore f(x) = (x-8)(x+3) + k$
$f(2) = (-6)(5) + k = 0$
$\therefore k = 30$
max $\frac{4}{5}$ *marks*

[10]

QUESTION 5

5.1 $1 + 4\log_4 3.\log_9 \frac{1}{2} = 1 + 4\left(\frac{\log 3}{\log 4}.\frac{\log \frac{1}{2}}{\log 9}\right)$ — ✓ change of base (once only)

$= 1 + 4.\frac{\log 3}{2\log 2}.\frac{-\log 2}{2\log 3}$ — ✓ simplification write in terms of log 2 & log 3

$= 1 + 4\left(-\frac{1}{4}\right) = 1 - 1 = 0$ (3) — ✓ for −1

OR $1+4(\log_{2^2}3)(\log_{3^2}2^{-1})$ ✓

$= 1+4(\frac{1}{2}\log_2 3)(-\frac{1}{2}\log_3 3)$ ✓

$= 1+4(-\frac{1}{4}) = 1-1$ ✓ $= 0$

OR $1+4\log_4 3.\frac{\log_4 \frac{1}{2}}{\log_4 9}$ ✓

$=1+4\log_4 3\ .\ \frac{\log_4 \frac{1}{2}}{2\log_4 3}$

$1+2\log_4 \frac{1}{2}$ ✓

$1+\log_4(\frac{1}{2})^2 = 1-1$ ✓ $= 0$

If start with = 0: max $\frac{2}{3}$

5.2	5.2.1	$2^{x+1}+7=2^{2-x}$		
		$2.2^x+7=\frac{4}{2^x}$		✓ exponential law $\frac{4}{2^x}$
		$2.2^{2x}+7.2^x-4=0$		✓ multiplying by LCD & std
		$(2^x+4)(2.2^x-1)=0$		✓ factorizing or $k = 2^x$
		$2^x=-4$ *or* $2.2^x=1$		✓ both equations or 2k = 1 on
		impossible $2^x=\frac{1}{2}=2^{-1}$		✓ $2^x>0$
		$x=-1$	(6)	✓ x – value

$2k+7-\frac{4}{k}=0$

$2k^2+7k-4=0$

$(2k-1)(k+4)=0$

$k=\frac{1}{2}$ *or* $k=-4$

$\therefore 2^x=2^{-1}$ *or* $2^x=-4$

$\therefore x=-1$ *N / A*

	5.2.2	$x\log 5=\log\frac{3}{5}+x\log 3$		
		$\log 5^x-\log 3^x=\log\frac{3}{5}$		✓ log law
		$\log\left(\frac{5}{3}\right)^x=\log\frac{3}{5}$		✓ single log
		$\left(\frac{5}{3}\right)^x=\frac{3}{5}=\left(\frac{5}{3}\right)^{-1}$		✓ common base
		$x=-1$	(4)	✓ answer

OR

$x\log 5 = \log\frac{3}{5} + x\log 3$

$x\log 5 = \log 3 - \log 5 + x\log 3$

$\log 5^{x+1} = \log 3^{x+1}$

✓ log law

$5^{x+1} = 3^{x+1}$

✓ removing logs

$x + 1 = 0$

✓ $5^0 = 3^0$

$x = -1$ (4)

