Paper Reference(s)

6663/01

Edexcel GCE

Core Mathematics C1

Advanced Subsidiary

Integration: Basic Integration

Calculators may NOT be used for these questions.

Information for Candidates

A booklet ‘Mathematical Formulae and Statistical Tables’ might be needed for some questions.

The marks for the parts of questions are shown in round brackets, e.g. **(2)**.

There are 26 questions in this test.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.

You must show sufficient working to make your methods clear.

Answers without working may not gain full credit.

1. Find

$$\int (8x^3 + 6x^{\frac{1}{2}} - 5)\,\mathrm{d}x$$

giving each term in its simplest form.

(Total 4 marks)

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2. The curve *C* has equation $y = \mathrm{f}(x)$, $x > 0$, where

$$\frac{\mathrm{d}y}{\mathrm{d}x} = 3x - \frac{5}{\sqrt{x}} - 2$$

Given that the point *P* (4, 5) lies on *C*, find

(a) f(x),

(5)

(b) an equation of the tangent to *C* at the point *P*, giving your answer in the form $ax + by + c = 0$, where *a*, *b* and *c* are integers.

(4)
(Total 9 marks)

3.
$$\frac{\mathrm{d}y}{\mathrm{d}x} = 5x^{-\frac{1}{2}} + x\sqrt{x}, \qquad x > 0$$

Given that $y = 35$ at $x = 4$, find *y* in terms of *x*, giving each term in its simplest form.

(Total 7 marks)

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4. Given that $y = 2x^3 + \frac{3}{x^2}$, $x \neq 0$, find

(a) $\frac{\mathrm{d}y}{\mathrm{d}x}$

(3)

(b) $\int y \, \mathrm{d}x$, simplifying each term.

(3)
(Total 6 marks)

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5. Find $\int (12x^5 - 8x^3 + 3) \, \mathrm{d}x$ giving each term in its simplest form.

(Total 4 marks)

6. A curve has equation $y = \mathrm{f}(x)$ and passes through the point (4, 22).

Given that

$$\mathrm{f}'(x) = 3x^2 - 3x^{\frac{1}{2}} - 7,$$

use integration to find $\mathrm{f}(x)$, giving each term in its simplest form.

(Total 5 marks)

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7. Find $\int (2 + 5x^2) \mathrm{d}x$.

(Total 3 marks)

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8. The gradiend of a curve C is given by $\frac{dy}{dx} = \frac{(x^2+3)^2}{x^2}$, $x \neq 0$.

(a) Show that $\frac{dy}{dx} = x^2 + 6 + 9x^{-2}$

(2)

The point (3, 20) lies on C.

(b) Find an equation for the curve C in the form $y = f(x)$.

(6)
(Total 8 marks)

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9. Find $\int (3x^2 + 4x^5 - 7)\,dx$.

(Total 4 marks)

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10. The curve C has equation $y = f(x)$, $x > 0$, and $f'(x) = 4x - 6\sqrt{x} + \frac{8}{x^2}$.

Given that the point P (4, 1) lies on C,

(a) find f(x) ands simplify your answer.

(6)

(b) Find an equation of the normal to C at the point P (4, 1).

(4)
(Total 10 marks)

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11. The curve C with equation $y = \text{f}(x)$ passes through the point (5, 65).

Given that $\text{f}'(x) = 6x^2 - 10x - 12$,

(a) use integration to find f (x).

(4)

(b) Hence show that $\text{f}(x) = x(2x + 3)(x - 4)$.

(2)

(c) Sketch C, showing the coordinates of the points where C crosses the x-axis.

(3)
(Total 9 marks)

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12. (a) Show that $(4 + 3\sqrt{x})^2$ can be written as $16 + k\sqrt{x} + 9x$, where k is a constant to be found.

(2)

(b) Find $\int (4 + 3\sqrt{x})^2 \, \text{d}x$.

(3)
(Total 5 marks)

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13. The curve C has equation $y = \text{f}(x)$, $x \neq 0$, and the point $P(2, 1)$ lies on C. Given that

$$\text{f}'(x) = 3x^2 - 6 - \frac{8}{x^2},$$

(a) find $\text{f}(x)$.

(5)

(b) Find an equation for the tangent to C at the point P, giving your answer in the form
$y = mx + c$, where m and c are integers.

