

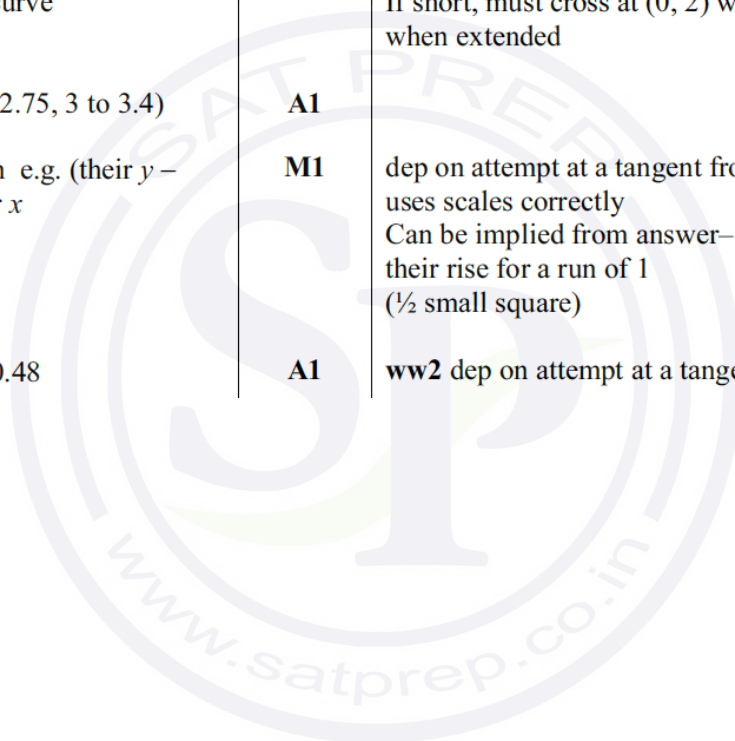
Extended Mathematics
Topic :Graph
Year :May 2013 -May 2023
Paper - 4
Answers

Question 1

| | | | |
|-----|-----------------------------------|---|---|
| (a) | -5.04, 1.75, 0 | 3 | B1 for each correct value |
| (b) | Fully correct curve | 5 | B3FT for 10 correct plots from <i>their</i> (a) B2FT for 8 or 9 correct plots or B1FT for 6 or 7 correct plots and SC1 for two branches not joined |
| (c) | -1.6 to -1.5 | 1 | |
| | -0.4 to -0.3 | 1 | |
| | 1.8 to 1.9 | 1 | |
| (d) | -2.6 to -2.5 www | 1 | |
| | -0.4 to -0.3 | 1 | |
| | 1 | 1 | After 0 scored, M1 for $y = 2x - 2$ drawn |
| (e) | 3.25 to 4.25 with correct tangent | 3 | B1 for correct tangent |
| | | | B2 for answer in range dep on close attempt at tangent |
| | | | M1dep for $[-] \frac{\text{rise}}{\text{run}}$ used with values soi from tangent, dep on correct or close attempt at tangent |

Question 2

| | | | |
|---------|--|-----------|---|
| (a) | 0, 2, 0, - 3 | 3 | B2 for 3 correct or B1 for 2 correct |
| (b) | Correct curve | B4 | B3FT for 8 points B2FT for 7 or 6 points B1FT for 5 or 4 points |
| (c) | $y = -1$ indicated | B1 | e.g. Could be mark[s] on curve isw other lines if not clearly used |
| | $x = 1.3$ to 1.4 and 4.1 to 4.2 | B1 | |
| (d) (i) | line drawn from (0, 2) to touch curve | M1 | No daylight at point of contact If short, must cross at (0, 2) within $\frac{1}{2}$ small square when extended |
| | (2.5 to 2.75, 3 to 3.4) | A1 | |
| (ii) | rise/run e.g. (their $y - 2$)/their x | M1 | dep on attempt at a tangent from (0, 2) in (d)(i) and uses scales correctly Can be implied from answer– check on tangent for their rise for a run of 1 ($\frac{1}{2}$ small square) |
| | 0.4 to 0.48 | A1 | ww2 dep on attempt at a tangent from (0, 2) in (d)(i) |



Question 3

(a) 3, 0.33[3...], 1

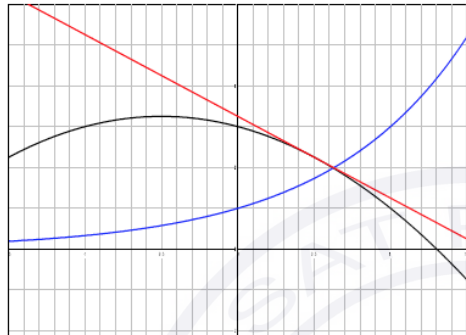
3 B1 for each correct value

(b) Correct quadratic curve

3 B2FT for 7 correct points
or
B1FT for 5 or 6 correct points

Correct exponential curve

3 B2FT for 7 correct points
or
B1FT for 5 or 6 correct points



(c) (i) Answer in range $1.2 < x < 1.4$

1

(ii) Answer in range $1.2 < x < 1.35$

1

Not from a line other than $y = 4$
(± 1 mm)

(iii) Answer in range $0.55 < x < 0.7$

1

(d) Correct tangent drawn
And answer in range $-2.5 < m < -1.5$

3

B1 for correct tangent at $x = 0.5$

B2 for answer in range dep on close attempt at tangent

M1 for $[-] \frac{\text{rise}}{\text{run}}$ used with values soi

from tangent, dep on close attempt at tangent or answer in range

$1.5 < m < 2.5$

or

SC1 for close attempt at tangent to exponential curve and answer in the range $1.6 < m < 2.2$

Question 4

(i) $\frac{3}{2}$ or 1.5

2 **M1** for $\frac{14 - (-4)}{8 - (-4)}$ oe

(ii) $y = \frac{3}{2}x + 2$ oe

2 **B1** for $y = \textit{their} \frac{3}{2}x + c$ o.e.
or $y = mx + 2, m \neq 0$
SC1 for $\frac{3}{2}x + 2$

Question 5

(a) 7, 11.5, 4.5

1,1,1

(b) Correct curve cao

5

B3FT for 10 correct plots, on correct vertical grid line and within correct 2 mm square vertically
Or B2FT for 8 or 9 correct plots
Or B1FT for 6 or 7 correct plots
and B1 indep for two separate branches on either side of y -axis

(c) (i) $0.69 < x < 0.81$

1

(ii) $-2.3 < x < -2.2$
 $-0.8 < x < -0.6$
 $0.35 < x < 0.5$

3

B1 for each correct
After 0 scored, allow **SC1** for drawing line $y = 7.5$ long enough to cross curve at least once

(d) (i) $y = 10 - 3x$ ruled correctly

B2

long enough to cross curve twice.

B1 for ruled line gradient -3 or y intercept at 10 but not $y = 10$
Or B1 for 'correct' but freehand

$-0.55 < x < -0.45$

B1dep

Dependent on at least **B1** scored for line

$0.35 < x < 0.45$

B1dep

After 0 scored, **SC2** for -0.5 and 0.4 [from solving equation]

(ii) $\begin{matrix} 10 & 1 & -2 \\ \text{or} & -10 & -1 & 2 \end{matrix}$

3

B2 for $2 - x - 10x^2 [= 0]$ oe

Or **B1** for $\frac{2}{x^2} - \frac{1}{x} - 10 = 0$ oe Correctly

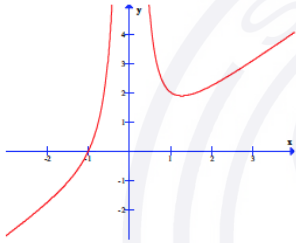
eliminating $-3x$

Or **B1** for $2 - x - 3x^3 = 10x^2 - 3x^3$ oe Correctly clearing fractions

Question 6

| | | | |
|-------|---|---|---|
| (i) | 1.4 to 1.6 | 1 | |
| (ii) | 1.15 to 1.25 | 1 | |
| (iii) | - 1 | 1 | |
| (iv) | - 2.25 to - 2.1 - 0.9 to - 0.75 2.2 to 2.35 | 3 | B2 for 2 correct or B1 for one correct or B1 for $y = x$ drawn ruled to cut curve 3 times |

Question 7

| | | | |
|-----|--|-------------|---|
| (a) | 0, 4.5, 3.11[1...] | 3 | B1, B1, B1 |
| (b) | Complete correct curve with minimum below $y = 2$ | 5 | B3 FT for 9 points correctly plotted B2 FT for 7 or 8 points correctly plotted or B1 FT 5 or 6 points correctly plotted and B1 indep two separate branches not touching or cutting y -axis |
| |  | | |
| (c) | - 0.5 to - 0.6 0.6 to 0.7 2.8 to 2.9 | 1 1 1 | if 0 SC1 for $y = 3$ indicated |
| (d) | Correct line or no line and - 0.7 to - 0.6 nfw | 3 | Must check line - not if wrong line B2 for $y = 1 - x$ ruled correctly or SC1 for ruled line with either gradient -1 or y -intercept 1 but not line $y = 1$ or correct freehand line |

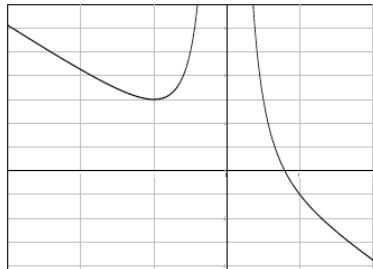
Question 8

(a) 3, 3, -1

3 **B1 B1 B1**

(b) Complete correct curve

5 **B3FT** 11 points
or B2FT for 9 or 10 points **or B1FT** for 7 or 8 points



And B1indep two separate branches not touching or crossing y -axis

(c) 0.5 to 0.6

1

(d) Correct line and 0.4 to 0.5
or no line and 0.4 to 0.5 nfw

3 Must check line - not if wrong line
B2 for $y = 2x + 3$ ruled correctly
or SC1 for correct freehand line
or ruled line with either gradient 2 or y -intercept 3 but not $y = 3$

(e) (i) Tangent at $x = -1.5$

1 No daylight at $x = -1.5$. Consider point of contact as midpoint between two vertices of daylight, the midpoint must be between $x = -1.7$ and -1.3

(ii) -2 to -1

2 **Dependent on** tangent mark awarded
 Allow integer/integer if in range
Or M1 for rise/run **also dep on** any tangent drawn or close attempt at tangent at any point
 Must see correct or implied calculation from a drawn tangent

Question 8

| | | | |
|-----|---|-----------|--|
| (a) | 2.125 and 2.375 | 2 | B1 for one correct value |
| (b) | Correct curve | B4 | B3FT for 11 correct plots or B2FT for 9 or 10 correct plots or B1FT for 7 or 8 correct plots |
| (c) | Ruled tangent at $x = 2$ | B1 | No daylight at $x = 2$. Consider point of contact as midpoint between two vertices of daylight, this must be between $x = 1.8$ and 2.2 |
| | Gradient from 7.8 to 10.2 | 2 | Dep on B1 awarded Allow integer/integer or a mixed number if within range or M1 dep for $(\text{change in } y) \div (\text{change in } x)$ Dependent on any tangent drawn or close attempt at a tangent at <u>any</u> point Must see correct or implied calculation from a drawn tangent |
| (d) | 0 and -1.75 to -1.65 and 1.65 to 1.75 | 2 | B1 for two correct values |
| (e) | -1.2 to $-0.8 < k < 2.8$ to 3.2 | 2 | B1 for each correct or SC1 for reversed answers |

Question 9

| | | | |
|------|-------------------------------|-----|---|
| (i) | (1, 2) | 1+1 | |
| (ii) | $y = 3x - 1$ cao final answer | 3 | M1 for gradient = $\frac{8 - -4}{3 - -1}$ oe and M1 for substituting (3, 8) or $(-1, -4)$ into <i>their</i> $y = 3x + c$ or for finding y -intercept is -1 |

Question 10

| | | | |
|---------|--|----------------|--|
| (a) | -3, 7.375, 8.875 | 1, 1, 1 | Accept 7.4 or 7.37 or 7.38 for 7.375 and 8.9 or 8.87 or 8.88 for 8.875 |
| (b) | Correct curve | 4 | B3FT for 8 or 9 correct plots B2FT for 6 or 7 correct plots B1FT for 4 or 5 correct plots Point must touch line if exact or be in correct square if not exact (including boundaries) |
| (c) (i) | Any integer less than 7 or greater than 10 | 1 | |
| (ii) | 7, 8 or 9 | 1 | |
| (d) | $y = 15x + 2$ ruled and fit for purpose | B2 | B1 for short line but correct or freehand full length correct line or for ruled line through (0, 2) (but not $y = 2$) or for ruled line with gradient 15 (acc ± 1 mm vertically for 1 horizontal unit) |
| | -1.45 to -1.35 and 0.4 to 0.5 | B2 | B1 for each |
| (e) | Tangent ruled at $x = 1.5$ | B1 | No daylight at point of contact. Consider point of contact as midpoint between two vertices of daylight, the midpoint must be between $x = 1.4$ and 1.6 |
| | 7 to 12 | 2 | Dep on B1 or close attempt at tangent at $x = 1.5$ M1 for y - step/ x - step for their tangent |

Question 11

| | | | |
|-----|--|-----------|---|
| (a) | 2 0 -2 2 | 3 | B2 for 3 correct B1 for 2 correct |
| (b) | smooth correct curve through correct points | 4 | B3FT for 8 or 9 correct plots B2FT for 6 or 7 correct plots B1FT for 4 or 5 correct plots |
| | | | FT <i>their</i> table |
| (c) | line $y = \frac{1}{2}(x+1)$ ruled <u>and</u> -2.85 to -2.95 -1 0.85 to 0.95 | 4 | Line must be fit for purpose B3 for correct line and 2 correct values or B2 for correct line and 1 correct value or B1 for correct line or SC2 for no/wrong line and 3 correct values or SC1 for no/wrong line and 2 correct values |
| (d) | tangent ruled | B1 | No daylight between tangent and curve at point of contact. Consider point of contact as midpoint between two vertices of daylight, the midpoint must be between $x = -1.85$ and $x = -1.65$ |
| | - 1.1 to - 1.5 | 2 | dep on B1 M1 for rise/run also dep on any tangent drawn or close attempt at tangent at any point Must see correct or implied calculation from a drawn tangent Accept M1 for answer in range 1.1 to 1.5 after B1 |

Question 12

| | | | |
|-----|--|-------------|---|
| (a) | 1 3 2.5 | 1 1 1 | |
| (b) | Fully correct graph | 5 | <p>B3FT for 11, 12 points correct or B2FT for 9, 10 correct points or B1FT for 7, 8 correct points</p> <p>B1 for branch each side of y-axis and not touching y-axis</p> <p>SC4 for correct graph but branches joined</p> |
| (c) | -2.6 to -2.4 | 1 | |
| (d) | Correct ruled line fit for purpose -1.0 to -1.5 | 2 1 | <p>SC1 for ruled line through (0, 1) but not $y = 1$ or ruled line with gradient -1 or for correct line but freehand</p> |
| (e) | Correct tangent and $0.9 \leq \text{grad} \leq 1.5$ | 3 | <p>Consider point of contact as midpoint between two vertices of daylight, the midpoint must be between $x = -3.4$ and -2.6</p> <p>B2 if close attempt at correct tangent and answer in range (may be small amount of daylight)</p> <p>or B1 for ruled tangent at $x = -5$ within tolerance, no daylight at the point of contact</p> <p>and M1 (dep on B1 or close attempt at tangent) for a tangent at any point and $\frac{\text{rise}}{\text{run}}$ used</p> |

Question 13

| | | | |
|---------|--|-----|--|
| (a) | 2 and 7 | 2 | B1 for each value |
| (b) | Complete correct curve | 5 | B3 FT for <i>their</i> 9 or 10 points or B2 FT for <i>their</i> 7 or 8 points or B1 FT for <i>their</i> 5 or 6 points and B1 independent for one branch on each side of the y -axis and not touching the y -axis SC4 for correct curve with branches joined |
| (c) | Correct tangent and $-13 \leq \text{grad} \leq -8$ | 3 | B2 for close attempt at tangent at $x = 1$ and answer in range OR B1 for ruled tangent at $x = 1$, no daylight at $x = 1$ Consider point of contact as midpoint between two vertices of daylight, the midpoint must be between $x = 0.8$ and 1.2 and M1 (dep on B1 or close attempt at tangent [at any point] for $\frac{\text{rise}}{\text{run}}$ |
| (d) (i) | 5 to 6 | 1 | |
| (ii) | 2 to 2.35 and -2.55 to -2.35 | 2FT | FT <i>their</i> k B1FT for each correct solution |
| (e) | $[a =] -5$ $[b =] -1$ $[c =] 12$ | 3 | B2 for two correct values or for $x^3 - 5x^2 - x + 12 [= 0]$ oe or M1 for $x^2 - 2x + \frac{12}{x} = 3x + 1$ |