✓ answer

$x = -1$

OR

$x(\log 5 - \log 3) = \log\frac{3}{5}$ ✓ factorisation

$x\log\frac{5}{3} = \log\frac{3}{5} = -\log\frac{5}{3}$ ✓ single log

$(x+1)\log\frac{5}{3} = 0$ ✓ factorisation

$x + 1 = 0$

$x = -1$ (4) ✓ x- value

$x = \frac{\log\frac{3}{5}}{\log\frac{5}{3}}$ ✓

$= -\log_{\frac{3}{5}}\frac{3}{5}$ ✓✓

$= -1$ ✓

OR

$0 = \log\frac{3}{5} + x(\log 3 - \log 5)$ ✓ factorisation

$= \log\frac{3}{5} + x\log\frac{3}{5}$ ✓ single log

$0 = (x+1)\log\frac{3}{5}$ ✓ factorisation

$x = -1$ (4) ✓ x-value

OR $x\log 5 = \log\frac{3}{5} + x\log 3$

$\log 5^x = \log\frac{3}{5}\,.\,3^x$ ✓

$5^x = \frac{3}{5}.3^x$ ✓

$\frac{5^x}{3^x} = \frac{3}{5} = (\frac{5}{3})^{-1}$ ✓

$x = -1$ ✓

5.2.3	$\log(2x-3) \geq -\log(x-2)$		
	$\log(2x-3)+\log(x-2) \geq 0$		
	$\log(2x-3)(x-2) \geq \log 1$		✓ single log
	$2x^2-7x+6 \geq 1$		✓ removing of logs if $2x^2-7x+6 \geq 0$ BD: $\frac{7}{10}$ if $2x^2-7x+5 \leq 1$ BD: $\frac{9}{10}$
	$2x^2-7x+5 \geq 0$		✓ std form
	$(x-1)(2x-5) \geq 0$		✓ factorization
*A	$x \leq 1$ or $x \geq \frac{5}{2}$		✓✓ each answer
	By definition of logs :		
	$2x-3>0$ and $x-2>0$		✓ use of definition if ≥ is used: -1
	$x>\frac{3}{2}$ and $x>2$		✓ values of x
	and $x \leq 1$ or $x \geq \frac{5}{2}$		
*B	∴ $x \geq \frac{5}{2}$		✓✓ solution writes down final solution fro
		(10)	*A to *B: full marks
OR	$\log(2x-3) \geq \log \frac{1}{x-2}$ ✓		
	$2x-3 \geq \frac{1}{x-2}$ ✓		
	$\frac{(2x-3)(x-2)-1}{(x-2)} \geq 0$		
	$\frac{2x^2-7x+5}{x-2} \geq 0$ ✓		
	$\frac{(2x-5)(x-1)}{x-2} \geq 0$ ✓		
	$x \geq 2½$ ✓ or $1 \leq x \leq 2$ ✓ …… 6 marks		+ last 4 marks

5.3 $f(x) = 3^{-x}$

5.3.1 For f^{-1} : $x = 3^{-y}$

$-y = \log_3 x$

$y = -\log_3 x$

Or $y = \log_{\frac{1}{3}} x$

OR $y = 3^{-x}$

$\log_3 y = -x$

$x \leftrightarrow y$

$\log_3 x = -y$

$y = -\log_3 x$

or $y = \log_{\frac{1}{3}} x$

(2)