(4)
(Total 9 marks)

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14. Find $\int (6x^2 + 2 + x^{-\frac{1}{2}})\, dx$, giving each term in its simplest form.

(Total 4 marks)

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15. The curve C with equation $y = f(x)$, $x \neq 0$, passes through the point $(3, 7\frac{1}{2})$.

Given that $f'(x) = 2x + \frac{3}{x^2}$,

(a) find f(x).

(5)

(b) Verify that f(–2) = 5.

(1)

(c) Find an equation for the tangent to C at the point (–2, 5), giving your answer in the form $ax + by + c = 0$, where a, b and c are integers.

(4)

(Total 10 marks)

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16. Given that $y = 2x^2 - \frac{6}{x^3}$, $x \neq 0$,

(a) find $\frac{dy}{dx}$,

(2)

(b) evaluate $\int_1^3 y\, dx$.

(4)

(Total 6 marks)

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17. Given that $y = 2x^2 - \frac{6}{x^3}$, $x \neq 0$,

(a) find $\frac{dy}{dx}$,

(2)

(b) find $\int y \, dx$.

(3)
(Total 5 marks)

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18. The curve with equation $y = f(x)$ passes through the point (1, 6). Given that

$$f'(x) = 3 + \frac{5x^2 + 2}{x^{\frac{1}{2}}}, \; x > 0,$$

find f (x) and simplify your answer.

(Total 7 marks)

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19. (a) Show that $\frac{(3 - \sqrt{x})^2}{\sqrt{x}}$ can be written as $9x^{-\frac{1}{2}} - 6 + x^{\frac{1}{2}}$.

(2)

Given that $\frac{dy}{dx} = \frac{(3 - \sqrt{x})^2}{\sqrt{x}}$, $x > 0$, and that $y = \frac{2}{3}$ at $x = 1$,

(b) find y in terms of x.

(6)
(Total 8 marks)

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20. (i) Given that $y = 5x^3 + 7x + 3$, find

(a) $\frac{dy}{dx}$,

(3)

(b) $\frac{d^2y}{dx^2}$.

(1)

(ii) Find $\int \left(1 + 3\sqrt{x} - \frac{1}{x^2}\right) dx$.

(4)
(Total 8 marks)

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21. The curve C with equation $y = f(x)$ is such that

$$\frac{dy}{dx} = 3\sqrt{x} + \frac{12}{\sqrt{x}}, \quad x > 0.$$

(a) Show that, when $x = 8$, the exact value of $\frac{dy}{dx}$ is $9\sqrt{2}$.

(3)

The curve C passes through the point (4, 30).

(b) Using integration, find f(x).

(6)
(Total 9 marks)

22.

$$\frac{dy}{dx} = 5 + \frac{1}{x^2}.$$

(a) Use integration to find y in terms of x.

(3)

(b) Given that $y = 7$ when $x = 1$, find the value of y at $x = 2$.

(4)
(Total 7 marks)

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23. $$y = 7 + 10x^{\frac{3}{2}}.$$

(a) Find $\dfrac{dy}{dx}$.

(2)

(b) Find $\int y \ \mathrm{d}x$.

(3)
(Total 5 marks)

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24. Evaluate $\int_1^4 \dfrac{2}{x^2} \,\mathrm{d}x$.

(Total 4 marks)

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25. Find $\int \left(x^2 - \dfrac{1}{x^2} + \sqrt[3]{x}\right) \mathrm{d}x$.

(Total 4 marks)

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26. For the curve C with equation $y = \mathrm{f}(x)$,

$$\frac{\mathrm{d}y}{\mathrm{d}x} = x^3 + 2x - 7.$$

(a) Find $\dfrac{\mathrm{d}^2 y}{\mathrm{d}x^2}$.

(2)

(b) Show that $\dfrac{\mathrm{d}^2 y}{\mathrm{d}x^2} \geq 2$ for all values of x.

(1)

Given that the point $P(2, 4)$ lies on C,

(c) find y in terms of x,

(5)

(d) find an equation for the normal to C at P in the form $ax + by + c = 0$, where a, b and c are integers.