Question 14

| | | | |
|-----|---------------------------|-----------|---|
| (a) | 1.5 1.25 -0.75 0.5 | 4 | B1 for each |
| (b) | Fully correct curve | 5 | B5 for correct curve over full domain or B3 FT for 11 or 12 points or B2 FT for 9 or 10 points or B1 FT for 7 or 8 points and B1 independent for one complete branch on each side of the y -axis and not touching or crossing the y -axis SC4 for correct curve with branches joined |
| (c) | -1.35 to -1.25 | 1 | |
| | -0.27 to -0.251 | 1 | |
| | 1.51 to 1.55 | 1 | |
| (d) | $k < 1.2$ or 1.15 to 1.25 | 2 | SC1 for 1.15 to 1.25 seen or horizontal line drawn at min point |
| (e) | tangent ruled at $x = -1$ | B1 | No daylight at $x = -1$ Consider point of contact as midpoint between two vertices of daylight, the midpoint must be between $x = -1.1$ and -0.9 |
| | -1.7 to -1.3 | 2 | dep on B1 or a close attempt at tangent at $x = -1$ or M1 for rise/run also dep on any tangent drawn or close attempt at tangent at any point. Must see correct or implied calculation from a drawn tangent |

Question 15

| | | | |
|---------|--|-----|---|
| (a) | -1.5, 0.5 | 2 | B1, B1 |
| (b) | Correct curve | 5 | B3 FT for 10 or 11 points or B2FT for 8 or 9 points or B1FT for 6 or 7 points and B1 independent for two branches SC4 for correct curve but branches joined |
| (c) | 1.25 to 1.35 | 1 | |
| (d) | -1 | 1 | |
| (e) (i) | $2 - x$ | 1 | |
| (ii) | Ruled line with gradient -1 through $(0, 2)$ and fit for purpose | 2FT | SC1 for ruled line, with gradient -1 or through $(0, 2)$, but not $y = 2$ FT <i>their</i> $y = mx + c$ from (e)(i), if $m \neq 0$ SC1FT for ruled line either with correct gradient or through $(0, c)$, but not $y = c$ |
| | 1.15 to 1.25 cao | 1 | |

Question 16

| | | | |
|-----|---|---------|---|
| (a) | 0 4 0.625 0.875 | 1,1,1,1 | |
| (b) | Fully correct smooth curve | 4 | B3 FT for 8 or 9 points or B2 FT for 6 or 7 points or B1 FT for 4 or 5 points |
| (c) | line $y = x + 1$ ruled and 0.2 to 0.3 and 1.8 to 1.95 | 3 | Line must be fit for purpose ie at least from $x = 0$ to $x = 2$ B2 for correct line and 1 correct value or B1 for correct line or SC1 for no/wrong line and 2 correct values |

| | | | |
|-----|-----------------------------|-----------|--|
| (d) | Tangent ruled at $x = -1.5$ | B1 | No daylight between tangent and curve at point of contact. Consider point of contact as midpoint between two vertices of daylight, the midpoint must be between $x = -1.6$ and $x = -1.4$ |
| | 2.2 to 5 | 2 | dep on B1 M1 for $\frac{\text{rise}}{\text{run}}$ also dep on any tangent drawn or close attempt at tangent at any point Must see correct or implied calculation from a drawn tangent |

Question 17

| | | | |
|-------|---------------------------------|------------|---|
| (i) | 0.25 oe and 1 | 2 | B1 for each |
| (ii) | Correct curve | 4 | B3FT for 6 or 7 correct plots or B2FT for 4 or 5 correct plots or B1FT for 2 or 3 correct plots |
| (iii) | 2.3 | 1FT | Correct or FT where $y = 5$ on <i>their</i> graph |
| (iv) | $y = 3x - 1$ oe 3 term equation | 3 | B2 for $3x - 1$ or $y = 3x [+ c]$ oe or for $m = 3$ and $c = -1$ or M1 for [gradient =] $\frac{8-2}{3-1}$ oe soi by $3x$ and M1 for substitution of (1, 2) or (3, 8) into <i>their</i> $y = mx + c$ |
| (v) | -1.7 to -1.5 and 2 | 2 | B1 for either or M1 for $y = x + 2$ seen or drawn |

Question 18

| | | | |
|-----|---------------------|----------|--|
| (a) | 3.5[0] 1.94 3.11 | 3 | B1 for each |
| (b) | Fully correct curve | 5 | B3 FT for 10 or 11 points or B2 FT for 8 or 9 points or B1 FT for 6 or 7 points B1 indep two separate branches not touching or cutting y -axis SC4 for correct curve, but branches joined |
| (c) | -0.7 to -0.6 | 1 | |

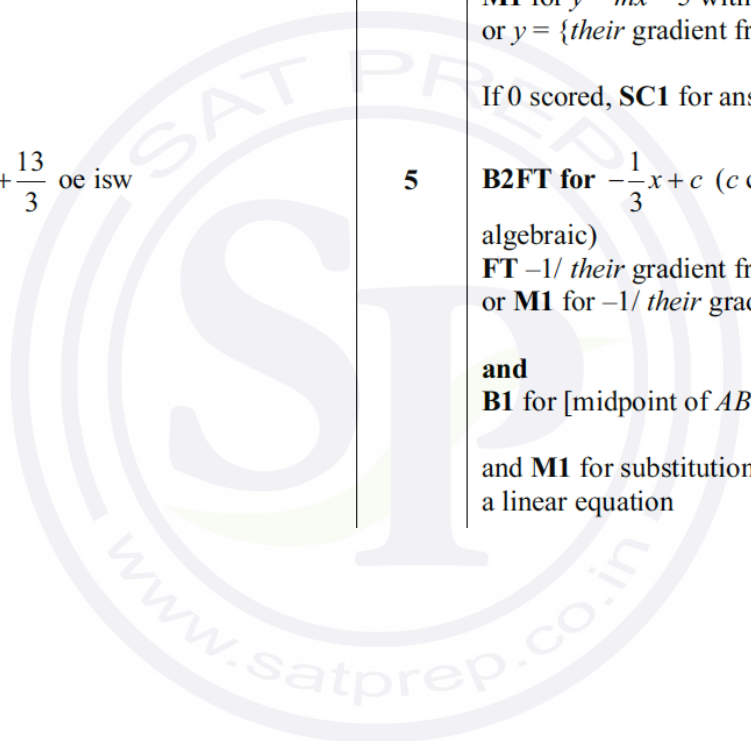
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|---------|---|---|--|
| (d) (i) | -1 2.5 | 1 | |
| (ii) | -0.6 to -0.5 with correct ruled line | 1 | If 0,0, M1 for $y = 2.5 - x$ oe seen in working |
| | | 3 | B2FT for drawing <i>their</i> ruled line from (d)(i) or M1 for ruled line through (0, 2.5)FT or gradient -1 FT |
| (e) | Correct tangent and $0.5 \leq \text{grad} \leq 0.85$ | 3 | B2 for close attempt at tangent at $x = 2$ and answer in range OR B1 for ruled tangent at $x = 2$, no daylight at $x = 2$ Consider point of contact as midpoint between two vertices of daylight, the midpoint must be between $x = 1.8$ and 2.2 and M1 (dep on B1 or close attempt at tangent [at any point] for $\frac{\text{rise}}{\text{run}}$ |

Question 19

| | | | |
|---------|--|-----|--|
| (a) (i) | 10 | 1 | |
| (ii) | -3.4 to -3.3 and -0.4 to -0.3 and 1.6 to 1.7 | 3 | B1 for each |
| (iii) | $y = -2.3$ to -2.1 oe $y = 10$ to 10.1 oe | 2 | B1 for each |
| (b) (i) | 2, -1, 4 | 3 | B1 for each |
| (ii) | Fully correct curve drawn | 4 | SC3 for correct curves but branches joined or touching y -axis or B2FT for 8 or 9 correct plots or B1FT for 6 or 7 correct plots and B1 indep for two separate branches not touching or crossing y - axis |
| (iii) | -3.4 to -3.2 and 1.8 to 1.9 | 2 | B1 for each |
| (c) | 3.2 oe | 2FT | FT 2 ÷ <i>their</i> (a)(i) + 3 M1 for $f(-2) = 10$ or <i>their</i> (a)(i) used |
| (d) | 1 | 1 | |

Question 20

| | | | |
|-----|---|-----|--|
| (a) | 19[.0] or 18.97.. nfw | 3 | M2 for $\sqrt{(4--2)^2 + (13--5)^2}$ oe or M1 for $(4--2)^2 + (13--5)^2$ oe |
| (b) | [y=] 3x + 1 | 3 | B2 for answer [y=]3x + c oe or answer $kx + 1$ ($k \neq 0$) or M1 for $\frac{13--5}{4--2}$ oe or 3 and M1 for correct substitution of $(-2, -5)$ or $(4, 13)$ into $y = (\text{their } m)x + c$ oe |
| (c) | $y = 3x - 5$ oe | 2FT | FT <i>their</i> gradient from (b) M1 for $y = mx - 5$ with other $m, m \neq 0$ or $y = \{\text{their gradient from (b)}\}x + c$ If 0 scored, SC1 for answer $3x - 5$ |
| (d) | $y = -\frac{1}{3}x + \frac{13}{3}$ oe isw | 5 | B2FT for $-\frac{1}{3}x + c$ (c can be numeric or algebraic) FT $-1/$ <i>their</i> gradient from (b) or M1 for $-1/$ <i>their</i> gradient from (b) soi and B1 for [midpoint of $AB =$] $(1, 4)$ and M1 for substitution of $(1, k)$ or $(k, 4)$ into a linear equation |



Question 21

| | | | |
|---|---|---|---|
| (a) (i) | $-2, -0.5$ or $-\frac{1}{2}$ | 2 | B1 for each |
| (ii) | Complete correct curve | 5 | SC4 for correct curves but branches joined or touching y -axis or B3FT 9 or 10 points or B2FT for 7 or 8 points or B1FT for 5 or 6 points |
| | | and B1indep two separate branches not touching or crossing y -axis | |
| (b) | -1.95 to -1.8 -0.4 to -0.2 2.05 to 2.2 | 3 | B1 for each |
| (c) | Any integer k where $k \leq -3$ | 1 | |
| (d) (i) | Correct line $y = -5x - 2$ ruled and -0.4 to -0.2 0.55 to 0.75 | 4 | M2 for correct ruled line or M1 for correct line but freehand or for ruled line gradient -5 or ruled line y -intercept -2 , but not $y = -2$ and A1 for each correct solution dependent on at least M1 |
| If 0 scored, SC1 for both correct with no line drawn | | | |
| (ii) | $[a =] 5$ and $[b =] -2$ | 2 | B1 for one correct value or M1 for $x^3 + 5x^2 - 2x - 1 = 0$ seen |

Question 22

| | | | |
|---------|---|------------|---|
| (a) (i) | $-\frac{1}{2}x + 2$ oe | 3 | <p>SC2 for $y = -\frac{1}{2}x + c$ oe or SC1 for $y = kx + 2$ oe, $k \neq 0$ or M1 for [gradient =] $-\frac{2}{4}$ and M1 for substituting (4, 0) or (0, 2) into $y = (\text{their } m)x + c$</p> |
| (ii) | $\frac{16}{a^2} \left[+ \frac{0^{[2]}}{b^2} \right] = 1$ or $\frac{4^2}{a^2} \left[+ \frac{0^{[2]}}{b^2} \right] = 1$ and $a^{[2]} = 4^{[2]}$ $\left[\frac{0^{[2]}}{a^2} \right] + \frac{4}{b^2} = 1$ or $\left[\frac{0^{[2]}}{a^2} \right] + \frac{2^2}{b^2} = 1$ and $b^{[2]} = 2^{[2]}$ | 1 1 | |
| (b) (i) | 1.73 or 1.732.. or $\sqrt{3}$ | 3 | <p>M2 for $\frac{k^2}{4} = \frac{3}{4}$ or better or M1 for $\frac{2^2}{16} + \frac{k^2}{4} = 1$ oe</p> |
| (ii) | 81.8 or 81.78 to 81.79 | 3 | <p>M2 for $2 \times \tan^{-1} \left(\frac{\text{their} \sqrt{3}}{2} \right)$ oe or M1 for $\tan = \frac{\text{their} \sqrt{3}}{2}$ oe</p> |
| (c) (i) | 8π final answer | 1 | |
| (ii) | 72π final answer | 2FT | <p>FT <i>their</i> (c)(i) $\times 9$ in terms of π M1 for area factor of 3^2 or 9 or [new a] = 12, [new b] = 6</p> |

Question 23

| | | | |
|---------|--|----------------------------|---|
| (a) | 9 10.5 | 1 1 | |
| (b) | Fully correct curve | 5 | SC4 for correct curve, but branches joined B3 FT for 9 or 10 points plotted or B2 FT for 7 or 8 points plotted or B1 FT for 5 or 6 points plotted and B1 for two separate branches not touching or cutting y -axis |
| (c) | 2.1 to 2.6 8.5 to 9 | 1 1 | |
| (d) | 2, 3, 5, 7 | 2 | SC1 for correct 4 values and no more than one extra positive integer or $\pm 2, \pm 3, \pm 5, \pm 7$ or 3 correct values and no extras |
| (e) | $(-2, -12)$ | 1 | |
| (f) (i) | $20 + x^2 = x^3$ $x^3 - x^2 - 20 = 0$ | M1 A1 | Multiplication by x No errors or omissions |
| (ii) | Fully correct curve $y = x^2$ | 2 | SC1 for U – shaped parabola, vertex at origin |
| (iii) | 2.5 to 3.5 | 1 | |
| (iv) | 3.[0] to 3.1 or FT their answer to (iii) | 1FT | FT dep on (iii) > 0 |

Question 24

| | | | |
|-----|---------------|---|---|
| (a) | -4.5 and 10.5 | 2 | B1 for each value |
| (b) | Correct curve | 5 | B4 for correct curve with branches joined OR B3 FT for 9 or 10 points or B2 FT for 7 or 8 points or B1 FT for 5 or 6 points and B1 independent for one branch on each side of the y -axis and not touching or crossing the y -axis |

| | | | |
|---------|--|---|---|
| (c) | 5 | 1 | |
| (d) (i) | Line $y = 15 - 3x$ ruled and -0.4 to -0.31 0.35 to 0.45 2.2 to 2.3 | 4 | B3 for correct line and 2 correct values or B2 for correct line or M1 for ruled line with gradient -3 or through $(0, 15)$ or SC2 for no/wrong line and three correct values or SC1 for no/wrong line and two correct values or for correct freehand line |
| (ii) | $[a =] 6$ $[b =] -14$ $[c =] 0$ | 3 | B2 for $6x^3 - 14x^2 + 2 = 0$ oe or M1 for correct removal of denominator or collection of terms on one side |

Question 25

| | | | |
|---------|--|--------------------------|---|
| (a) | 1 1 | 1 1 | |
| (b) | Fully correct graph | 4 | B3FT for 6 or 7 points plotted or B2FT for 4 or 5 points plotted or B1FT for 2 or 3 points plotted |
| (c) (i) | $-1 < \text{ans} < -0.8$ $1.25 < \text{ans} < 1.45$ $2.5 < \text{ans} < 2.6$ | 1 1 1 | |
| (ii) | $-0.7 < \text{ans} < -0.5$ | 2 | M1 for evidence of $y = -x$ or $\frac{x^3}{3} - x^2 + 1 = -x$ |
| (d) (i) | $y = 1$ to 1.1 oe $y = -0.4$ to -0.33 oe | 1FT 1FT | FT only if a clear maximum point FT only if a clear minimum point |
| (ii) | -0.4 to -0.33 oe | 1FT | Correct or FT <i>their</i> graph |