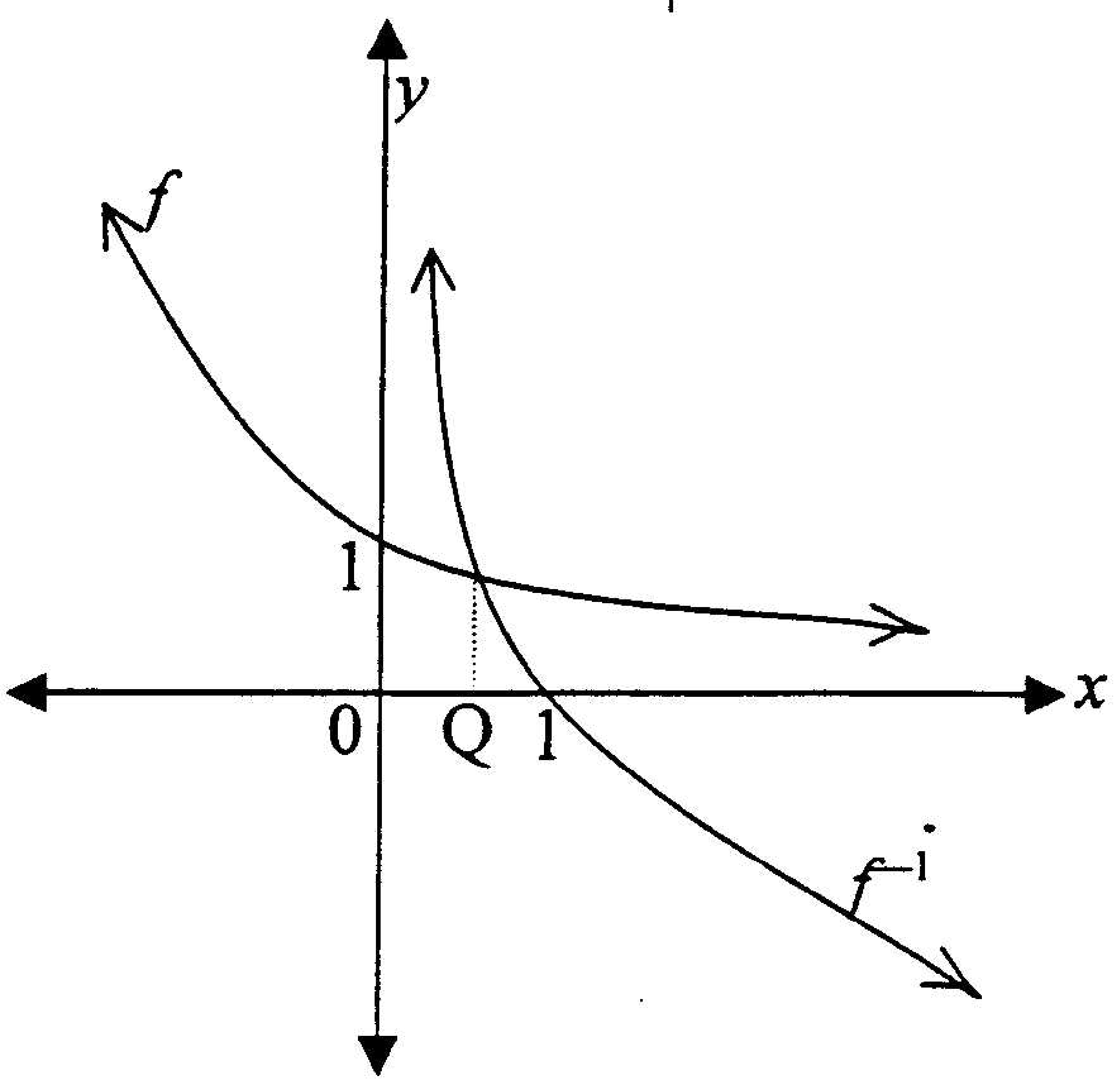
✓ writing in log form

$y = \left(\frac{1}{3}\right)^x$ (1*mark*)

$\therefore f^{-1}(x) = \log_{\frac{1}{3}} x$ (1*mark*

✓ equation

5.3.2



(4)

✓ curve of f / shape

✓ y-intercept

✓ curve of f^{-1}/ shape

✓ x-intercept

no or incorrect label: $\frac{3}{4}$

if f incorrect: max: 2 marks

5.3.3 At Q on graph

(1)

✓ answer

no mark if no intersect

5.4 Let $x = \log_3 90$

$90 = 3^x$ ✓

$30 = \frac{3^x}{3} = 3^{x-1}$

$3^{3,096} = 3^{x-1}$ ✓

$3,096 = x - 1$

$x = 4,096$ ✓

$30 = 3^{3,096}$

$\therefore 3.30 = 3.3^{3,906}$(1*mark*)

$90 = 3^{4,096}$(1*mark*)

$\therefore \log_3 90 = 4,096$(1*mark*)

(3)

✓ expressing in log form

✓ exponential form

✓ answer

OR

$30 = 3^{3,096}$

$\therefore \log_3 30 = 3,096$

$\log_3 90 = \log_3 3 + \log_3 30$

$= 1 + 3,096$

$= 4,096$

(3)

✓ log form

✓ log law

✓ answer

OR $3^{3,096} = 30$

$\log_3 30 = 3,096$ ✓

$\log_3 30 + \log_3 3 = 3,096 + \log_3 3$ ✓ (3)

$\log_3 90 = 3,096 + 1$

$= 4.096$ ✓

[33]

QUESTION 6

6.1 $S_n = \frac{n}{2}(7n+15)$

6.1.1 $425 = \frac{n}{2}(7n+15)$

✓ substitution $S_n = 425$

$850 = 7n^2 + 15n$

$7n^2 + 15n - 850 = 0$

✓ standard form

$(7n+85)(n-10) = 0$

✓ factors or

$n = \frac{-15 \pm \sqrt{24025}}{14}$

✓ accepting $n = 10$

$n = -\frac{85}{7}$ /-12,14 or $n = 10$

N/A

(5)

✓ rejecting the other solution

correct answer only $\frac{3}{5}$

6.1.2 $T_6 = S_6 - S_5$

✓✓ interpretation

if d = $S_2 - S_1 = 18$ (max 1)