(5)
(Total 13 marks)

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1. $\frac{8x^4}{4} + \frac{6x^{\frac{3}{2}}}{\frac{3}{2}} - 5x + c$ M1 A1

$2x^4 + 4x^{\frac{3}{2}}, -5x + c$ A1 A1

<u>Note</u>

M1 for some attempt to integrate a term in x: $x^n \to x^{n+1}$

1st A1 for correct, possibly un-simplified x^4 or $x^{\frac{3}{2}}$ term. e.g. $\frac{8x^4}{4}$ or $\frac{6x^{\frac{3}{2}}}{\frac{3}{2}}$

2nd A1 for <u>both</u> $2x^4$ and $4x^{\frac{3}{2}}$ terms correct and simplified on the same line

N.B. some candidates write $4\sqrt{x^3}$ or $4x^{1\frac{1}{2}}$ which are, of course, fine for A1

3rd A1 for $-5x + c$. Accept $-5x^1 + c$.
The $+c$ must appear on the same line as the $-5x$
N.B. We do not need to see one line with a fully correct integral

Ignore ISW (ignore incorrect subsequent working) if a correct answer is followed by an incorrect version.

Condone poor use of notation e.g. $\int 2x^4 + 4x^{\frac{3}{2}} - 5x + c$ will score full marks.

[4]

2. (a) $(y =)\frac{3x^2}{2} - \frac{5x^{\frac{1}{2}}}{\frac{1}{2}} - 2x \quad (+c)$ M1 A1 A1

$f(4) = 5 \quad \Rightarrow 5 = \frac{3}{2} \times 16 - 10 \times 2 - 8 + c$ M1

<u>$c = 9$</u> A1 5

$\left[f(x) = \frac{3}{2}x^2 - 10x^{\frac{1}{2}} - 2x + 9 \right]$

Note

1st M1 for an attempt to integrate $x^n \to x^{n+1}$

1st A1 for at least 2 correct terms in x (unsimplified)

2nd A1 for all 3 terms in x correct (condone missing $+c$ at this point). Needn't be simplified

2nd M1 for using the point (4, 5) to form a linear equation for c. Must use $x = 4$ and $y = 5$ and have no x term and the function must have "changed".

3rd A1 for $c = 9$. The final expression is not required.

(b) $m = 3\times 4 - \frac{5}{2} - 2 \quad \left(= 7.5 \text{ or } \frac{15}{2}\right)$ M1

Equation is: $y - 5 = \frac{15}{2}(x - 4)$ M1 A1

$\underline{2y - 15x + 50 = 0}$ o.e. A1 4

Note

1st M1 for an attempt to evaluate f′(4). Some correct use of $x = 4$ in f′(x) but condone slips. They must therefore have at least 3×4 or $-\frac{5}{2}$ and clearly be using f′(x) with $x = 4$. Award this mark wherever it is seen

2nd M1 for using their value of m [or their $-\frac{1}{m}$ (provided it clearly comes from using $x = 4$ in f'(x)) to form an equation of the line through (4, 5)).

Allow this mark for an attempt at a normal or tangent. Their m must be numerical. Use of $y = mx + c$ scores this mark when c is found.

1st A1 for any correct expression for the equation of the line

2nd A1 for any correct equation with integer coefficients. An "=" is required. e.g. $2y = 15x – 50$ etc as long as the equation is correct and has integer coefficients.

Normal

Attempt at normal can score both M marks in (b) but A0A0

[9]

3. $x\sqrt{x} = x^{\frac{3}{2}}$ (Seen, or implied by correct integration) B1

$x^{-\frac{1}{2}} \to kx^{\frac{1}{2}}$ or $x^{\frac{3}{2}} \to kx^{\frac{5}{2}}$ (k a non-zero constant) M1

$(y =)\dfrac{5x^{\frac{1}{2}}}{\frac{1}{2}} .... + \dfrac{x^{\frac{5}{2}}}{\frac{5}{2}} (+C)$ ("$y =$" and "$+C$" are not required for these marks) A1 A1

$35 = \dfrac{5 \times 4^{\frac{1}{2}}}{\frac{1}{2}} + \dfrac{4^{\frac{5}{2}}}{\frac{5}{2}} + C$ An equation in C is required (see conditions below). M1

(With their terms simplified or unsimplified).

$C = \dfrac{11}{5}$ or equivalent $2\dfrac{1}{5}$, 22 A1

$y = 10x^{\frac{1}{2}} + \dfrac{2x^{\frac{5}{2}}}{5} + \dfrac{11}{5}$ (Or equivalent simplified) A1 ft

I.s.w. if necessary, e.g. $y = 10x^{\frac{1}{2}} + \dfrac{2x^{\frac{5}{2}}}{5} + \dfrac{11}{5} = 50x^{\frac{1}{2}} + 2x^{\frac{1}{2}} + 11$

The final A mark requires an equation "$y =$..." with correct x terms (see below).