Question 26

| | | | |
|-----|--|---|---|
| (a) | 0.92,, 0.5, -1,, -1, 0.5,, 0.92 | 3 | B2 for 4 or 5 correct or B1 for 2 or 3 correct |
| (b) | Fully correct graph | 5 | B4 for correct graph but branches joined OR B3FT for 11 or 12 correct points or B2FT for 9 or 10 correct points or B1FT for 7 or 8 correct points |

| | | | |
|---------|---|--------|---|
| (c) (i) | Correct ruled line through $(-2, 1)$ and $(2, -3)$ | 2 | B1 for straight line with gradient -1 or cutting y -axis at -1 or correct line but freehand or short correct ruled line |
| (ii) | 0.7 to 0.95 | 1 | |
| (iii) | $[p =] 2$ and $[q =] -2$ | 3 | B2 for $x^3 + 2x^2 - 2 = 0$ oe or B1 for $x^2 - 2 = -x^3 - x^2$ oe or better or $1 + 1 - \frac{2}{x^2} + x [= 0]$ or better |
| (d) (i) | (1.3 to 1.6, 0) | 1 | |
| (ii) | Ruled line from $(0, -2)$ to intersection of <i>their</i> graph with positive x -axis | 1FT | |
| (iii) | Tangent [to curve] A or (1.3 to 1.6, 0) | 1 1 | |

Question 27

| | | | |
|---------|--|-------------------------------|--|
| (a) | 0 0.5 oe 1.25 oe | 1, 1, 1 | |
| (b) | Fully correct smooth curve | 4 | B3 FT for 7 or 8 points or B2 FT for 5 or 6 points or B1 FT for 3 or 4 points |
| (c) | 3.6 to 3.8 | 2 | M1 for $y = 3.5$ soi |
| (d) | line $y = x + 1$ ruled -1.55 to -1.40 4.55 to 4.8 | M1 A1 A1 | If 0 scored SC1 for $y = x + 1$ stated or implied or for 2 correct values given |
| (e) (i) | Point plotted at $(5, 5)$ | 1 | |
| (ii) | Tangent ruled from A | 1 | |
| (iii) | 1.2 to 1.4 | B2 | B2 and M1 dep on reasonable attempt at tangent from $(5, 5)$ M1 for change in y / change in x of <i>their</i> ruled line |

Question 28

| | | | |
|----------|----------------------------|-----|--|
| 3(a) | 0 2.25 2 1.25 | 4 | B1 for each |
| 3(b) | Fully correct smooth curve | 4 | B3 FT for 7 or 8 points or B2 FT for 5 or 6 points or B1 FT for 3 or 4 points |
| 3(c) | 1 | 1 | |
| 3(d)(i) | $[y =]x + 1$ | 1 | |
| 3(d)(ii) | -2.2 to -2.1 | 1 | |
| | -0.45 to -0.4 | 1 | |
| | 0.51 to 0.6 | 1 | If zero scored, SC1 for <i>their</i> line in (d)(i) drawn. It must be of the form $y = mx + c$ ($m \neq 0$) and drawn 'fit for purpose' |
| 3(e) | $-1.33 < k < 0$ to 0.1 | 2FT | FT Strict fit of <i>their</i> max point and min point dep on cubic graph or accept correct answer from calculus B1 for each If zero scored, SC1 for two correct values reversed |

Question 29

| | | | |
|---------|--|-------|--|
| 4(a) | -1.75 to -1.7 | 1 | |
| | 1.7 to 1.75 | 1 | |
| (b)(i) | Correct ruled solid tangent at (-1.5, 3.5) | 1 | |
| (b)(ii) | -7 to -5 | 2 dep | dep on close attempt at ruled solid tangent at $x = -1.5$ in part (b)(i) M1 for rise/run dep on close attempt at ruled solid tangent at $x = -1.5$ |
| (c)(i) | 1 | 1 | |
| (c)(ii) | Correct curve | 3 | B2 for 4 or 5 correct points or B1 for 2 or 3 correct points |

| | | | |
|---------|--|-----|-----------------------------------|
| (d)(i) | -0.95 to -0.8 | 1 | |
| | 1.1 to 1.45 | 1 | |
| (d)(ii) | <i>their</i> (-0.95 to -0.8) < x < <i>their</i> (1.1 to 1.45) oe | 1FT | correct or FT their (d)(i) |
| (e)(i) | 0.125 oe and 0.03125 oe and 0.000976 to 0.000977 oe | 1 | |
| (e)(ii) | 0 | 1 | accept zero, nought, etc |

Question 30

| | | | |
|-----|---|-----------|---|
| (a) | -1.6 to -1.4 | 1 | |
| (b) | -0.5 | 1 | |
| (c) | $k > -4$ | 2 | B1 for identifying the -4 or for horizontal line drawn $y = -4$ |
| (d) | $y = x - 5$ ruled and -2.3 to -2.1 -1.2 to -1.1 1.3 to 1.4 | 3 | B2 for correct line and 2 correct values or no line and 3 correct values or B1 for no line and 2 correct values or B1 for correct line |
| (e) | Tangent ruled at $x = 1$ | B1 | No daylight at point of contact. Consider point of contact as midpoint between two vertices of daylight, the midpoint must be between $x = 0.8$ and 1.2 |
| | -6 to -4 | 2 | Dep on B1 or close attempt at tangent at $x = 1$ M1 for rise/run for <i>their</i> tangent at $x = 1$ |

Question 31

| | | | |
|---------|----------------------------------|---|--------------------------------|
| (a)(i) | 5 | 1 | |
| (a)(ii) | $-\frac{3}{2}$ oe | 1 | |
| 8(b) | $\left(\frac{4}{5}, 0\right)$ oe | 2 | M1 for $5x - 4 = 0$ soi |

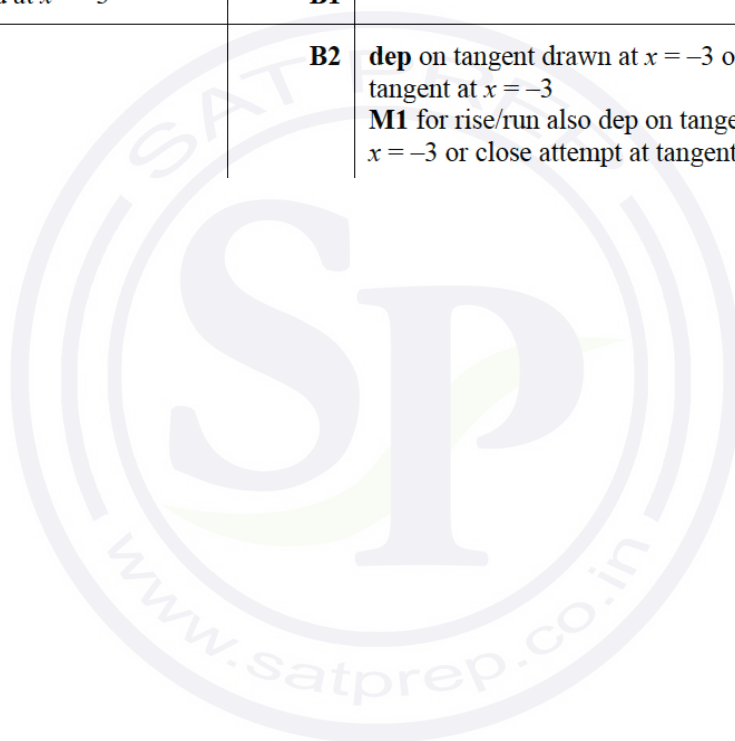
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|-----|-------------------------------|---|--|
| (c) | $y = -0.2x + 11$ final answer | 4 | M2 for $y = -0.2x + c$ oe (any form) FT <i>their (a)</i> or B1FT for $\text{grad} = \frac{-1}{\text{their (a)(i)}}$ soi and M1 for substitution of (10, 9) into <i>their</i> equation |
| (d) | (2, 6) | 3 | M1 for elimination of one variable A1 for $x = 2$ or $y = 6$ |
| (e) | 13 | 3 | M2 for $(4 + 9) \times \text{their } 2 \div 2$ oe or B1 for 9 oe or 4 or -4 seen |

Question 32

| | | | |
|-----|---|-----|---|
| (a) | 9, -6, 9 | 3 | B1 for each |
| (b) | Correct graph | 4 | B3FT for 6 or 7 correct points or B2FT for 4 or 5 correct points or B1FT for 2 or 3 correct points |
| (c) | -3.5 to -3.35 and 0.8 to 0.9.. | 2FT | FT <i>their</i> graph B1FT for either |
| (d) | $a = \frac{5}{4}$ or $1\frac{1}{4}$ or 1.25 $b = -\frac{49}{8}$ or $-6\frac{1}{8}$ or -6.125 | 3 | B2 for either correct or M1 for $[2]\left(x + \frac{5}{4}\right)^2$ seen isw or for $2x^2 + 4ax + 2a^2 + b$ |

Question 33

| | | | |
|---------|--|-----------|---|
| 5(a) | 3.2 or 3.15 or 3.152 to 3.153 5.2 or 5.19 or 5.20 or 5.196... | 2 | B1 for each |
| 5(b) | Correct graph for $0.5 \leq x \leq 3.5$ | 4 | B3FT for 6 or 7 correct points or B2FT for 4 or 5 correct points or B1FT for 2 or 3 correct points |
| 5(c) | 1.7 to 1.8 | 1FT | FT <i>their</i> graph if one answer |
| (d)(i) | Any integer $k \geq -1$ | 1 | |
| (d)(ii) | Any integer $k < -1$ | 1 | |
| 5(e) | Tangent ruled at $x = -3$ | B1 | |
| | 2.5 to 4 | B2 | dep on tangent drawn at $x = -3$ or close attempt at tangent at $x = -3$ M1 for rise/run also dep on tangent at $x = -3$ or close attempt at tangent at $x = -3$ |



| | | | |
|---------|--|-----------|--|
| (f)(i) | $y = 6 - x$ ruled accurately | M2 | M1 for correct line but freehand or ruled line gradient -1.1 to -0.9 , or through $(0, 6)$ but not $y = 6$ |
| | $2.85 \leq x \leq 3$ | A1 | |
| (f)(ii) | $[a =] 8$ $[b =] -48$ $[c =] -16$ | 4 | B3 for 2 correct or $x^5 + 8x^3 - 48x^2 - 16 = 0$ seen or $-x^5 - 8x^3 + 48x^2 + 16 = 0$ seen or M2 for correct multiplication by $8x^2$ or B1 for answers $\pm 8, \pm 48, \pm 16$ or M1 for $\frac{x^2 \times x^3 - 8 \times 2}{x^2 \times 8} = 6 - x$ or M1 for correct multiplication by 8 or M1 for correct multiplication by x^2 |

Question 34

| | | | |
|----------|---|----------|---|
| 0(a) | 10.8 or 10.81 to 10.82 | 3 | M2 for $\sqrt{(6 - (-3))^2 + (-2 - 4)^2}$ oe or M1 for $(6 - (-3))^2 + (-2 - 4)^2$ oe |
| (b)(i) | (6, 4) | 2 | B1 for each |
| (b)(ii) | 2 | 2 | M1 for $\frac{12 - (-4)}{10 - 2}$ oe |
| (b)(iii) | $y = -\frac{1}{2}x + 4$ oe final answer | 3 | M1 for gradient = $-\frac{1}{2}$ or $-\frac{1}{\text{their (b)(ii)}}$ M1 for $(2, 3)$ substituted into <i>their</i> $y = mx + c$ or $y - y_1 = m(x - x_1)$ oe |

Question 35

| | | | |
|---------|---|----------|--|
| (a) | 0 -0.17 2.4 | 3 | B1 for each |
| (b) | Fully correct smooth curve | 4 | B3FT for 9 or 10 correct points or B2FT for 7 or 8 correct points or B1FT for 5 or 6 correct points |
| (c) | $x \leq 0.17$ to 0.25 and $x \geq 2.25$ to 2.3 | 3 | B2 for strict inequalities or one correct or B1 for 0.17 to 0.25 and 2.25 to 2.3 seen |
| (d)(i) | $y = 4 - x$ oe final answer | 2 | B1 for $4 - x$ or $y = k - x$ or $y = 4 + kx$ oe |
| (d)(ii) | correct ruled line | 1 | FT if in form $y = mx + c$ oe ($m, c \neq 0$) |
| | 0.125 to 0.2 and 2.15 to 2.2 | 2 | B1 for each |

Question 36

| | | | |
|---------|-----------------------------|---|---|
| (a)(i) | 1,,,, 16 | 2 | B1 for each |
| (a)(ii) | 14,,,, -2 | 2 | B1 for each |
| 2(b) | Fully correct smooth curves | 6 | B3 for correct curve of $y = 2^x$ or B2FT for 4 or 5 correct points or B1FT for 2 or 3 correct points B3 for correct curve of $y = 14 - x^2$ or B2FT for 4 or 5 correct points or B1FT for 2 or 3 correct points |
| (c)(i) | 3.5 to 3.7 | 1 | |
| (c)(ii) | 2.65 to 2.8 | 1 | |
| (d)(i) | Correct line | 1 | Ruled, through (4, 2) and gradient -4 |
| (d)(ii) | Tangent (2, 10) | 2 | B1 for each |

Question 37

| | | | |
|---------|--|---|--|
| (a) | $-2[.0], -0.2, 2.5$ | 3 | B1 for each |
| (b) | Fully correct curve | 5 | B4 for correct curve, but branches joined or B3FT for 9 or 10 correct plots or B2FT for 7 or 8 correct plots or B1FT for 5 or 6 correct plots and B1 indep two separate branches not touching or cutting y-axis |
| (c)(i) | Correct tangent and $3 \leq \text{grad} \leq 5$ | 3 | B2 for close attempt at tangent to curve at $x = -2$ and answer in range OR B1 for ruled tangent at $x = -2$, no daylight at $x = -2$ and M1dep (dep on B1 or close attempt at tangent) [at $x = -2$] for $\frac{\text{rise}}{\text{run}}$ |
| (c)(ii) | [y =] their(c)(i) x + their y-intercept final answer | 2 | Strict FT their y-intercept for their line M1 for $y = \text{their(c)(i)} x + \text{any value}$ or 'c' oe seen or for $y = \text{any value}(\text{non-zero}) x$ or 'mx' + their y-intercept seen oe |

| | | | |
|---------|--|----------|--|
| (d)(i) | 1.05 to 1.25 | 1 | |
| (d)(ii) | - 2.3 to - 2.2 - 0.4 to - 0.3 0.3 to 0.4 | 3 | B1 for each After 0 scored B1 for $y = -4$ ruled |
| i(e) | [a =] 2 [b =] 24 [n =] 5 | 3 | B2 for 2 correct or for $2x^5 + 24x^2 [-3 = 0]$ or B1 for 1 correct or for $\frac{2x^5 - 3 + 4(6x^2)}{6x^2} [= 0]$ oe If 0 scored SC1 for $2x^5$ seen in final line of algebra |

Question 38

| | | | |
|---------|---|-----------|---|
| (a) | $x = 0$ | 1 | |
| (b) | Tangent ruled at $x = 0.5$ | B1 | No daylight between tangent and curve at point of contact |
| | -9 to -6.5 | 2 | dep on ruled tangent or close attempt at tangent at $x = 0.5$ M1 for rise/run also dep on tangent or close attempt at tangent at $x = 0.5$ |
| (c)(i) | 0 2.4 or better 4 | 3 | B1 for each |
| (c)(ii) | Correct smooth curve | 4 | B3FT for 6 or 7 correct plots or B2 FT for 4 or 5 correct plots or B1 FT for 2 or 3 correct plots FT <i>their</i> table |
| (d) | $x^3 + 3x + 4 = 10 - 8x^2$ and correctly completed | 1 | |
| (e) | line $y = -2x + 2$ drawn and -0.45 to -0.35 nfw | 3 | B2 for ruled $y = -2x + 2$ or B1 for $-2x + 2$ seen or for line $y = -2x + c$ drawn or for $y = cx + 2$ ($c \neq 0$) drawn and B1 for -0.45 to -0.35 nfw |

Question 39

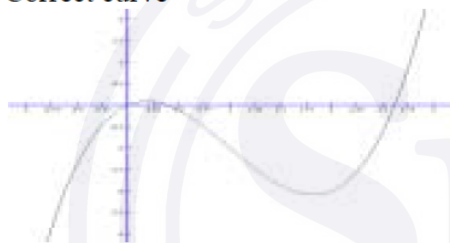
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|----------|--|---|---|
| (a) | -3, 17 | 2 | B1 for each |
| (b) | Fully correct curve | 4 | B3 FT for 10 or 11 points or B2 FT for 8 or 9 points or B1 FT for 6 or 7 points |
| (c)(i) | Correct ruled tangent for <i>their</i> curve through (0, -17) | 1 | |
| (c)(ii) | (1.7 to 2.2, -1 to 2.5) | 1 | |
| (c)(iii) | [y =] 9x - 17 final answer | 3 | M2dep for answer [y =] 9x[+] - c OR M1dep for gradient = $\frac{\text{rise}}{\text{run}}$ for <i>their</i> tangent at any point B1 for answer [y =] kx[+] - 17 ($k \neq 0$) |
| (d) | y = 3x + 2 ruled correctly and -2.2 ... to -2.1 -0.6 to -0.4 2.6 to 2.8 | 4 | B2 for y = 3x + 2 ruled or B1 for [y =] 3x + 2 soi or y = 3x + k ruled or y = kx + 2 but not y = 2 B2 for all 3 values or B1 for 2 values |