$= \frac{6}{2}(7 \times 6 + 15) - \frac{5}{2}(7 \times 5 + 15)$

✓ substitution

$= 3(57) - 5(25)$

$= 171 - 125$

$= 46$

(4) ✓ answer

OR	**6.1.2**	$T_1 = S_1 = \frac{1}{2}(7.1 + 15) = 11$		✓ calculating term 1
		$T_2 = S_2 - S_1 = \frac{2}{2}(7.2 + 15) - 11 = 18$		✓ calculating 2^{nd} term
		$\therefore d = T_2 - T_1 = 7$		✓ common difference
		$T_6 = a + 5d$ $= 11 + 5.7$ $= 46$	(4)	✓ answer
		OR		
		$425 = 5(2a + 9d)$ $\therefore 85 = 2a + 9d \cdots\cdots\cdots (1) \ldots. 1 mark$ $171 = 3(2a + 5d)$ $\therefore 57 = 2a + 5d \cdots\cdots\cdots (2) \ldots\ldots 1 mark$ $(1) - (2): \quad 28 = 4d$ $\therefore \quad d = 7$ $\therefore \quad a = 11 \ldots\ldots 1 mark\ for\ a\ and\ d$ $T_6 = 11 + 5.7 = 46 \quad \ldots\ldots 1 mark$		
6.2	GS with $a = 400, \quad r = 1{,}1$			✓ values for *a* and *r*
	6.2.1	$T_7 = ar^{n-1}$ or $T_7 = 400\left(1 + \frac{10}{100}\right)^6$		✓ formula
		$= 400(1{,}1)^6$		✓ substitution
		$= R708{,}62$ Accept T_7 even if AP Max $\frac{1}{4}$ marks	(4)	✓ answer
		OR		
		400; 440; ✓ 484; ✓532,40; 585,64; 644,20; 708,62 ✓✓		Full marks
	6.2.2	$S_n = \frac{a(r^n - 1)}{r - 1}$		✓ formula
		$= \frac{400\left[(1{,}1)^7 - 1\right]}{1{,}1 - 1}$ Accept S_7 even if AP. Max $\frac{1}{3}$ marks		✓ substitution
		$= R3\ 794{,}87$	(3)	✓ answer
OR		400 + 440 + 484 + 532,40 + 585,04 + 644,20 = 3794,86		Adding all the terms ✓✓; answer ✓ T_6=3086,24 $\left(\frac{2}{3}\right)$

6.2.3 $T_n = ar^{n-1} > 1500$ ✓

$400(1,1)^{n-1} > 1500$ ✓ substitution

$(1,1)^{n-1} > 3,75$

$n-1 > \frac{\log 3,75}{\log 1,1}$ ✓ log law

$n-1 > 13,9 \therefore n > 14,9$ ✓ simplification

$\therefore$ in the 15th month ✓ value of n & answer

(5) if n = 14,9: max $\frac{3}{5}$

OR

T_7 = 708,62; 779 ; 857; 943; 1037;
1141; 1255; 1380; T_{15} = 1518
In the 15th month Full marks

OR $S_n > 1\,500$

$\frac{400(1,1)^n - 1}{1.1 - 1} > 1500$

$400[(1,1)^n - 1] > 150$

$(1,1)^n - 1 > 0,375$

$(1,1)^n > 1,375$

n > 3,35

n = 4 (BD: $\frac{4}{5}$)

6.3 $a+1;\ a-1;\ 2a-5$

6.3.1 $\frac{a-1}{a+1} = \frac{2a-5}{a-1}$ or $\frac{T_2}{T_1} = \frac{T_3}{T_2}$ ✓ equation

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

$a^2 - a - 6 = 0$ ✓ std form

$(a-3)(a+2) = 0$ ✓ factors

*A $a = 3$ *or* $a = -2$ ✓ both values of a

$a = 3:\ 4; 2; 1; \cdots$ ✓ sequence when $a = 3$

$a = -2: -1; -3; -9; \cdots$ ✓ sequence when $a = -2$

OR
$r = \frac{a-1}{a+1}$ ✓
$r = \frac{1}{2}$ *or* $r = 3\ (N/A)$ ✓
$\therefore a = 3$ ✓