Note

B mark: $x^{\frac{3}{2}}$ often appears from integration of $\sqrt{x}$, which is B0.

1st A: Any unsimplified or simplified correct form, e.g. $\dfrac{5\sqrt{x}}{0.5}$

2nd A: Any unsimplified or simplified correct form, e.g. $\dfrac{x^2\sqrt{x}}{2.5}, \dfrac{2(\sqrt{x})^5}{5}$.

2nd M: Attempting to use $x = 4$ and $y = 35$ in a changed function (even if differentiated) to form an equation in C.

3rd A: Obtaining $C = \dfrac{11}{5}$ with no earlier incorrect work.

4th A: Follow-through only the value of C (i.e. the other terms must be correct).
Accept equivalent simplified terms such as $10\sqrt{x} + 0.4x^2\sqrt{x}$ ..

[7]

4. (a) $\frac{dy}{dx} = 6x^2 - 6x^{-3}$ M1 A1 A1 3

Note

M1 for an attempt to differentiate $x^n \rightarrow x^{n-1}$

1st A1 for $6x^2$

2nd A1 for $-6x^{-3}$ or $-\frac{6}{x^3}$ Condone $+ -6x^{-3}$ here. Inclusion of $+c$ scores A0 here.

(b) $\frac{2x^4}{4} + \frac{3x^{-1}}{-1} (+C)$ M1 A1

$\frac{x^4}{2} - 3x^{-1} + C$ A1 3

Note

M1 for some attempt to integrate an x term of the given y. $x^n \rightarrow x^{n+1}$

1st A1 for **both** x terms correct but unsimplified– as printed or better. Ignore $+c$ here

2nd A1 for both x terms correct and simplified and $+c$. Accept $-\frac{3}{x}$ but

NOT $+ -3x^{-1}$

Condone the +c appearing on the first (unsimplified) line but missing on the final (simplified) line

Apply ISW if a correct answer is seen

If part (b) is attempted first and this is clearly labelled then apply the scheme and allow the marks. Otherwise assume the first solution is for part (a).

[6]

5. $(I =)\frac{12}{6}x^6 - \frac{8}{4}x^4 + 3x + c$ M1

$= 2x^6 - 2x^4 + 3x + c$ A1A1A1

Note

M1 for an attempt to integrate $x^n \rightarrow x^{n+1}$

(i.e. ax^6 or ax^4 or ax, where a is any non-zero constant).

Also, this M mark can be scored for just the + c (seen at some stage), even if no other terms are correct.

1st A1 for $2x^6$

2nd A1 for $-2x^4$

3rd A1 for $3x + c$ (or $3x + k$, etc., any appropriate letter can be used as the constant)

Allow $3x^1 + c$, but <u>not</u> $\frac{3x^1}{1} + c$.

Note that the A marks can be awarded at separate stages, e.g.

$\frac{12}{6}x^6 - 2x^4 + 3x$ scores 2nd A1

$\frac{12}{6}x^6 - 2x^4 + 3x + c$ scores 3rd A1

$2x^6 - 2x^4 + 3x$ scores 1st A1 (even though the c has now been lost).

Remember that all the A marks are dependent on the M mark.

If applicable, isw (ignore subsequent working) after a correct answer is seen.

Ignore wrong notation if the intention is clear,

e.g. Answer $\int 2x^6 - 2x^4 + 3x + c \, dx$.

[4]

6. $(\text{f}(x) =) \frac{3x^3}{3} - \frac{3x^{\frac{3}{2}}}{\frac{3}{2}} - 7x(+c)$ M1

$= x^3 - 2x^{\frac{3}{2}} - 7x(+c)$ A1A1

$\text{f}(4) = 22 \Rightarrow 22 = 64 - 16 - 28 + c$ M1

$\boldsymbol{c = 2}$ A1cso 5

<u>Note</u>

1st M1 for an attempt to integrate ($3x^3$ or $x^{\frac{3}{2}}$ seen). The *x* term is insufficient for this mark and similarly the + *c* is insufficient.