Question 40

| | | | |
|-----|-------------------------------|---|--|
| (a) | (5, 6) | 1 | |
| (b) | [y =] $-\frac{4}{5}x + 3$ nfw | 3 | B2 for [y =] $-\frac{4}{5}x + c$ nfw or M1 for $\frac{\text{rise}}{\text{run}}$ using any two of (-5, 7) (0, 3) and (5, -1) and B1 for [y =] mx + 3 ($m \neq 0$) |
| (c) | y = $-\frac{4}{5}x - 2$ oe | 2 | FT <i>their</i> gradient from 8(b) B1 for y = (<i>their</i> gradient)x + c (c not 0) or for y = mx - 2 ($m \neq 0$) or for $-\frac{4}{5}x - 2$ alone |

| | | | |
|----------|---------------------------|---|--|
| (d)(i) | $y = \frac{5}{4}x + 4$ oe | 3 | M1 for $\frac{1}{\text{their gradient}}$ from 8(b) M1 for (8, 14) substituted into their $y = mx + c$ or $\frac{y-14}{x-8} = m$ or better |
| (d)(ii) | 8.54 or 8.544... | 3 | M2 for $(14 - \text{their } 6)^2 + (8 - \text{their } 5)^2$ or better or M1 for $14 - \text{their } 6$ and $8 - \text{their } 5$ seen |
| (d)(iii) | (4, 6) | 2 | B1 for each |

Question 41

| | | | |
|---------|---|---|---|
| (a) | 0 -2 0.9 | 3 | B1 for each |
| (b) | Correct curve  | 4 | B3 FT for 9 or 10 points or B2 FT for 7 or 8 points or B1 FT for 5 or 6 points |
| (c) | -0.45 to -0.35 1 2.35 to 2.45 | 3 | FT their graph B1 for each in the correct position If zero scored, SC1FT for 3 correct values |
| (d)(i) | $y = 1 - x$ oe | 2 | B1 for $y = 1 - kx$ oe, $k \neq 0$ or $y = k - x$ oe or $1 - x$ |
| (d)(ii) | Correct ruled line and 2.25 to 2.4 | 3 | B2FTdep for correct ruled line or B1 dep for line through (0, 1) when extended but not $y = 1$ or with gradient -1.1 to -0.9 or correct line but freehand or SC2 for $y = x - 1$ ruled after answer [$y =$] $x - 1$ in (d)(i) and B1 for 2.25 to 2.4 |
| (e) | Correct tangent and 1.7 to 3.7 | 3 | No daylight between tangent and curve at $x = -0.25$. Point of contact is the midpoint between two vertices of daylight and this point of contact must be between -0.35 and -0.15 B2 for close attempt at tangent at $x = -0.25$ and answer in range |

Question 42

| | | | |
|-----|--|-----------|--|
| (a) | -2.1, 1.6, -1.7, 2.1 | 3 | B2 for 3 correct or B1 for 2 correct |
| (b) | Fully correct curve | 4 | B3FT for 8 or 9 correct plots or B2FT for 6 or 7 correct plots or B1FT for 4 or 5 correct plots |
| (c) | line $y = \frac{1}{2}(1-x)$ ruled | M2 | M1 for line with gradient $-\frac{1}{2}$ M1 for line through $(0, \frac{1}{2})$ but not $y = \frac{1}{2}$ |
| | -2.15 to -2.01 -0.45 to -0.2 2.25 to 2.45 | B2 | B1 for two correct |
| (d) | number of intersections of <i>their</i> curve and the line $y = 1$ | 1 | strict FT for <i>their</i> curve |

Question 43

| | | | |
|-----------|-----------------------------|---|--|
| i(a)(i) | -3 | 1 | |
| (a)(ii) | 6.2 to 6.4 oe | 2 | M1 for 3 seen or used |
| (b) | $y = 5 - 3x$ ruled | 2 | B1 for $y = 5 - 3x$ soi or ruled line with gradient -3 or with y -intercept at 5 (but not $y = 5$) or B1FT for incorrect line equation/expression shown in working and <i>their</i> line correctly drawn |
| | -0.3 to -0.2 1.65 to 1.8 | 2 | B1 for each, dep on $y = 5 - 3x$ drawn or FT <i>their</i> line provided equation/expression shown in working, dep on B1FT for line |
| (c) | Tangent ruled at $x = -2$ | 1 | B1 for correct tangent |
| | -4.5 to -2.5 | 2 | Dep on B1 for tangent or close attempt at tangent at $x = -2$ M1 for rise/run also dep on tangent drawn or close attempt at correct tangent Must see correct or implied calculation from a drawn tangent |
| 5(d)(i) | 8, 4, 0.25 oe | 3 | B1 for each |
| 5(d)(ii) | Correct graph | 3 | B2FT for 6 or 7 correct plots or B1FT for 4 or 5 correct plots |
| i(d)(iii) | 1.8 to 1.9 | 1 | |

Question 44

| | | | |
|---------|---|-----------|---|
| (a) | 2.45, 0.25, - 0.25 | 3 | B1 for each |
| (b) | Fully correct smooth curve | 4 | B3FT for 6 or 7 points or B2 FT for 4 or 5 points or B1 FT for 2 or 3 points |
| (c) | 0.7 to 0.8 | 1 | FT <i>their</i> curve |
| (d)(i) | Correct ruled line | 2 | M1 for good freehand, or ruled line with gradient -1.05 to -0.95 or ruled line through (0, 2) but not line $y = 2$ |
| (d)(ii) | Both intersections of <i>their</i> (b) and <i>their</i> (d)(i) | 2 | Strict FT intersection of <i>their</i> (b) and <i>their</i> (d)(i) B1FT for one correct OR B2 for 0.27 to 0.28 and 2.38 to 2.39 |
| (e) | Substitutes $x = \sqrt{2}$ into $\frac{1}{2x} - \frac{x}{4}$ OR Identifies $y = 0$ oe OR Correctly manipulates to a single fraction e.g. $\frac{2-x^2}{4x}$ oe seen | M1 | |
| | Concludes 'read the graph at $y = 0$ ' oe OR Manipulates $0 = \frac{1}{2x} - \frac{x}{4}$ oe leading to $x^2 = 2$ OR States $\frac{2-x^2}{4x}$ oe = 0 leading to $x^2 = 2$ | A1 | |

Question 45

| | | | |
|---------|----------------------------------|---|---|
| (a)(i) | 1.5 oe | 1 | |
| (a)(ii) | (0, 2) | 1 | |
| (b)(i) | $y = -2x + 6$ oe final answer | 3 | B2 for $y = -2x + c$ oe or $y = mx + 6$ oe $m \neq 0$ or for answer $-2x + 6$ or B1 for [gradient =] $-\frac{6}{3}$ oe or $c = +6$ soi |
| (b)(ii) | $y = 0.5x - 1.5$ oe final answer | 3 | B1 for [gradient =] -1 divided by <i>their</i> gradient from (b)(i) evaluated soi M1 for substitution of (9, 3) into $y = (\text{their } m)x + c$ seen in working |
| (c)(i) | 12.6 or 12.64 to 12.65 | 3 | M2 for $\sqrt{(8 - -4)^2 + (5 - 1)^2}$ oe or M1 for $(8 - -4)^2 + (5 - 1)^2$ oe |
| (c)(ii) | (2, 3) | 2 | B1 for each |

Question 46

| | | | |
|-----|-----------------|-----------|--|
| (a) | 2, 2, 6 | 3 | B1 for each |
| (b) | Correct graph | 4 | B3FT for 10 or 11 correct plots or B2FT for 8 or 9 correct plots or B1FT for 6 or 7 correct plots |
| (c) | -3.3 to -3.1 | 1 | FT <i>their</i> graph |
| (d) | $y = -2x$ ruled | M1 | or B1 for $y = -2x$ stated |
| | -2.6 to -2.45 | A1 | |
| (e) | 3 or 4 or 5 | 1 | FT <i>their</i> graph Allow more than one correct value |

Question 47

| | | | |
|-----|---------------------------------|---|---|
| (a) | 5, -3, 21 | 3 | B1 for each |
| (b) | Fully correct curve | 4 | B3 FT for 9 or 10 points or B2 FT for 7 or 8 points or B1 FT for 5 or 6 points |
| (c) | -2.9 to -2.7 0 1.7 to 1.9 | 2 | B1 for 2 correct values |

| | | | |
|-----|--------------------------|-----------|--|
| (d) | Tangent ruled at $x = 2$ | B1 | |
| | 10 to 14 | B2 | Dep on correct tangent or close attempt at tangent at $x = 2$ M1 for rise/run also dep on correct tangent drawn or close attempt at tangent Must see correct or implied calculation from a drawn tangent |
| (e) | 6 | 1 | |

Question 48

| | | | |
|---------|---|----------|--|
| (a) | 3.5, 15, 3.9 | 3 | B1 for each |
| (b) | Correct graph | 5 | B4 for correct curves but branches joined or touching y -axis or B3FT 10 or 11 points or B2FT for 8 or 9 points or B1FT for 6 or 7 points B1indep two separate branches not touching or crossing y -axis |
| (c) | 0.5 to 0.6 and 1.3 to 1.6 | 2 | B1 for each or both correct but in reverse order |
| (d) | 1 | 1 | |
| (e)(i) | $y = 3x + 1$ ruled and 0.3 to 0.49 | 3 | B2 for correct ruled line that crosses <i>their</i> curve or B1 for $y = 3x + 1$ soi or freehand line or ruled line with gradient 3 or with y – intercept at 1 (but not $y = 1$) |
| (e)(ii) | $[a =] -6$ $[b =] -2$ $[c =] -4$ | 3 | M2 for $x^4 + 2 - 4x = 6x^3 + 2x^2$ or better seen or B1 for each correct value to a maximum of 2 marks If 0 scored, SC1 for answer $[a =] 6, [b =] 2$ and $[c =] 4$ or for $x^5 + 2x - 4x^2 = 6x^4 + 2x^3$ or better |

Question 49

| | | | |
|------|---|---|---|
| (i) | (3, 5.5) | 2 | B1 for either value correct |
| (ii) | $\frac{5}{4}x + \frac{7}{4}$ final answer | 3 | B2 for answer $\frac{5}{4}x + c$ oe or for correct equation in different form or M1 for $\frac{8-3}{5-1}$ oe and M1 for correct substitution shown of (1, 3) or (5, 8) or <i>their</i> (a)(i) into $y = (\textit{their } m)x + c$ oe |

Question 50

| | | | |
|----------|--|---|--|
| 2(a)(i) | 3 2.25 1 | 3 | B1 for each |
| (a)(ii) | Fully correct smooth curve | 4 | B3FT for 7 or 6 correct plots B2FT for 5 or 4 correct plots B1FT for 3 correct plots |
| (a)(iii) | -0.6 to -0.51, 0.75 to 0.85, 1.7 to 1.85 | 3 | B1 for each If 0 scored, SC1 for $y = 1.5$ drawn |
| (a)(iv) | -3 or -2 or -1 or 0 | 1 | |
| 2(b)(i) | Tangent ruled at $x = 1$ | 1 | |
| (b)(ii) | 4.4 to 5.6 | 2 | Dep on tangent at $x = 1$ or close attempt M1 for rise/run for <i>their</i> line |
| (b)(iii) | $y = (4.4 \text{ to } 5.6)x - (1.8 \text{ to } 2.2)$ or [$y =$] <i>their</i> (b)(ii) $x + \textit{their}$ (y -intercept) | 2 | FT for any line but not horizontal or vertical line for 2 marks or B1 B1FT for [$m =$] <i>their</i> 5 or for <i>their</i> y -intercept |

Question 51

| | | | |
|--------|--|---|--|
| (a)(i) | $\left(-\frac{1}{2}, 4\right)$ and $\left(\frac{1}{2}, 2\right)$ | 5 | B2 for $12x^2 - 3 = 0$ or B1 for $12x^2$ or -3 M1 for <i>their</i> derivative = 0 or $dy/dx = 0$ B1 for [$x =$] $-\frac{1}{2}$ and $\frac{1}{2}$ or one coordinate pair correct |
|--------|--|---|--|

| | | | |
|---------|---|-----------|---|
| (a)(ii) | $\left(-\frac{1}{2}, 4\right)$ Max with reason $\left(\frac{1}{2}, 2\right)$ Min with reason | 3 | B2 for one correct with reason or M1 for correct attempt to find e.g. 2nd derivative/gradients/sketch |
| (b) | line $y = x + 3$ ruled | M2 | B1 for $[y =]x + 3$ identified or rules $y = x + k$ or $y = px + 3$ |
| | -0.7 to -0.8 2.7 to 2.8 | A1 | |

Question 52

| | | | |
|---------|----------------------|-----------|--|
| (a)(i) | $x + 5$ | 2 | B1 for linear equation with positive gradient or intercept 5 |
| (a)(ii) | $2 \sin x$ oe | 2 | B1 for recognition of sin or $\cos(x - 90)$ |
| (b) | tangent ruled at P | B1 | |
| | 1.3 to 1.4 | B2 | dep on tangent drawn M1 for rise/run |

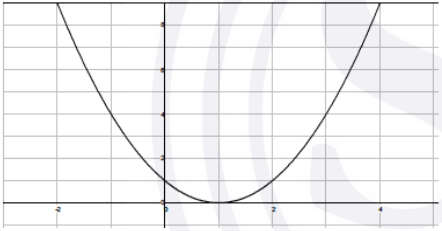
Question 53

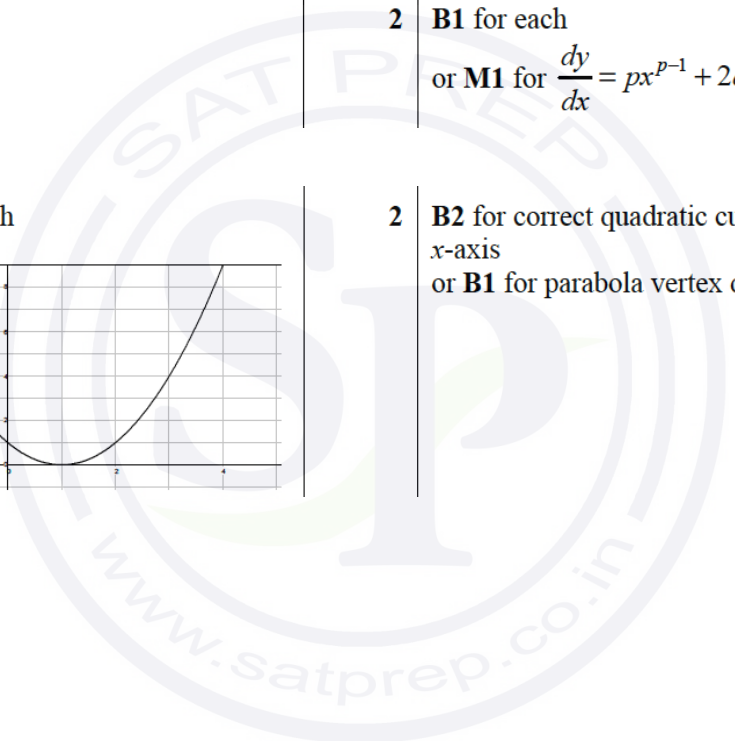
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|----------|-------------------------------------|---|---|
| (a)(i) | $\frac{3}{8}$ | 2 | M1 for $8y = 3x + 20$ or better |
| (a)(ii) | $(0, 2.5)$ oe | 1 | |
| (a)(ii) | $(0, 2.5)$ oe | 1 | |
| (b)(i) | 15.6 or 15.62... | 3 | M2 for $\sqrt{(9 - -3)^2 + (-2 - 8)^2}$ oe seen or M1 for $(9 - -3)^2$ or $(-2 - 8)^2$ oe seen |
| (b)(ii) | $y = -\frac{5}{6}x + 4$ oe | 3 | M1 for gradient $\frac{-2 - 8}{9 - -3}$ oe M1 for substituting $(6, -1)$ into a linear equation oe |
| (b)(iii) | $y = \frac{6}{5}x - \frac{3}{5}$ oe | 4 | M1 for gradient -1 / <i>their</i> $\left(-\frac{5}{6}\right)$ B1 for midpoint at $(3, 3)$ M1 for <i>their</i> midpoint substituted into $y = \text{their } m \times x + c$ oe |

Question 54

| | | | |
|---------|---------------------|---|---|
| (a)(i) | 5 | 2 | M1 for $(-1)^4 - 4(-1)^3$ |
| (a)(ii) | (0, 0) and (3, -27) | 6 | B2 for $4x^3 - 12x^2 [= 0]$ or B1 for $4x^3$ or $12x^2$ AND M1 for derivative = 0 or <i>their</i> derivative = 0 M1 for $4x^2(x - 3)[= 0]$ B1 for [x =] 0 and [x =] 3 or [y =] 0 and [y =] -27 or for one correct coordinate pair |
| (b) | [p =] 11 [q =] 5 | 2 | B1 for each or M1 for $\frac{dy}{dx} = px^{p-1} + 2qx^{q-1}$ |

Question 55

| | | | |
|--------|--|---|--|
| (i)(a) | Correct sketch  | 2 | B2 for correct quadratic curve with min touching x-axis or B1 for parabola vertex downwards |
|--------|--|---|--|



(i)(b)

Correct sketch



2

B2 for correct straight line intersecting curve on y-axis
or **B1** for straight line with positive gradient and positive y-intercept

(ii)

2.8[0] or 2.795...