*B $\therefore a = 3$ series convergent. ✓ value of a

*if goes directly from *A to *B: full marks*

(7)

OR If only 4; 2; 1 ∴ r = ½ and series convergent ∴ a = 3: full marks

OR Answer only: a = 3 max: $\frac{1}{7}$

6.3.2

$$S_\infty = \frac{a}{1-r} \quad : \quad r = \frac{1}{2}$$

✓✓ formula & value for r

$$= \frac{4}{1-\frac{1}{2}}$$

✓ substitution

$$= 2(4)$$

✓ answer

$$= 8$$

(4) If working with a = -2 or with both values of a: max $\frac{2}{4}$

[32]

QUESTION 7

7.1

$$f(x) = 3x - x^2$$

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h} \qquad h \neq 0$$

✓ definition/ formula

$$f'(x) = \lim_{h \to 0} \frac{3(x+h) \; - (x+h)^2 - (3x - x^2)}{h}$$

✓ substitution

$$= \lim_{h \to 0} \frac{3x + 3h - x^2 - 2xh - h^2 - 3x + x^2}{h}$$

✓ simplification / expansion

$$= \lim_{h \to 0} \frac{3h - 2xh - h^2}{h}$$

✓ simplification

$$= \lim_{h \to 0} \frac{h(3 - 2x - h)}{h}$$

✓ factorization

$$= \lim_{h \to 0} (3 - 2x - h)$$

-1 $\lim\limits_{h\to 0}$ = or $\lim\limits_{h\to 0}$ missing

$$= 3 - 2x$$

✓ answer

(6) answer only: no marks

7.2 7.2.1 $xy = 5$

$y = \frac{5}{x} = 5x^{-1}$

✓y subject with negative exponent

$\frac{dy}{dx} = -5x^{-2}$ or $-\frac{5}{x^2}$

✓derivative (2)

7.2.2 $y = \frac{1 - 2x + \sqrt{x}}{x^2}$

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

✓ simplification

$\frac{dy}{dx} = -2x^{-3} + 2x^{-2} - \frac{3}{2}x^{-\frac{5}{2}}$

✓✓✓ derivative of each term

C/A if simplifying incorrectly, but 3rd mark for similar difficulty of 3rd term (4)

Notation: -1

7.3 $f(x) = 2x^2 + x - 1$

$f'(x) = -3$

$4x + 1 = -3$

$4x = -4$

$x = -1$

$y = 2(-1)^2 + (-1) - 1$

$= 0$

$y - y_1 = m(x - x_1)$

$\therefore y = -3(x+1)$

$\therefore y = -3x - 3$

$$\boxed{\begin{array}{l} \text{If } f'(-3) = -11 \\ \therefore f(-3) = 14 \ ✓ \\ y - 14 = -11(x+3) \ ✓ \\ y = -11x - 19 \ ✓ \\ \text{max}: \frac{4}{6} \ ✓ \end{array}}$$

$$\boxed{\begin{array}{l} y = mx + c \\ y = -3x + c \\ 0 = -3(-1) + c \\ c = -3 \\ y = -3x - 3 \ ✓ \end{array}}$$