1st A1 for $\frac{3}{3}x^3$ or $-\frac{3x^{\frac{3}{2}}}{\frac{3}{2}}$ (An unsimplified or simplified correct form)

2nd A1 for all three *x* terms correct and simplified… (the simplification may be seen later). The + *c* is not required for this mark.

Allow $-7x^1$, but <u>not</u> $-\frac{7x^1}{1}$.

2nd M1 for an attempt to use $x = 4$ <u>and</u> $y = 22$ in a changed function (even if differentiated) to form an equation in c.

3rd A1 for $c = 2$ with no earlier incorrect work (a final expression for f(*x*) is not required).

[5]

7. $2x + \frac{5}{3}x^3 + c$ M1A1A1 3

M1 for an attempt to integrate $x^n \to x^{n+1}$. Can be given if $+c$ is only correct term.

1st A1 for $\frac{5}{3}x^3$ or $2x + c$. Accept $1\frac{2}{3}$ for $\frac{5}{3}$ Do <u>not</u> accept $\frac{2x}{1}$ or $2x^1$ as final answer

2nd A1 for as printed (no extra or omitted terms). Accept $1\frac{2}{3}$ or $1.\dot{6}$ for $\frac{5}{3}$ but not 1.6 or 1.67 etc

Give marks for the first time correct answers are seen e.g. $\frac{5}{3}$ that later becomes 1.67, the 1.67 is treated as ISW

NB M1A0A1 is not possible

[3]

8. (a) $(x^2 + 3)^2 = x^4 + 3x^2 + 3x^2 + 3^2$ M1

$\frac{(x^2+3)^2}{x^2} = \frac{x^4+6x^2+9}{x^2} = x^2 + 6 + 9x^{-2}$ (*) A1cso 2

M1 for attempting to expand $(x^2 + 3)^2$ and having at least 3 (out of the 4) correct terms.

A1 at least this should be seen and no incorrect working seen.
If they never write $\frac{9}{x^2}$ as $9x^{-2}$ they score A0.

(b) $y = \frac{x^3}{3} + 6x + \frac{9}{-1}x^{-1} (+c)$ M1A1A1

$20 = \frac{27}{3} + 6\times3 - \frac{9}{3} + c$ M1

$c = -4$ A1

$[y =]\ \frac{x^3}{3} + 6x - 9x^{-1} - 4$ A1ft 6

1st M1 for some correct integration, one correct x term as printed or better
Trying $\frac{\int u}{\int v}$ loses the first M mark but could pick up the second.

1st A1 for two correct x terms, un-simplified, as printed or better

2nd A1 for a fully correct expression. Terms need not be simplified and $+c$ is not required.
No + c loses the next 3 marks

2nd M1 for using $x = 3$ and $y = 20$ in their expression for $f(x)\left[\neq \frac{dy}{dx}\right]$ to form a linear equation for c

3rd A1 for $c = -4$

4th A1ft for an expression for y with simplified x terms:
$\frac{9}{x}$ for $9x^{-1}$ is OK.
Condone missing "$y =$ "
Follow through their numerical value of c only.

[8]

9.	$3x^2 \to kx^3$ or $4x^5 \to kx^6$ or $-7 \to kx$ (k a non-zero constant)	M1	
	$\frac{3x^3}{3}$ or $\frac{4x^6}{6}$ (Either of these, simplified or unsimplified)	A1	
	$x^3 + \frac{2x^6}{3} - 7x$ or equivalent unsimplified, such as $\frac{3x^3}{3} + \frac{4x^6}{6} - 7x^1$	A1	
	$+ C$ (or any other constant, e.g. $+ K$)	B1	4

M: Given for increasing by one the power of x in one of the three terms.

A marks: 'Ignore subsequent working' after a correct unsimplified version of a term is seen.

B: Allow the mark (independently) for an integration constant appearing at any stage (even if it appears, then disappears from the final answer).

This B mark can be allowed even when no other marks are scored.

[4]

10. (a) $4x \to kx^2$ or $6\sqrt{x} \to kx^{3/2}$ or $\frac{8}{x^2} \to kx^{-1}$ (k a non-zero constant) M1

$f(x) = 2x^2, \ -4x^{3/2}, -8x^{-1}$ (+ C) (+ C not required) A1, A1, A1

At $x = 4$, $y = 1$: $1 = (2 \times 16) - \left(4 \times 4^{3/2}\right) - \left(8 \times 4^{-1}\right) + C$ Must be in part (a) M1

$C = 3$ A1 6

The first 3 A marks are awarded in the order shown, and the terms must be simplified.