7

B3 for $x^2 - \frac{5}{2}x = 0$ oe

or **M1** for $(x-1)^2 = \frac{1}{2}x+1$

B1 for $[(x-1)^2 =] x^2 - x - x + 1$

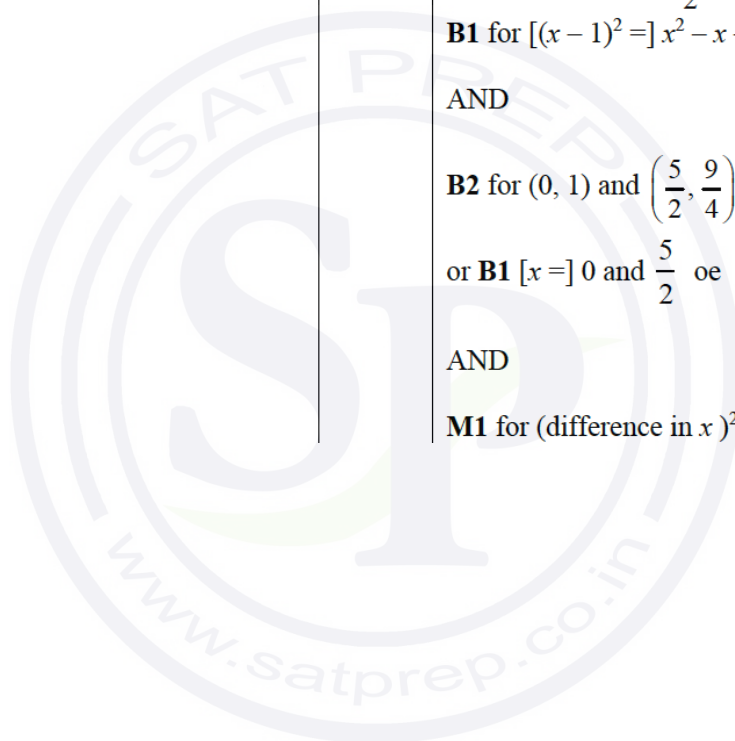
AND

B2 for $(0, 1)$ and $(\frac{5}{2}, \frac{9}{4})$ oe

or **B1** $[x =] 0$ and $\frac{5}{2}$ oe

AND

M1 for $(\text{difference in } x)^2 + (\text{difference in } y)^2$



Question 56

| | | | |
|----------|--|----|--|
| (a)(i) | 15.7 or 15.65... | 3 | M2 for $\sqrt{(4-10)^2 + (4-3)^2}$ oe or M1 for $(-4-10)^2 + (4-3)^2$ oe |
| (a)(ii) | $\frac{-10-4}{4-3}$ [= -2] oe | M1 | |
| | 10 = -2(-3) + c Or -4 = -2(4) + c and correct completion to $y = -2x + 4$ | A1 | |
| (a)(iii) | $y = \frac{1}{2}x + \frac{11}{4}$ oe | 4 | M1 for grad = $\frac{1}{2}$ soi M1 for [midpoint =] ($\frac{1}{2}$, 3) M1 for substitution of (1/2, 3) into <i>their</i> $y = mx + c$ oe |
| (b)(i) | $(-\frac{1}{3}, -\frac{22}{27})$ oe and (-5, 50) | 6 | B2 for $3x^2 + 16x + 5$ Or B1 for one correct M1 for derivative = 0 or <i>their</i> derivative = 0 M1 for $[x =] -\frac{1}{3}$ and $[x =] -5$ B1 for $-\frac{22}{27}$ and 50 |
| (b)(ii) | $(-\frac{1}{3}, -\frac{22}{27})$ minimum (-5, 50) maximum with correct reasons | 3 | B2 for one correct with reason or M1 for correct attempt e.g. 2 nd derivatives, gradients or sketching |

Question 57

| | | | |
|---------|---|---|--|
| (a)(i) | Correct sketch | 2 | B1 for correct shape but inaccurate |
| (a)(ii) | Rotational [symmetry] order 2 [centre] (180, 0) | 2 | B1 for rotational [symmetry] |
| (b) | 48.6 or 48.59 to 48.60 and 131.4 or 131.40 to 131.41 | 3 | B2 for 48.6 or 48.59 to 48.60 or 131.4 or 131.40 to 131.41 or M1 for $\sin x = 0.75$ or better If 0 scored, SC1 for two answers adding to 180 |
| (c)(i) | $(x + 5)^2 - 11$ | 2 | M1 for $(x + 5)^2 + k$ or $(x + \textit{their } 5)^2 + 14 - (\textit{their } 5)^2$ or $a = 5$ |
| (c)(ii) | Sketch of U-shaped parabola with a minimum indicated at (-5, -11) with no part of graph in 4 th quadrant | 3 | FT <i>their</i> $(x + 5)^2 - 11$ provided in that form B1 for U shape curve B1FT for turning point at (-5, k) or (k , -11) |

Question 58

(1.74 , 7.21 to 7.24)
and
(-3.74 , -9.20 to -9.22) cao

6 For the y values accept any value rounded to 2 decimal places in the given range

B5 for (1.74 , 7.21 to 7.24)
or (-3.74 , -9.20 to -9.22)
or $x = 1.74$ and $x = -3.74$

OR

M2 for $2x^2 + 4x - 13 = 0$
or $2y^2 + 4y - 133 = 0$

or **M1** for $2x^2 + 7x - 11 = 3x + 2$

or $y = 2\left(\frac{y-2}{3}\right)^2 + 7\left(\frac{y-2}{3}\right) - 11$

AND

FT *their* quadratic expression (not $2x^2 + 7x - 11$)

M2FT for $\frac{-4 \pm \sqrt{4^2 - 4 \times 2 \times -13}}{2 \times 2}$

or $-1 \pm \sqrt{\frac{15}{2}}$ oe

or **M1FT** for $\sqrt{4^2 - 4 \times 2 \times -13}$ oe

or for $\frac{-4 + \sqrt{k}}{2 \times 2}$ or $\frac{-4 - \sqrt{k}}{2 \times 2}$

or $(x + 1)^2 [-13/2 - 1 = 0]$

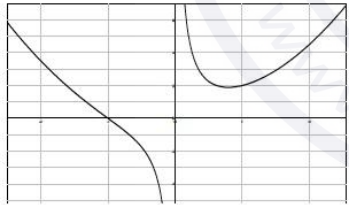
Question 59

(a)(i) $(8 - x)(3 + x)$

2 **M1** for $8(3 + x) - x(3 + x)$
or $3(8 - x) + x(8 - x)$
or $(a - x)(b + x)$ where $ab = 24$ or
 $a - b = 5$

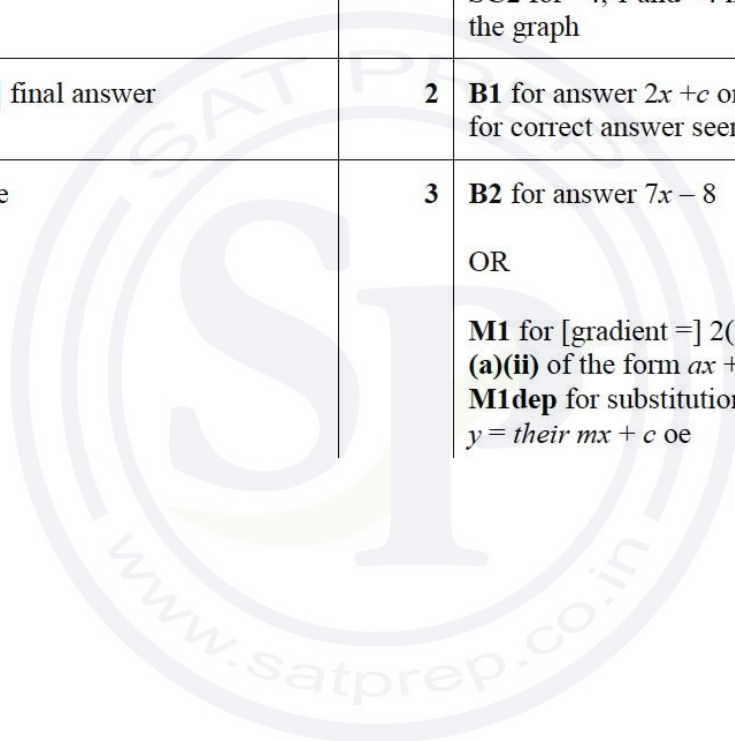
| | | | |
|----------|--|---|---|
| (a)(ii) | $[a =] -3$ $[b =] 8$ $[c =] 24$ | 3 | FT <i>their (a)(i)</i> for a and b B1FT for each of a and b or both correct but reversed B1 for $[c =] 24$ |
| (a)(iii) | 8 | 3 | M2 for $5 - 2x$ or M1 for $-2x$ or $5 - kx, k \neq 0$ |
| (b)(i) | Correct sketch: positive cubic shape and max on the y -axis or to the right of y -axis with one root at $(-1, 0)$ and turning point at $(3, 0)$ and y -intercept at $(0, 9)$ all labelled | 4 | B1 for positive cubic shape with max on the y -axis or to the right of y -axis B1 for root at $(-1, 0)$ B1 for turning point at $(3, 0)$ B1 for y -intercept $(0, 9)$ If 0 score SC1 for all three intercepts on axes identified |
| (b)(ii) | $x^3 - 5x^2 + 3x + 9$ final answer | 3 | B2 for correct expansion of three brackets unsimplified B1 for correct expansion of two brackets with at least 3 terms correct |

Question 60

| | | | |
|---------|--|---|--|
| (a) | 2, 4.5 | 2 | B1 for each |
| (b) | Correct graph  | 4 | B3 FT for 6 or 7 correct points FT <i>their</i> table or B2 FT for 4 or 5 correct points FT <i>their</i> table or B1 FT for 2 or 3 correct points FT <i>their</i> table |
| (c)(i) | -0.5 to -0.4 | 1 | |
| (c)(ii) | $y = 1 - x$ ruled and -1.9 to -1.75 | 2 | M1 for $[y =] 1 - x$ or $\left[x^2 + \frac{1}{x} = \right] 1 - x$ soi or B1 for -1.9 to -1.75 |
| (d) | Any integer ≥ 2 | 1 | |

Question 61

| | | |
|----------|---------------------------------------|---|
| (a)(i) | $A(-4, 0)$ $B(1, 0)$ $C(0, -4)$ | <p>4 B3 for A and B correct Or B2 for B $(-4, 0)$ and A $(1, 0)$</p> <p>Or B1 for $(x + 4)(x - 1)$ or for $\frac{-3 \pm \sqrt{3^2 - 4 \times 1 \times -4}}{2}$ oe and B1 for A or B correct</p> <p>B1 for C$(0, -4)$ OR</p> <p>SC2 for $-4, 1$ and -4 in correct positions on the graph</p> |
| (a)(ii) | $2x + 3$ [± 0] final answer | <p>2 B1 for answer $2x + c$ or for $ax + 3, a \neq 0$ or for correct answer seen</p> |
| (a)(iii) | $y = 7x - 8$ oe | <p>3 B2 for answer $7x - 8$</p> <p>OR</p> <p>M1 for [gradient =] $2(2) + 3$ FT <i>their</i> part (a)(ii) of the form $ax + b$ M1dep for substitution of $(2, 6)$ into $y = \text{their } mx + c$ oe</p> |



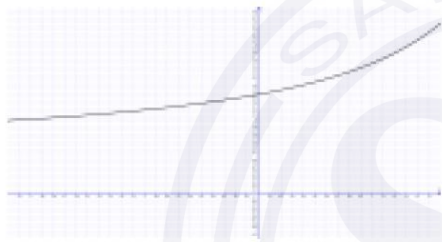
Question 62

| | | | |
|----------|-----------------------------|---|---|
| (a) | 17 | 3 | M2 for $3 \times 2x^2 - 7$ or better isw or M1 for $3 \times 2x^2$ oe or $kx^2 - 7$ seen |
| (b)(i) | 13.4 or 13.41 to 13.42 | 3 | M2 for $\sqrt{(-5-7)^2 + (8-2)^2}$ oe or M1 for $(-5-7)^2 + (8-2)^2$ oe |
| (b)(ii) | [y =] $2x + 5$ final answer | 4 | M1 for [gradient of $AB =$] $\frac{8-2}{-5-7}$ oe M1dep for gradient $p = -1 \div \text{their} - \frac{1}{2}$ oe M1dep on previous M1 for substituting $(-1, 3)$ into $y = \text{their } px + c$ oe where $\text{their } p \neq 0$ |
| (b)(iii) | (5, 0) | 4 | B3 for $\overline{AD} = \begin{pmatrix} -2 \\ -2 \end{pmatrix}$ or $\overline{DA} = \begin{pmatrix} 2 \\ 2 \end{pmatrix}$ or coordinates of C $(-7, 6)$ and $[\overline{CD} =] \begin{pmatrix} 12 \\ -6 \end{pmatrix}$ oe seen or B2 for $a = b = 2$ soi or coordinates of C $(-7, 6)$ or M1 for $a = b$ oe soi or for $a^2 + b^2 = (\sqrt{8})^2$ oe or $\cos 45 = \frac{a}{\sqrt{8}}$ oe or for $[\overline{DC} =] \begin{pmatrix} -12 \\ 6 \end{pmatrix}$ or $[\overline{CD} =] \begin{pmatrix} 12 \\ -6 \end{pmatrix}$ seen or $\frac{y-8}{x-5} = 1$ oe or $\frac{y-2}{x-7} = 1$ |

Question 63

| | | |
|----------|---|--|
| (a)(i) | 2.7 to 2.8 | 1 |
| (a)(ii) | tangent ruled at $x = -2$ | B1 |
| | 6 to 10 | <p>2 dep on B1 or a close attempt at tangent at $x = -2$</p> <p>or M1 for rise/run for <i>their</i> tangent, or close attempt, at any point</p> <p>Must see correct or implied calculation from a drawn tangent</p> <p>After M0, SC1 for gradient of tangent (or close attempt) in range embedded in $y = mx + c$</p> |
| (a)(iii) | $y = 2x - 2$ ruled and $x = -2.9$ to -2.8 cao | <p>3 B2 for correct ruled line</p> <p>or B1 for short line or for freehand line or broken line or ruled line with gradient 2 or with y-intercept at -2 (but not $y = -2$)</p> |
| (b) | $A(4, 17) B(-1.5, 0.5)$ | <p>5 B4 for $(-1.5, 0.5)$ and $(4, 17)$, or for $x = 4$ and $x = -1.5$</p> <p>OR</p> <p>B3 for $A(4, 17)$ or $B(-1.5, 0.5)$</p> <p>OR</p> <p>M1 for $2x^2 - 2x - 7 = 3x + 5$ oe</p> <p>AND either</p> <p>M2 for $(2x + 3)(x - 4)$</p> <p>or M1 for $2x(x - 4) + 3(x - 4)$</p> <p>or $x(2x + 3) - 4(2x + 3)$</p> <p>or $(2x + c)(x + d)$</p> <p>where $cd = -12$ or $c + 2d = -5$</p> <p>[c and d are integers]</p> <p>OR</p> <p>M2 for</p> $\frac{-\text{their } b \pm \sqrt{(\text{their } b)^2 - 4(\text{their } a)(\text{their } c)}}{2(\text{their } a)}$ <p>or M1 for $\sqrt{(\text{their } b)^2 - 4(\text{their } a)(\text{their } c)}$</p> <p>or for $p = -\text{their } b$, $r = 2(\text{their } a)$ if in the form $\frac{p + \sqrt{q}}{r}$ or $\frac{p - \sqrt{q}}{r}$</p> |