✓

✓✓ derivative & = -3

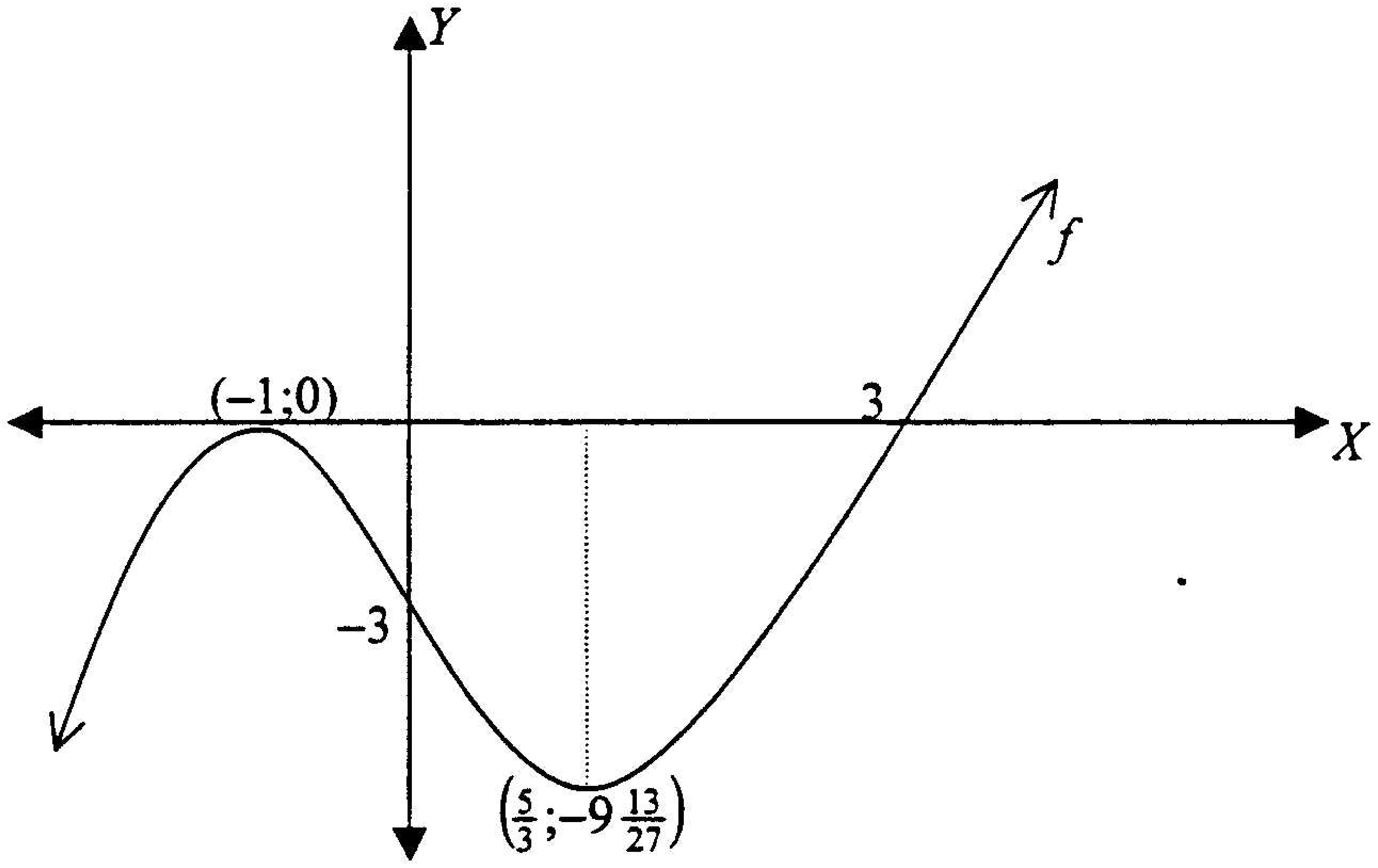
✓ value of x

✓ value of y

✓ substitution

(6) ✓ equation

7.4 $f(x)=x^3-x^2-5x-3$	
y – intercept (0 ; –3)	
$f(-1)=0 \quad \therefore x+1$ is a factor of $f(x)$	✓ factor or $(x-3)$
$\therefore \quad f(x)=(x+1)(x^2-2x-3)$	✓✓ quadratic factor
for x-intercepts: $f(x)=0$	✓$y = 0$
i.e. $(x+1)^2(x-3)=0$	✓ factorisation
$\therefore \quad x=-1$ or $x=3$	✓ both values
For turning points : $f'(x)=0$	✓ definition = 0
$3x^2-2x-5=0$	✓ derivative
$(3x-5)(x+1)=0$	✓ factorization
$x=\frac{5}{3}$ or $x=-1$	✓ both values
$f(-1)=0 \quad \therefore \quad (-1;0)$	✓ y-value/ TP
$f(\frac{5}{3})=-9\frac{13}{27} \quad \therefore \quad (\frac{5}{3};-9\frac{13}{27}) \ / \therefore \ (\frac{5}{3};-9{,}48)$	✓ y – value/ TP



✓✓ each turning point

✓ y-intercept on graph or in calculations

✓ x-intercept

✓ shape

(17)

[35]

QUESTION 8

8.1.1 $A = \pi R^2 + \pi r^2$ .... (1) ✓✓ equation on A (2 or 0)

$R + r = 200$ .... (2)