'Simplified' coefficient means $\frac{a}{b}$ where a and b are integers with no common factors. Only a single + or – sign is allowed (e.g. + – must be replaced by –).

2nd M: Using $x = 4$ and $y = 1$ (not $y = 0$) to form an eqn in C. (No C is M0)

(b) $f'(4) = 16 - (6 \times 2) + \frac{8}{16} = \frac{9}{2}$ (= m) (M: Attempt $f'(4)$ with the given f'. Must be in part (b)) M1

Gradient of normal is $-\frac{2}{9}\left(= -\frac{1}{m}\right)$ (M: Attempt perp. grad. rule. Dependent on the use of their $f'(x)$) M1

Eqn. of normal: $y - 1 = -\frac{2}{9}(x - 4)$

(or any equiv. form, e.g. $\frac{y-1}{x-4} = -\frac{2}{9}$) M1A1 4

Typical answers for A1: $\left(y = -\frac{2}{9}x + \frac{17}{9}\right)$ $(2x + 9y - 17 = 0)$ $(y = -0.\dot{2}x + 1.\dot{8})$

Final answer: gradient $-\frac{1}{\left(9/2\right)}$ or $-\frac{1}{4.5}$ is A0 (but all M marks are available).

2nd M: Dependent upon use of their $f'(x)$.

3rd M: eqn. of a straight line through (4, 1) with any gradient except 0 or ∞.

Alternative for 3rd M: Using (4, 1) in $y = mx + c$ to find a value of c, but an equation (general or specific) must be seen.

Having coords the wrong way round, e.g. $y - 4 = -\frac{2}{9}(x - 1)$,

loses the 3rd M mark unless a correct general formula is seen, e.g. $y - y_1 = m(x - x_1)$.

N.B. The A mark is scored for any form of the correct equation… be prepared to apply isw if necessary.

[10]

11. (a) $f(x) = \frac{6x^3}{3} - \frac{10x^2}{2} - 12x\ (+C)$ M1A1

$x = 5$: $250 - 125 - 60 + C = 65$ $C = 0$ M1A1 4

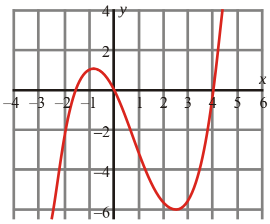
1st M1	for attempting to integrate, $x^n \to x^{n+1}$
1st A1	for all x terms correct, need not be simplified. Ignore $+C$ here.
2nd M1	for some use of $x = 5$ and f(5) = 65 to form an equation in C based on their integration. There must be some visible attempt to use $x = 5$ and f(5) =65. No $+C$ is M0.
2nd A1	for $C = 0$. This mark cannot be scored unless a suitable equation is seen.

(b) $x(2x^2 - 5x - 12)$ or $(2x^2 + 3x)(x - 4)$ or $(2x + 3)(x^2 - 4x)$ M1

$= x(2x + 3)(x - 4)$ (*) A1cso 2

M1	for attempting to take out a correct factor or to verify. Allow usual errors on signs. They must get to the equivalent of one of the given partially factorised expressions or, if verifying, $x(2x^2 + 3x - 8x - 12)$ i.e. with no errors in signs.
A1cso	for proceeding to printed answer with no incorrect working seen. Comment not required. This mark is dependent upon a fully correct solution to part (a) so M1A1M0A0M1A0 for (a) & (b). Will be common or M1A1M1A0M1A0. To score 2 in (b) they must score 4 in (a).

(c)



Shape B1

Through origin B1

$\left(-\frac{3}{2}, 0\right)$ and (4, 0) B1 3

1st B1	for positive x^3 shaped curve (with a max and a min) positioned anywhere.
2nd B1	for any curve that passes through the origin (B0 if it only touches at the origin)
3rd B1	for the two points clearly given as coords or values

marked in appropriate places on x axis.
Ignore any extra crossing points (they should have lost first B1).
Condone (1.5, 0) if clearly marked on –ve x-axis.
Condone (0, 4) etc if marked on +ve x axis
Curve can <u>stop</u> (i.e. not pass through) at (–1.5, 0) and (4, 0).
A point on the graph overrides coordinates given elsewhere.