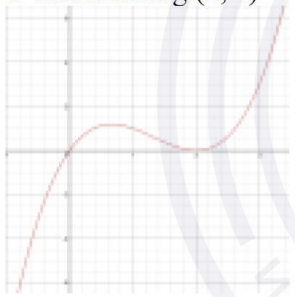
Question 64

| | | | |
|----------|---|---|--|
| (a)(i) | $[a =] 4$ $[b =] - 3$ nfw | 2 | B1 for $[a =] 4$ B1 for $[b =] - 3$ nfw |
| (a)(ii) | $y = 4$ oe | 1 | |
| (a)(iii) | $y = -6x + 7$ oe final answer | 2 | B1 for answer $-6x + 7$ or answers $y = -6x + c$ or $y = kx + 7$ ($k < 0$) |
| (b)(i) | 2.25 2.67 3.5 | 3 | B1 for each |
| (b)(ii) | correct curve  | 4 | B3 FT for 7 or 8 points or B2 FT for 5 or 6 points or B1 FT for 3 or 4 points |
| (c)(i) | -0.78 to -0.72 and 0.55 to 0.59 | 2 | B1 for each |
| (c)(ii) | $3x^3 - 9x^2 - 3x + 4$ [= 0] final answer | 4 | B3FT for 3 out of 4 correct terms or for $bx^3 - 3bx^2 + (a - 1)x + 8 - 3a$ [= 0] oe or B2FT for 2 out of 4 correct terms or for 3 out of 4 terms from $bx^3 - 3bx^2 + (a - 1)x + 8 - 3a$ [= 0] or M1 for $1 + \frac{5}{3-x} = \text{their } 4 + (\text{their}(-3))x^2$ oe |

Question 65

| | | | |
|---------|------------------------|---|--|
| (a)(i) | (2, 7) | 2 | B1 for each coordinate |
| (a)(ii) | $-\frac{1}{2}x + 8$ oe | 4 | <p>Correct equivalent in different form scores 3 marks.</p> <p>M1 for gradient of $AB = \frac{9-5}{3-1}$ or $\frac{4}{2}$ or 2</p> <p>M1 dep for gradient</p> $p = -\frac{1}{\text{their grad of } AB}$ <p>M1 (dep on previous M1) for substitution of <i>their</i> midpoint into $y = (\text{their } p)x + c$ oe where <i>their</i> $p \neq 0$</p> |

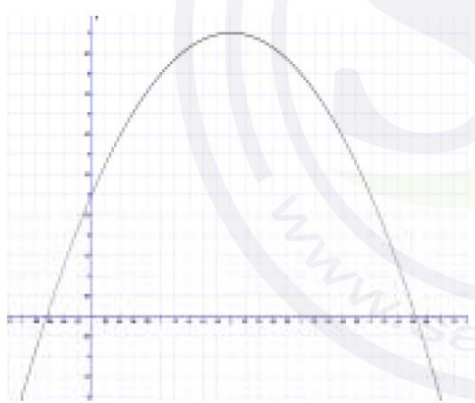
Question 66

| | | | |
|---------|---|---|--|
| (a)(i) | 2 | 2 | M1 for $x(x^2 - 4x + 4)$ or $x(x - 2)^2$ or $(x^2 - 2x)(x - 2)$ or $x^3 - 2ax^2 + a^2x$ |
| (a)(ii) | <p>Correct sketch with curve passing through O and touching $(2, 0)$</p>  | 4 | <p>B1 for any positive cubic</p> <p>B1 for sketch through or touching O</p> <p>B1 for sketch with min or max touching x-axis once only but not at $(0, 0)$</p> <p>B1FT <i>their</i> (a)(i) for sketch with min or max touching x-axis at $(\text{their } 2, 0)$ and <i>their</i> 2 is labelled or clearly indicated</p> |
| (b) | $y = 20x - 64$ final answer nfw | 7 | <p>B6 for equivalent correct equation OR</p> <p>B2 for $3x^2 - 8x + 4$ isw or B1 for $3x^2$ or $-8x$ seen</p> <p>M2dep for [grad =] 20 soi nfw or M1dep for substituting 4 into <i>their</i> derivative isw</p> <p>B1 for $(4, 16)$ soi</p> <p>M1dep for $16 = \text{their } 20 \times 4 + c$ oe</p> |

Question 67

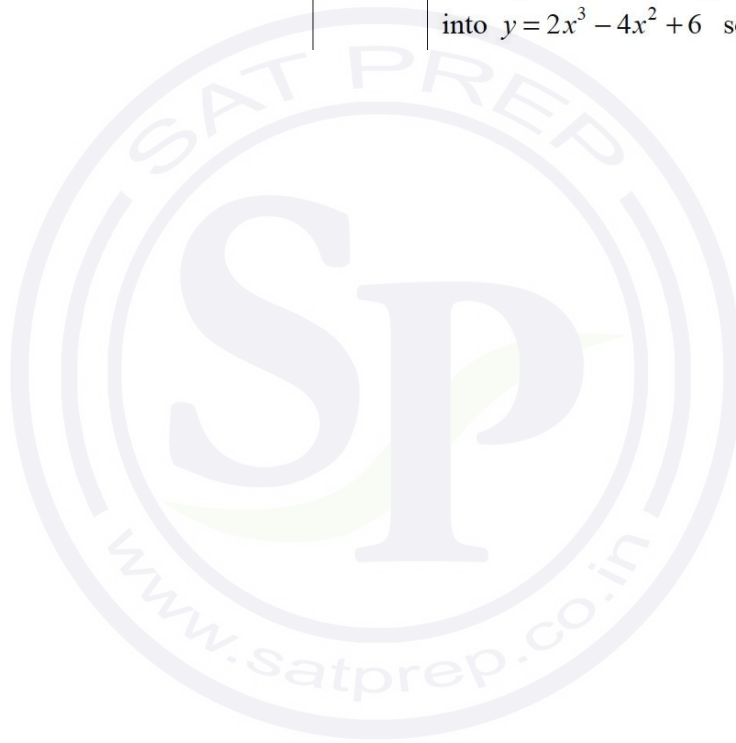
| | | | |
|---------|----------------------|----|---|
| (a)(i) | 1, -0.5 oe | 2 | B1 for each |
| (a)(ii) | Correct curve | 4 | B3FT for 6 or 7 correct plots or B2FT for 4 or 5 correct plots or B1FT for 2 or 3 correct plots |
| (b) | $y = 2.5 - 2x$ ruled | B2 | B1 for $y = k - 2x$ or $y = px + 2.5$ ruled ($p \neq 0$) or for $[y =] 2.5 - 2x$ oe identified |
| | 1.3 to 1.4 | B1 | |
| (c) | -1 | B1 | |
| | $y = -1$ | B1 | FT their k (must be negative) |

Question 68


| | | | |
|-----|---|----|---|
| (a) | 0.75 3 7 3 0.75 | 3 | B2 for 4 or 3 correct or B1 for 2 correct |
| (b) | correct curve | 4 | B3FT for 8 or 9 correct plots B2FT for 6 or 7 correct plots B1FT for 4 or 5 correct plots |
| |  | | |
| (c) | Accept any integer ≥ 8 | 1 | |
| (d) | line $y = 4 - \frac{1}{2}x$ ruled | B3 | B2 for $[y =] 4 - \frac{1}{2}x$ identified or B1 for ruled line with gradient $-\frac{1}{2}$ or B1 for ruled line through (0, 4) but not $y = 4$ |
| | 0.2 to 0.3 4.2 to 4.3 | B1 | |

Question 69

| | | | |
|-------|--|---|--|
| (i) | $6x^2 - 8x$ final answer | 2 | B1 for each term in final answer or M1 for correct answer seen and spoilt |
| (ii) | 64 | 2 | FT <i>their (c)(i)</i> correctly evaluated provided at least 2 terms but not the original equation M1 for substituting $x = 4$ into <i>their (c)(i)</i> |
| (iii) | (0, 6) $\left(\frac{4}{3}, \frac{98}{27}\right)$ oe | 4 | M1 for <i>their</i> derivative = 0 or $\frac{dy}{dx} = 0$ soi B1 for $x = 0$ and $x = \frac{4}{3}$ M1dep for substituting one of <i>their</i> x values into $y = 2x^3 - 4x^2 + 6$ soi |



Question 70

| | | | |
|-----|---|-----------|---|
| (a) | (0, 0), (1, 0), (2, 0) | 2 | B1 for any two correct If 0 scored, SC1 for all three x values clearly identified |
| (b) | $x(x^2 - x - 2x + 2)$ or $(x^2 - x)(x - 2)$ or $(x - 1)(x^2 - 2x)$ leading to $x^3 - 3x^2 + 2x$ with no errors or omissions | 2 | B1 for $x(x^2 - x - 2x + 2)$ or $(x^2 - x)(x - 2)$ or $(x - 1)(x^2 - 2x)$ |
| (c) | $3x^2 - 6x + 2$ | B2 | B1 for 2 correct terms |
| | <i>their</i> $\frac{dy}{dx} = 0$ | M1 | |
| | <i>their</i> $\frac{-(-6) \pm \sqrt{(-6)^2 - 4(3)(2)}}{2(3)}$ | M2 | M1 for $\sqrt{(-6)^2 - 4(3)(2)}$ or for $p = -(-6)$ and $r = 2(3)$ if in form $\frac{p \pm \sqrt{q}}{r}$ |
| | (0.4, 0.4) (1.6, -0.4) | B3 | B2 for 0.4 or 0.42... and 1.6 or 1.57 to 1.58 or for one correct pair of coordinates or B1 for 0.4 or 0.42... or 1.6 or 1.57 to 1.58 If 0 scored SC1 for $1 + \sqrt{\frac{1}{3}}$ and $1 - \sqrt{\frac{1}{3}}$ or better or for one correct pair of coordinates in any form |
| (d) | Correct sketch  | 2 | FT <i>their</i> (c) but must be cubic i.e. correct shape cubic through origin and max and min in correct quadrants B1 for cubic shape sketch |

Question 71

| | | |
|-----|---|--|
| (a) | (2, -10) and (-2, 22) | <p>5 B2 for $3x^2 - 12$ isw or B1 for $3x^2 + k$ or $px^2 - 12$ ($p \neq 0$) or for $3x^2 - 12 + 6$ isw</p> <p>M1 for setting <i>their</i> derivative = 0 or $\frac{dy}{dx} = 0$</p> <p>B1 for $x = \pm 2$ or for one correct coordinate pair</p> |
| (b) | <p>(2, -10) minimum with correct reason or sketch</p> <p>(-2, 22) maximum with correct reason or sketch</p> | <p>3 B2 for 1 correct with correct reasoning or B2FT for correct evaluation with correct 2nd derivative for both of <i>their</i> different x values</p> <p>or M1 for showing [2nd derivative =] $6x$ or gradients for one value on either side of one correct stationary point or for reasonable sketch of cubic</p> |

Question 72

| | | |
|-----|---|--|
| (a) | -1, -0.375, 3 | <p>3 B1 for each</p> |
| (b) | Correct graph | <p>4 B3FT for 8 or 9 correct points or B2FT for 6 or 7 correct points or B1FT for 4 or 5 correct points</p> |
| (c) | <p>$y = 2 - x$ ruled correctly AND -0.45 to -0.35 1 2.35 to 2.45</p> | <p>4 B2 for $y = 2 - x$ ruled or B1 for $[y =] 2 - x$ so i or $y = k - x$ ruled or $y = kx + 2$ ruled, but not $y = 2$ B2 for all three values or B1 for any two values</p> |

Question 73

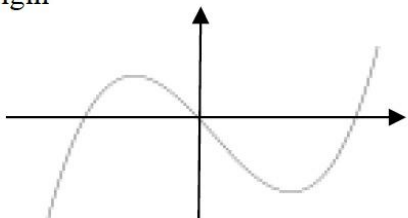
| | | | |
|-------|--|---|---|
| (i) | $20.25 - (1.5 + x)^2$ | 3 | <p>Method 1 B1 for $(\pm 1.5 \pm x)^2$ seen B1 for [b =] $18 + \text{their } 1.5^2$ OR Method 2 B1 for $b - a^2 - 2ax - x^2$ or for $b = 20.25$ B1 for $a = 1.5$</p> |
| (ii) | Correct sketch with max in correct quadrant at $(-1.5, 20.25)$ | 3 | <p>FT <i>their</i> $20.25 - (\text{their } 1.5 + x)^2$ provided in that form B1 for \cap shape or for \cup shape if in form $c + (d + x)^2$ in part (b)(i) B1 for TP at $(-1.5, k)$ or $(k, 20.25)$ FT <i>their</i> $20.25 \pm (\text{their } 1.5 + x)^2$ or for $(-1.5, 20.25)$ seen</p> |
| (iii) | [y =] $34 - 11x$ | 6 | <p>B2 for $-3 - 2x$ or B1 for either $kx - 3$, $k \neq 0$ or $-2x + n$ or for $18 - 3 - 2x$ M1dep for gradient = <i>their</i> $(-3 - 2(4))$ B1 for y-value at $x = 4$, is -10 M1dep for <i>their</i> $-10 = (\text{their } -11)4 + c$ oe</p> |

Question 74

| | | | |
|---------|--|---|---|
| (a)(i) | 9.5, 4.8 and 8.5 | 3 | B1 for each |
| (a)(ii) | correct curve | 5 | B4 for correct curve, but branches joined or touching y axis or B3FT for 9 or 10 correct plots or B2FT for 7 or 8 correct plots or B1FT for 5 or 6 correct plots AND B1 indep two separate branches not touching or cutting y-axis |
| (b) | $y = \frac{24}{5} - 2x$ ruled and - 0.4 to - 0.2 and 1.45 to 1.7 | 4 | B2 for correct ruled line crossing curve twice or B1 for correct freehand or for short ruled line or for line with negative gradient through (0, 4.8) or for line with gradient - 2 B1 for each value |
| (c) | [a =] 10 [b =] 20 [c =] - 48 | 4 | B3 for $10x^3 - 15 = 48x - 20x^2$ oe or better or B2 for 2 correct values or B1 for 1 correct value or for $5x^2 - \frac{15}{2x} = 24 - 10x$ or better or for $2x^3 - 3 = \frac{48}{5}x - 4x^2$ or better or for $x^3 - \frac{3}{2} = \frac{24}{5}x - 2x^2$ After 0 scored SC1 for correct elimination of a denominator of 5, x or 2x from a four term expression. |

Question 75

correct shape and passes through origin



3 **B1** for any positive cubic shape

B1 for sketch with one max and one min and with 3 roots including zero

 If 0 scored, **SC1** for $x(x + 2)(x - 2)$ soi

Question 76

$a = -12$
 $b = 5$
 $k = -11$


6 **B5** for 2 correct
 OR
B2 for $3x^2 + a$
 or **B1** for $3x^2$ isw

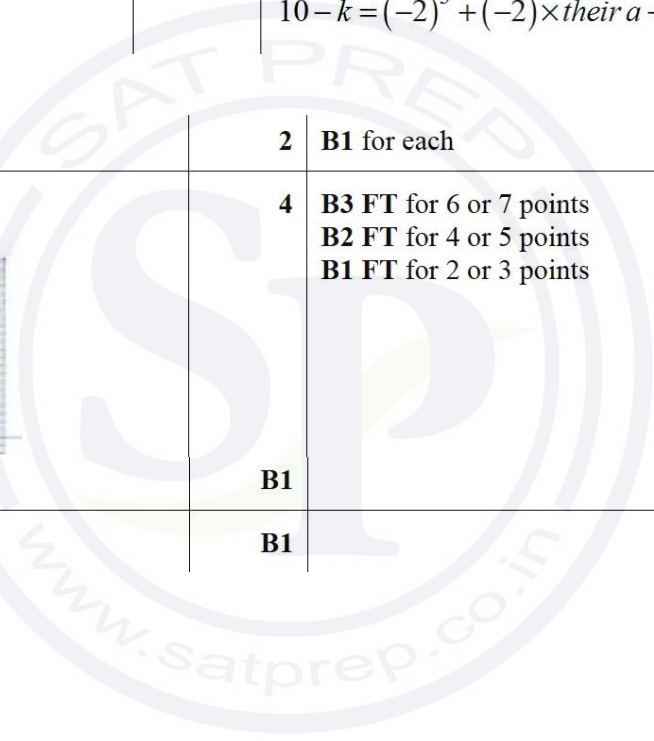
M1dep on at least **B1** for *their* $\frac{dy}{dx} = 0$