$\therefore r = 200 - R$ ✓ equation

Subst (2) in (1):

$A = \pi R^2 + \pi(200 - R)^2$ ✓ substitution

$= \pi R^2 + \pi(40\,000 - 400R + R^2)$

$= 2\pi R^2 - 400\pi R + 40\,000\pi$ (4)

8.1.2 At minimum: $\frac{dA}{dR} = 0$ ✓ derivative = 0

i.e. $4\pi R - 400\pi = 0$ ✓ correct calculation of derivative

$R = \frac{400\pi}{4\pi}$

$= 100\ mm$ ✓ value for R

$\therefore r = 100\ mm$ (4) ✓ value of r

8.1.3 Since $R = r = 100$ one will not get the desired shape but a shape with two equal circle which touch externally. (2) ✓✓ valid explanation

Equal radius : 1 mark

If a diagram is drawn, showing 2 touching circles (2 marks)

8.2 8.2.1 No profit $\Rightarrow P = 0$

$-\frac{3}{80}x^2 + 6x - 180 = 0$ ✓ P = 0

$x^2 - 160x + 4800 = 0$

$(x - 40)(x - 120) = 0$ ✓ factorization

$x = 40\ km/h \quad or \quad x = 120\ km/h$ (3) ✓ both values of x

	8.2.2	$P=-\frac{3}{80}x^2+6x-180$		**-1 if units is left out in 8.2.2**
		max P : $\frac{dP}{dx}=0$		✓ interpretation / = 0
		$-\frac{6}{80}x+6=0$		✓ derivative
		$480-6x=0$		
		$x=80\ km/h$		✓ value of x
		OR $x=\frac{40+120}{2}=80\ km/h$		✓✓✓
		$P=-\frac{3}{80}(80)^2+6(80)-180$		✓ substitution
		$P=-240+480-180$		
		$=R\ 60,00$	(5)	✓ value for P
		OR		
	8.2.2	$x=-\frac{b}{2a}$		✓ formula
		$x=-\frac{6}{2\left(\frac{-3}{80}\right)}$		✓ substitution
		$x=(-6)(-\frac{80}{6})$		
		$x=80$ km/h		✓ speed
		$P=R\ 60,00$		✓✓ substitution & answer
8.2	8.2.3	For loss P < 0		
		$-\frac{3}{80}x^2+6x-180<0$		✓ setting up the inequality
		$x^2-160x+4800>0$	(3)	
		$(x-40)(x-120)>0$		
		$30\leq x<40$ km/h or $x>120$ km/h		✓✓ accept any of these 2
		$30\leq x\leq 40$ km/h or $x\geq 120$ km/h		possible answers
			[21]	ignore: $x\geq 30$ (given)
OR		If $40<x<120$ or		
		If $40\leq x\leq 120$		max $\frac{1}{3}$

QUESTION 9

C/A marks throughout the question

9.1	9.1.1 $x \le 60$ $y \le 100$	(2)	✓✓ each inequality if x = M; y = B in inequalities if = sign left out: -1 once
	9.1.2 $x + y \ge 80$	(1)	✓ inequality
	9.1.3 $\frac{2}{3}x + \frac{1}{2}y \le 60$ or $4x + 3y \le 360$	(2)	✓ LHS ✓ RHS + inequality
9.2	Profit = $40x + 80y = P$	(1)	✓ equation
9.3	See graph below	(1)	✓ either dotted line
9.4	Maximum profit if $x = 15$ and $y = 100$ (accept any x between 15 and 20)	(3)	✓✓✓ or 0
9.5	$P_{\max} = 40(15) + 80(100)$ = R 8 600	(2)	✓ substitution ✓ answer
9.6	$\frac{2x}{3} + \frac{y}{2} = 50$ $\Rightarrow 4x + 3y = 300$ max. P now if $x = 0$ and $y = 100$ i.e. 0 type M, 100 type B. $P_{\max} = 40(0) + 80(100)$ $= R\,8\,000$	(4)	✓ new equation (-1 if inequality) ✓✓ values of x & y If m = -2: feasible region is li segment. Answer (60; 20) $P_{\max}$ = R4000 ✓ answer
		[16]	**TOTAL : 200**

If m = -2 is used for search line give $\frac{3}{3}$ for (60;40) and $\frac{2}{2}$ for $P_{\max}$ =5600