[9]

12. (a) $(4 + 3\sqrt{x})(4 + 3\sqrt{x})$ seen, or a numerical value of k seen, $(k \neq 0)$. M1
(The k value need not be explicitly stated… see below).

$16 + 24\sqrt{x} + 9x$, or $k = 24$ A1cso 2

e.g. $(4 + 3\sqrt{x})(4 + 3\sqrt{x})$ alone scores M1 A0, (but <u>not</u> $(4 + 3\sqrt{x})^2$ alone).
e.g $16 + 12\sqrt{x} + 9x$ scores M1 A0.
$k = 24$ or $16+ 24\sqrt{x} + 9x$, with no further evidence,
scores full marks M1 A1.
Correct solution only (cso): any wrong working seen loses the A mark.

(b) $16 \to cx$ or $k^{1/2} \to cx^{3/2}$ or $9x \to cx^2$ M1

$\int (16 + 24\sqrt{x} + 9x)\mathrm{d}x = 16x + \frac{9x^2}{2} + C, + 16x^{3/2}$ A1, A1ft 3

A1: $16x + \frac{9x^2}{2} + C$. Allow 4.5 or $4\frac{1}{2}$ as equivalent to $\frac{9}{2}$.

A1ft: $\frac{2k}{3}x^{3/2}$ (candidate's value of k, or general k).

For this final mark, allow for example $\frac{48}{3}$ as equivalent to 16,

but do <u>not</u> allow unsimplified "double fractions" such as $\frac{24}{\left(\frac{3}{2}\right)}$,

and do <u>not</u> allow unsimplified "products" such as $\frac{2}{3} \times 24$.

A single term is required, e.g. $8x^{3/2} + 8x^{3/2}$ is not enough.

An otherwise correct solution with, say, C missing, followed by an incorrect solution including + C can be awarded full marks (isw, but allowing the C to appear at any stage).

[5]

13. (a) $3x^2 \to cx^3$ or $-6 \to cx$ or $-8x^{-2} \to cx^{-1}$ M1

$f(x) = \frac{3x^2}{3} - 6x - \frac{8x^{-1}}{-1}$ $(+C)$ $\left(x^3 - 6x + \frac{8}{x}\right)$ A1A1

Substitute $x = 2$ and $y = 1$ into a 'changed function' to form an equation in C. M1

$1 = 8 - 12 + 4 + C$ $C = 1$ A1cso 5

First 2 A marks: $+ C$ is not required, and coefficients need not be simplified, but powers must be simplified.

All 3 terms correct: A1 A1
Two terms correct: A1 A0
Only one term correct: A0 A0

Allow the M1 A1 for finding C to be scored either in part (a) or in part (b).

(b) $3 \times 2^2 - 6 - \frac{8}{2^2}$ M1

$= 4$ A1

Eqn. of tangent: $y - 1 = 4(x - 2)$ M1

$y = 4x - 7$ (Must be in this form) A1 4

1st M: Substituting $x = 2$ into $3x^2 - 6 - \frac{8}{x^2}$ (must be this function).

2nd M: Awarded generously for attempting the equation of a straight line through (2, 1) or (1, 2) with any value of m, however found.

2nd M: Alternative is to use (2, 1) or (1, 2) in $y = mx + c$ to find a value for c.

If calculation for the gradient value is seen in part (a), it must be used in part (b) to score the first M1 A1 in (b).

Using (1, 2) instead of (2, 1): Loses the 2nd method mark in (a).
Gains the 2nd method mark in (b).

MISREAD

$3x^2$ misread as $3x^3$

(a) $f(x) = \frac{3x^4}{4} - 6x - \frac{8x^{-1}}{-1}$ M1 A1 A0

$1 = 12 - 12 + 4 + C$ $C = -3$ M1 A0

(b) $m = 3 \times 2^3 - 6 - \frac{8}{2^2} = 16$ M1 A1

Eqn. of tangent: $y - 1 = 16(x - 2)$ M1

$y = 16x - 31$ A1

[9]

14. $\frac{6x^3}{3} + 2x + \frac{x^{\frac{1}{2}}}{\frac{1}{2}}$ $(+c)$ M1 A1

$= 2x^3 + 2x + 2x^{½}$ A1

$+ c$ B1

M1 for some attempt to integrate $x^n \to x^{n+1}$

1st A1 for either $\frac{6}{3}x^3$ or $\frac{x^{\frac{1}{2}}}{\frac{1}{2}}$ or better

2nd A1 for all terms in x correct. Allow $2\sqrt{x}$ and $2x^1$.