M1dep on at least **B1M1** for $x = 2$ or $x = -2$
 substituted in *their* $\frac{dy}{dx} = 0$ equation

M1 for $k = 2^3 + 2 \times \text{their } a + b$ **and**
 $10 - k = (-2)^3 + (-2) \times \text{their } a + b$

Question 77

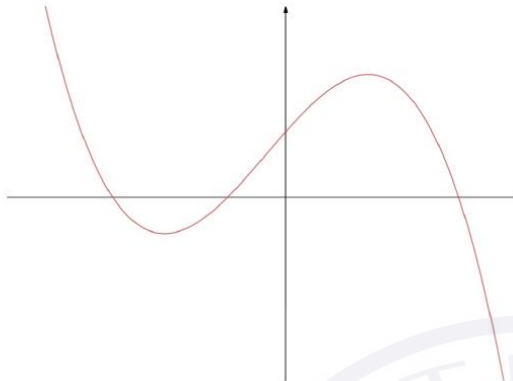
| | | | |
|-----|---|-----------|--|
| (a) | 1[.0] 0.9 | 2 | B1 for each |
| (b) | correct curve  | 4 | B3 FT for 6 or 7 points B2 FT for 4 or 5 points B1 FT for 2 or 3 points |
| (c) | ruled line at $y = -1$ | B1 | |
| | 0.3 to 0.32 | B1 | |



Question 78

(a)

Correct sketch of negative cubic crossing the x -axis at -3 , -1 and 3 and crossing the y -axis at 9



4

B1 for any negative cubic shape with two turning points

B2 for three intercepts only with x -axis labelled at -3 , -1 and 3

or **B1** for one or two correctly labelled x -intercepts

B1 for intercept with y -axis labelled at 9

If no graph drawn, **SC1** for all four intercepts labelled on axes.

(b)(i)

$3 - x + 3x - x^2$ or better

or

$3 + x + 3x + x^2$ or better

or

$9 [- 3x + 3x] - x^2$

M1

At least 3 of the four terms correct

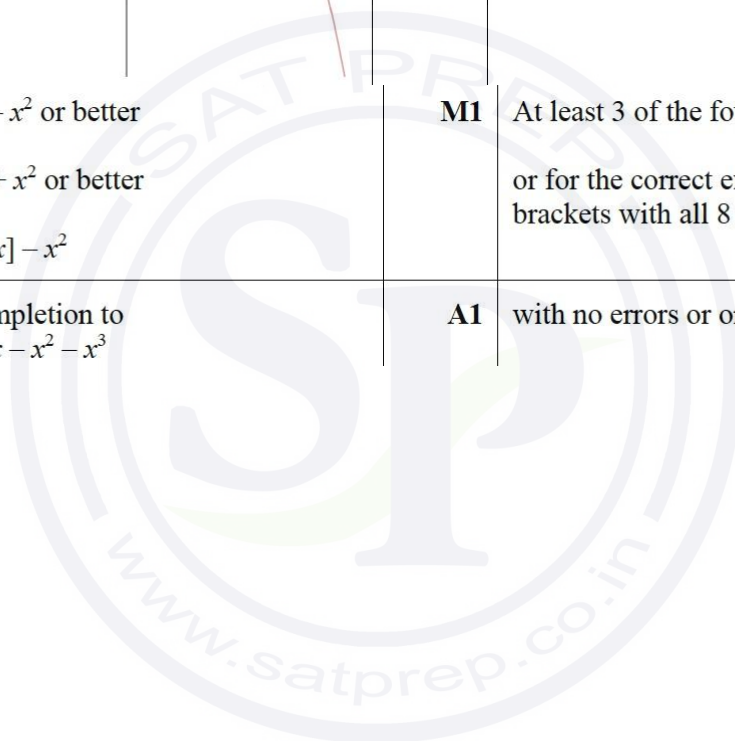
or for the correct expansion of all three brackets with all 8 terms correct

Correct completion to

$[y =] 9 + 9x - x^2 - x^3$

A1

with no errors or omissions seen

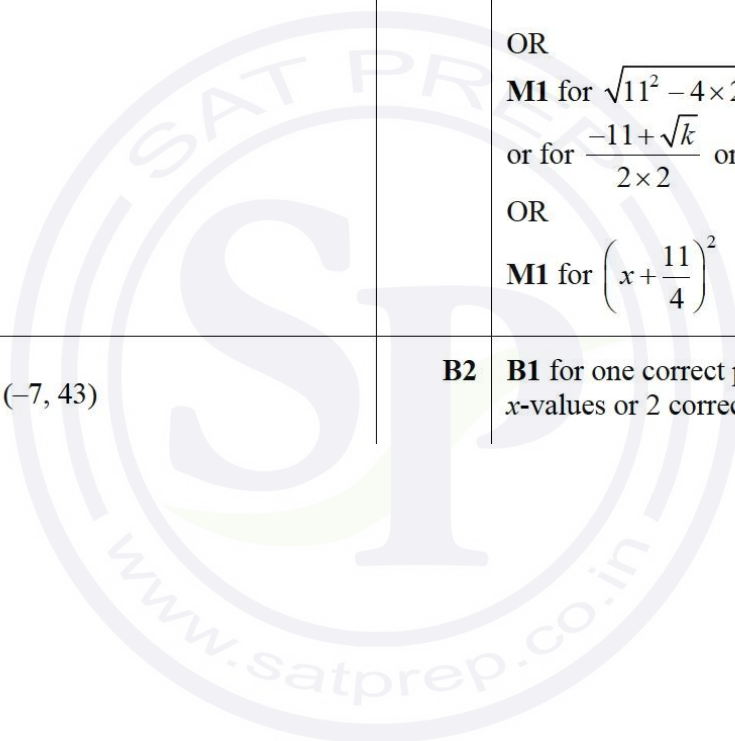


| | | |
|----------|---|---|
| (b)(ii) | $9 - 2x - 3x^2 = 0$ oe | B3 B2 for $9 - 2x - 3x^2$ or B1 for two correct terms M1 for <i>their</i> derivative = 0 or stating $\frac{dy}{dx} = 0$ |
| | $\frac{- -2 \pm \sqrt{(-2)^2 - 4 \times -3 \times 9}}{2 \times -3}$ oe OR $-\frac{1}{3} \pm \sqrt{\frac{9}{3} + \left(\frac{1}{3}\right)^2}$ oe | B2 FT <i>their</i> derivative B1FT for $\sqrt{(-2)^2 - 4(-3)(9)}$ or better or for $\frac{-(-2) + \sqrt{q}}{2 \times -3}$ or $\frac{-(-2) - \sqrt{q}}{2 \times -3}$ OR B1 for $\left(x + \frac{1}{3}\right)^2$ |
| | -2.10 and 1.43 final answer | B2 B1 for each or for answers -2.1 or -2.097 ... and 1.4 or 1.430 to 1.431 or SC1 for -2.097... and 1.43[0] to 1.431 seen in working or for -1.43 and 2.10 as final answer |
| (b)(iii) | [a =] -6 [b =] 17 | 3 B2 for either <i>a</i> correct or <i>b</i> correct or for [a =] -5.04 or -5.049 to -5.05 and [b =] 16.9... seen or M1 for substitution of one of <i>their</i> solutions into $9 + 9x - x^2 - x^3$ oe or SC1 for reversed answers, $a = 17,$ $b = -6$ |

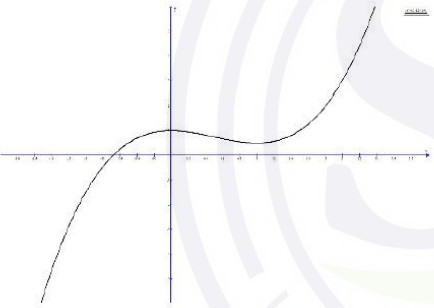
Question 79

| | | | |
|----------|--|---|--|
| 3(a)(i) | $(-0.5, 1)$ | 2 | B1 for each |
| 3(a)(ii) | $\begin{pmatrix} 7 \\ -3 \end{pmatrix}$ | 2 | B1 for each |
| (a)(iii) | 7.62 or 7.615 to 7.616 | 2 | FT <i>their</i> (a)(ii) M1 for $(\text{their } 7)^2 + (\text{their } -3)^2$ oe |
| (a)(iv) | $[y =] -4x - 1$ final answer | 3 | B2 for answer $-4x + c$ [oe] or for correct equation in different form or for $-4x + -1$ or for $-4m - 1$ OR M1 for $\frac{-5 - 7}{1 - -2}$ oe M1 for correct substitution shown of $(-2, 7)$ or $(1, -5)$ or <i>their</i> $(-0.5, 1)$ into $y = (\text{their } m)x + c$ oe OR M1 for $7 = -2m + c$ and $-5 = m + c$ A1 for $m = -4$ and $c = -1$ |
| 3(a)(v) | $[y =] \frac{1}{4}x + \frac{11}{4}$ final answer | 3 | M1 for grad = $\frac{1}{4}$ oe nfwf soi, FT negative reciprocal of <i>their</i> gradient from (iv) M1 for correct substitution shown of $(5, 4)$ into $y = (\text{their } m)x + c$ oe or, if no substitution shown, $(5, 4)$ satisfies <i>their</i> final linear equation. |

| | | | |
|-----|--|-----------|--|
| (b) | $2x^2 + 11x - 21 [= 0]$ | M2 | or M1 for $8 - 5x = 2x^2 + 6x - 13$ oe or better |
| | $(2x - 3)(x + 7) [= 0]$ oe or $\frac{-11 \pm \sqrt{11^2 - 4 \times 2 \times (-21)}}{2 \times 2}$ or $-\frac{11}{4} \pm \sqrt{\frac{21}{2} + \left(\frac{11}{4}\right)^2}$ oe | M2 | Allow correct method to solve <i>their</i> quadratic equation e.g. formula, complete the square but not for $2x^2 + 6x - 13$ M1 FT <i>their</i> equation for $2x(x + 7) - 3(x + 7) [= 0]$ or $x(2x - 3) + 7(2x - 3) [= 0]$ or $(2x + a)(x + b) [= 0]$ where $ab = -21$ or $2b + a = 11$ OR M1 for $\sqrt{11^2 - 4 \times 2 \times -21}$ or for $\frac{-11 + \sqrt{k}}{2 \times 2}$ or $\frac{-11 - \sqrt{k}}{2 \times 2}$ OR M1 for $\left(x + \frac{11}{4}\right)^2$ |
| | $\left(\frac{3}{2}, \frac{1}{2}\right)$ and $(-7, 43)$ | B2 | B1 for one correct pair or for 2 correct x -values or 2 correct y -values |



Question 80

| | | | |
|-----|--|-----------|--|
| (a) | $3x^2 - 2kx$ | M2 | M1 for $3x^2$ or $-2kx$ |
| | <i>their</i> $\frac{dy}{dx} = 6$ | M1 | Dep on at least M1 for derivative |
| | $x = 2$ substituted in <i>their</i> $\frac{dy}{dx}$ | M1 | Dep on at least M1 for derivative |
| | Correct working leading to 1.5 oe | A1 | A0 if any errors in working leading to 1.5 |
| (b) | (0, 1) (1, 0.5) | 4 | B3 for $x = 0$ and $x = 1$ or for (1, 0.5) OR M1 for <i>their</i> $\frac{dy}{dx} = 0$ B1 for $3x^2 - 3x$ oe or better |
| (c) | correct sketch  | 2 | with max on positive y-axis and min in 1st quadrant B1 for positive cubic or for graph with one max which is on pos y-axis and one min which is in 1st quadrant |

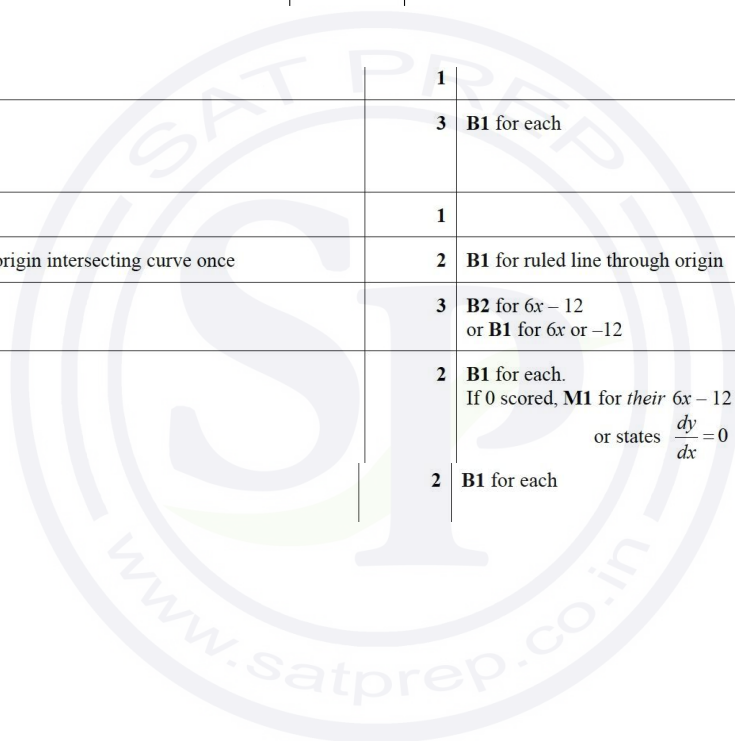
Question 81

| | | | |
|-----|------------------|----------|---|
| (a) | 8.25 or 8.246... | 3 | M2 for $(3 - -5)^2 + (2 - 4)^2$ oe or better or M1 for $(3 - -5)$ and $(2 - 4)$ oe seen |
| (b) | $[y =] 4x + 7$ | 5 | B1 for [midpoint] $(-1, 3)$ soi M1 for [gradient of $l =$] $\frac{4 - 2}{-5 - 3}$ oe M1 for gradient -1 / <i>their</i> $\left(-\frac{1}{4}\right)$ M1dep on at least M1 for <i>their</i> $(-1, 3)$ substituted into $y = \text{their } m \times x + c$ oe |

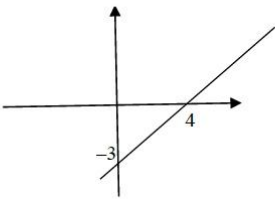
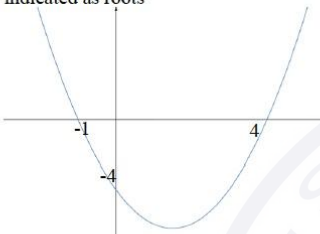
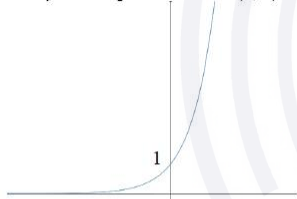
| | | | |
|------|---------------------|---|--|
| i(c) | (0, -8) and (0, 16) | 4 | B3 for (0, -8) or (0, 16) or for -8 and 16 OR B2 for distance = $[\pm]12$ soi or M1 for $13^2 - (5[-0])^2$ oe B1 for both answers (0, k), $k \neq 0$ or 4 ALT METHOD B3 for (0, -8) or (0, 16) or for -8 and 16 OR M2 for $y^2 - 8y - 128 [= 0]$ or for $(y - 4)^2 = 144$ or better or M1 for $13^2 = (-5 - 0)^2 + (4 - y)^2$ oe B1 for both answers (0, k), $k \neq 0$ or 4 |
|------|---------------------|---|--|

Question 82

| | | | |
|----------|---|---|---|
| i(a)(i) | -3 | 1 | |
| (a)(ii) | -1 1.55 to 1.6 4.4 to 4.45 | 3 | B1 for each |
| (a)(iii) | -8 | 1 | |
| (a)(iv) | Ruled line through origin intersecting curve once | 2 | B1 for ruled line through origin |
| i(b)(i) | 18 | 3 | B2 for $6x - 12$ or B1 for $6x$ or -12 |
| (b)(ii) | (2, -5) | 2 | B1 for each. If 0 scored, M1 for <i>their</i> $6x - 12 = 0$ or states $\frac{dy}{dx} = 0$ |
| (c) | $[p =] 7$ $[q =] 3$ | 2 | B1 for each |



Question 82

| | | |
|----------|---|--|
| (a)(i) | <p>Correct sketch of $3x - 4y = 12$ with $y = -3$ and $x = 4$ indicated on axes</p>  | <p>2 B1 for line with positive gradient</p> |
| (a)(ii) | <p>Correct sketch of $y = x^2 - 3x - 4$ with $(0, -4)$ indicated as y-intercept and $x = -1$ and $x = 4$ indicated as roots</p>  <p>Minimum in fourth quadrant, not at $x = 0$</p> | <p>4 B3 for correct sketch with one value omitted or incorrect or for a poor sketch with all 3 intercepts correct.</p> <p>or B2 for roots $x = -1$ and $x = 4$ soi with no extra roots or for correct shape with $y = -4$ indicated or B1 for correct shape or for $(x - 4)(x + 1)$ shown or for incorrect sketch with $(0, -4)$ indicated as y-intercept</p> |
| (a)(iii) | <p>Correct sketch of $y = 6^x$ with y-intercept indicated at $(0, 1)$</p>  | <p>2 B1 for increasing exponential graph seen on both sides of the y-axis.</p> |
| (b)(i) | <p>$8 - 4x^2 [+ 0]$</p> | <p>2 B1 for two terms correct and one extra incorrect term or for one of two terms correct or for correct answer seen and spoilt</p> |
| (b)(ii) | <p>4</p> | <p>2 M1 for substitution of $x = -1$ into <i>their</i> (b)(i)</p> |
| (b)(iii) | <p>$(3, -7)$ and $(-3, 17)$</p> | <p>5 B4 for $(3, -7)$ or $(-3, 17)$ or B3 for $x = \pm 3$ or M2 for $x^2 = 9$ or $k(x - 3)(x + 3) = 0$ oe or for correct method for solving <i>their</i> (b)(i) = -28 or M1 for <i>their</i> (b)(i) = -28</p> |

Question 83

| | | | |
|-----|--|----|--|
| (a) | (22, 11) | 2 | B1 for each value |
| (b) | $\frac{\text{their } 11 - 3}{\text{their } 22 - 2}$ oe or better | M1 | |
| | $-\frac{1}{\text{their } m}$ | M1 | |
| | Substitution of (12, 7) into $y = (\text{their } m)x + c$ | M1 | Accept $y - 7 = \text{their } m(x - 12)$ oe |
| | leading to $2y + 5x = 74$ final answer | A1 | Without error or omission |
| (c) | 32 | 1 | |
| (d) | 145 | 2 | M1 for $\frac{1}{2} \times (\text{their } 32 - 3) \times 10$ oe or $\frac{1}{2} \times \sqrt{(7-3)^2 + (12-2)^2} \times \sqrt{(\text{their } 32 - 7)^2 + (2-12)^2}$ oe |

Question 84

$6x + 4$

2

B1 for $6x$ or 4 or $6x + 4$ with one extra term seen

Question 85

| | | | |
|---------|-------------------------|---|---|
| (a)(i) | $\frac{14}{18}$ oe | 1 | |
| (a)(ii) | 17.5 | 4 | M3 for $\frac{1}{2}(10+24)18 + 22 \times 24 - 134 = 40v$ oe or M2 for $\frac{1}{2}(10+24)18 + 22 \times 24$ oe or B2 for [distance covered by bus =] 700 or M1 for correct method for any partial area for the car or for $40v$ |
| (b) | 92.8 or $92\frac{4}{5}$ | 3 | M1 for $\frac{\text{figs } 162[4]}{\text{their } 10 \text{ min } 30 \text{ sec}}$ oe M1 for correct conversion to km/h, e.g. $\times \frac{60}{1000}$ |

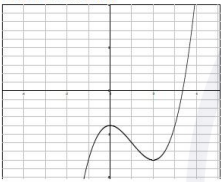
Question 86

| | | | |
|----------|---|----|---|
| (a)(i) | 28 | 1 | |
| (a)(ii) | Correct curve | 4 | B3FT for 9 or 10 correct points or B2FT for 7 or 8 correct points or B1FT for 5 or 6 correct points |
| (a)(iii) | 2.5 to 2.8 8.2 to 8.5 | 2 | B1 for each value |
| (b)(i) | $2x^2 + 4x(9 - x)$ oe | M1 | Accept the sum of individual areas if done in smaller parts |
| | $2x^2 + 36x - 4x^2$ oe Leading to $36x - 2x^2$ | A1 | With intermediate step shown and brackets removed with no errors or omissions |
| (b)(ii) | 144 | 3 | B1 for $x = 6$ identified from graph or using calculus M1 for $36 \times \text{their } 6 - 2 \times (\text{their } 6)^2$ |

Question 87

| | | | |
|---------|------------------------------|-----------|---|
| (a)(i) | 4 or 5 or 7 or 8 or 9 | 1 | |
| (a)(ii) | $[a =] 3, [b =] 10$ | 2 | B1 for each or for a and b transposed |
| (b) | $6x^5 - 30x^4$ | B2 | B1 for $6x^5$ or $-30x^4$ |
| | <i>their</i> derivative = 0. | M1 | |
| | (0, 0) and (5, -3125) | B2 | B1 for (5, -3125) or for $x = 0$ and $x = 5$ |

Question 88

| | | | |
|-----|--|---|---|
| (a) | -3 | 3 | B2 for $3x^2 - 6x$ or B1 for $3x^2 - kx$ or for $kx^2 - 6x$ or for $3x^2 - 6x + c$ |
| (b) | (0, -4) and (2, -8) | 4 | B3 for $x = 0$ and 2 or for (2, -8) OR M1 for <i>their</i> $3x^2 - 6x = 0$ or stating $\frac{dy}{dx} = 0$ oe |
| (c) | <p>Correct sketch</p>  | 2 | M1 for correct method to solve <i>their</i> $3x^2 - 6x = 0$ 2 Max on negative y-axis and min in correct quadrant and extends into first quadrant |
| | | | B1 for positive cubic graph and two turning points |

Question 89

| | | | |
|---------|--|-----------|---|
| (a) | $y = 4$ oe | 1 | |
| (b) | $[y =] -\frac{1}{2}x + 4$ final answer | 2 | B1 for grad = $-\frac{4}{8}$ oe soi or $[y =] kx + 4$ |
| (c)(i) | Gradient = $\frac{-1}{\text{their gradient in (b)}}$ | M1 | Accept e.g. $2 \times -\frac{1}{2} = -1$ oe or states negative reciprocal of $-\frac{1}{2} = 2$ |
| | Substituting (2, 3) in <i>their</i> equation. | M1 | $3 = 2 \times \text{their } m + c$ |
| | leading to $y = 2x - 1$ | A1 | No errors or omissions |
| (c)(ii) | 3.35 or 3.354... | 5 | B2 for $(\frac{1}{2}, 0)$ soi or x-coordinate of $D = \frac{1}{2}$ or M1 for $2x - 1 = 0$ M2 for $(2 - \text{their } \frac{1}{2})^2 + (3 - \text{their } 0)^2$ oe or M1 for $(2 - \text{their } \frac{1}{2})$ and $(3 - \text{their } 0)$ oe |

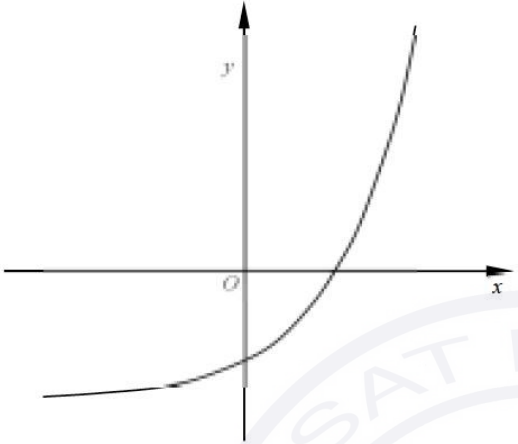
Question 90

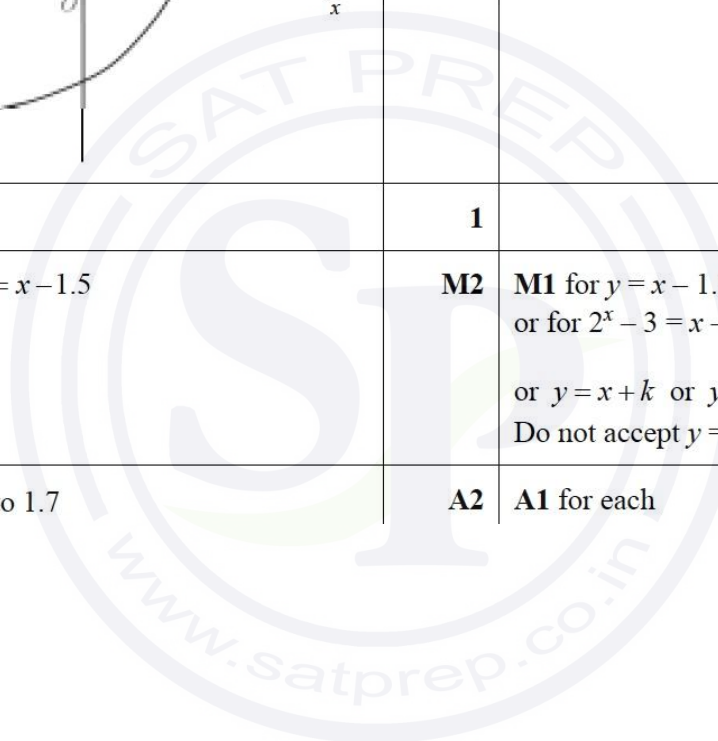
| | | | |
|-----|--|-----------|---|
| (a) | $4x^3 - 16x$ cao | 2 | M1 for $4x^3 + kx$ or $kx^3 - 16x$ or $4x^3 - 16x + k$ or $4x^3 - 16$ as final answers |
| b | Their $\frac{dy}{dx} = 0$ or stating $\frac{dy}{dx} = 0$ | B1 | |
| | Correct method to solve <i>their</i> $4x^3 - 16x = 0$ | M1 | e.g. $4x(x^2 - 4)$ or $4x(x - 2)(x + 2)$ oe |
| | $[x =] 0, -2, 2$ | A1 | Or B1 for $(-2, -11)$ and $(2, -11)$ |
| | $(0, 5) (-2, -11) (2, -11)$ | A1 | |
| (c) | $(0, 5)$ with correct reasoning | 2 | M1 for any of <ul style="list-style-type: none"> • correct use of 2nd derivative $12x^2 - 16$ • evaluates correctly both values of y on either side • evaluates correctly the gradient on either side • reasonable correct sketch |

Question 91


| | | | |
|-----|--|---|---|
| (a) | 10 | 3 | M2 for $(1 - -7)^2 + (4 - -2)^2$ oe or M1 for $(1 - -7)$ or $(4 - -2)$ oe |
| (b) | $\frac{4}{3}$ or $\frac{8}{6}$ | 2 | M1 for $\frac{1 - -7}{4 - -2}$ oe |
| (c) | $y = -\frac{3}{4}x - \frac{9}{4}$ or $4y + 3x + 9 = 0$ oe final answers | 4 | B3 for $-\frac{3}{4}x - \frac{9}{4}$ OR B1 for midpoint $(1, -3)$ M1 for gradient $-\frac{3}{4}$ or $-\frac{1}{\text{their (b)}}$ M1 for substituting <i>their</i> $(1, -3)$ into $y = (\text{their } m)x + c$ or for <i>their</i> $m = \frac{y - -3}{x - 1}$ oe |

Question 92

| | | |
|-----|--|---|
| (a) | -2.5 -2 -1 | 3 B1 for each |
| (b) | <p>Correct curve</p>  | <p>4 B3 FT for 8 or 7 correct plots B2 FT for 6 or 5 correct plots B1 FT for 4 or 3 correct plots</p> |
| (c) | 2.3 to 2.4 | 1 |
| (d) | ruled line $y = x - 1.5$ | <p>M2 M1 for $y = x - 1.5$ soi or for $2^x - 3 = x - 1.5$ seen. or $y = x + k$ or $y = kx - 1.5$ drawn Do not accept $y = -1.5$</p> |
| | -1 and 1.55 to 1.7 | A2 A1 for each |



Question 93

| | | | |
|---------|--|-----------|--|
| (a)(i) | <p>Correct expansion of a pair of brackets</p> $x^2 - 4x + [1]x - 4$ <p>or $x^2 - 4x - 2x + 8$</p> <p>or $x^2 + [1]x - 2x - 2$</p> | M1 | <p>accept</p> $x^2 - 3x - 4$ <p>or $x^2 - 6x + 8$</p> <p>or $x^2 - [1]x - 2$</p> |
| | $x^3 - 4x^2 + x^2 - 4x - 2x^2 + 8x - 2x + 8$ <p>leading to and stating</p> $[y =] x^3 - 5x^2 + 2x + 8$ | A1 | <p>Accept</p> $x^3 - 3x^2 - 4x - 2x^2 + 6x + 8$ <p>or $x^3 - 6x^2 + [1]x^2 + 8x - 6x + 8$</p> <p>or $x^3 - [1]x^2 - 2x - 4x^2 + 4x + 8$</p> <p>leading to and stating</p> $[y =] x^3 - 5x^2 + 2x + 8$ |
| (a)(ii) | <p>Correct labelled sketch</p> <p>positive cubic</p> <p>Crossing x-axis at $-1, 2$ and 4 only</p> <p>Crossing y-axis at 8 only</p>  | 4 | <p>B1 for positive cubic</p> <p>B2 for three intercepts only with x-axis labelled at $-1, 2$ and 4</p> <p>or B1 for 1 or 2 correctly labelled x-intercepts</p> <p>B1 for a single intercept on y-axis labelled at 8 but not if line $y = 8$</p> |
| (b) | $3x^2 - 10x - 8 [= 0]$ | M3 | <p>B2 for derivative = $3x^2 - 10x + 2$ isw</p> <p>OR</p> <p>B1 for derivative with $3x^2$ or $-10x$ given in expression isw</p> <p>M1dep on B1 for <i>their</i> first derivative = 10</p> |
| | $x = 4 \text{ and } x = -\frac{2}{3}$ | B1 | |
| | $(4, 0) \text{ and } \left(-\frac{2}{3}, \frac{112}{27}\right) \text{ oe}$ | B1 | |
| | <p>$[y =] 10x - 40$</p> <p>and</p> $[y =] 10x + \frac{292}{27}$ | B2 | <p>B1 for each</p> <p>or for two different equations of the form $[y =] 10x + c$ (c must be numeric)</p> <p>or for $c = -40$ and $\frac{292}{27}$</p> |

Question 94

| | | | |
|----------|---|---|--|
| i(a) | (5, 2) (2, - 2) | 4 | <p>B3 for 3 correct values or answers for <i>C</i> and <i>D</i> reversed or correct coordinates given on diagram wrongly labelled or B2 for one correct coordinate pair correctly labelled or M2 for <i>A, B, C</i> and <i>D</i> correctly plotted or M1 for <i>A</i> and <i>B</i> correctly plotted</p> <p>If 0 or 1 scored instead award SC2 for answers (-3, 8) and (-6, 4) or answers (1.5, 1.5) and (-2.5, 4.5)</p> |
| (b)(i) | (2.5, 3.5) oe | 2 | B1 for each |
| (b)(ii) | 7.07 or 7.071... | 3 | <p>M2 for $(6 - -1)^2 + (4 - 3)^2$ oe or M1 for $(6 - -1)$ or $(4 - 3)$ oe</p> |
| (b)(iii) | $\frac{1}{7}$ | 2 | M1 for $\frac{4-3}{6--1}$ oe |
| (b)(iv) | $y = \frac{1}{7}x - \frac{2}{7}$ or $7y = x - 2$ oe final answer | 3 | <p>M1 for gradient = <i>their</i> (iii) M1dep for substituting (2, 0) in a linear equation with their <i>m</i> allow if (2, 0) satisfies $y = (\text{their}(\mathbf{b})(\mathbf{iii}) \text{ gradient})x + c$</p> |