B1 for + c, when first seen with a changed expression.

[4]

15. (a) $f(x) = \frac{2x^2}{2} + \frac{3x^{-1}}{-1}(+c)$ $-\frac{3}{x}$ is OK M1A1

$(3, 7\frac{1}{2})$ gives $\frac{15}{2} = 9 - \frac{3}{3} + c$ 3^2 or 3^{-1} are OK instead of 9 or $\frac{1}{3}$ M1A1f.t.

$c = -\frac{1}{2}$ A1 5

1^{st} M1 for some attempt to integrate $x^n \to x^{n+1}$

1^{st} A1 both x terms as printed or better. Ignore (+c) here.

2^{nd} M1 for use of $(3, 7\frac{1}{2})$ or (–2, 5) to form an equation for c.
There must be some correct substitution. No +c is M0. Some changes in x terms of function needed.

2^{nd} A1f.t. for a correct equation for c. Follow through their integration. They must tidy up fraction/fraction and signs (e.g. $- -$ to +).

(b) $f(-2) = 4 + \frac{3}{2} - \frac{1}{2}$ (*) B1c.s.o 1

B1cso If (–2, 5) is used to find c in (a) B0 here unless they verify f(3) = 7.5.

(c) $m = -4 + \frac{3}{4}, = -3.25$ M1,A1

Equation of tangent is: $y - 5 = -3.25(x + 2)$ M1

$4y + 13x + 6 = 0$ o.e. Al 4

1^{st} M1 for attempting $m = f'(\pm 2)$

1^{st} A1 for $-\frac{13}{4}$ or -3.25

2^{nd} M1 for attempting equation of tangent at (–2, 5), f.t. their m, based on $\frac{dy}{dx}$.

2^{nd} A1 o.e. must have a, b and c integers and = 0.
Treat (a) and (b) together as a batch of 6 marks.

[10]

16.	(a)	$\frac{dy}{dx} = 4x + 18x^{-4}$	$x^n \mapsto x^{n-1}$ M1 A1	2
	(b)	$\int (2x^2 - 6x^{-3})dx = \frac{2}{3}x^3 + 3x^{-2}$	$x^n \mapsto x^{n+1}$ M1 A1	
		$[...]_1^3 = \frac{2}{3} \times 3^3 + \frac{3}{9} - \left(\frac{2}{3} + 3\right)$	M1	
		$= 14\frac{2}{3}$ $\quad \frac{44}{3}, \frac{132}{9}$ or equivalent	A1	4

[6]

17.	(a)	$\frac{dy}{dx} = 4x + 18x^{-4}$	M1: $x^2 \to x$ or $x^{-3} \to x^{-4}$	M1 A1	2
	(b)	$\frac{2x^3}{3} - \frac{6x^{-2}}{-2} + C$	M1: $x^2 \to x^3$ or x^{-3} 3 $\to x^{-2}$ or + C	M1 A1 A1	3
		$\left(= \frac{2x^3}{3} + 3x^{-2} + C\right)$	First A1: $\frac{2x^3}{3} + C$		
			Second A1: $-\frac{6x^{-2}}{-2}$		

In both parts, accept any correct version, simplified or not. Accept $4x^1$ for $4x$.

<u>+ C in part (a) instead of part (b)</u>:
Penalise only once, so if otherwise correct scores M1 A0, M1 A1 A1.

[5]

18. $\dfrac{5x^2+2}{x^{\frac{1}{2}}} = 5x^{\frac{3}{2}} + 2x^{-\frac{1}{2}}$ M1: One term correct. M1 A1

A1: Both terms correct, and no extra terms.

$f(x) = 3x + \dfrac{5x^{\frac{5}{2}}}{\left(\frac{5}{2}\right)} + \dfrac{5x^{\frac{1}{2}}}{\left(\frac{1}{2}\right)} (+C)$ (+ C not required here) M1 A1ft

$6 = 3 + 2 + 4 + C$ Use of $x = 1$ and $y = 6$ to form eqn. in C M1

$C = -3$ A1cso

$3x + 2x^{\frac{5}{2}} + 4x^{\frac{1}{2}} - 3$ (simplified version required) A1 (ft C)

[or: $3x + 2\sqrt{x^5} + 4\sqrt{x} - 3$ or equiv.] 7

[7]

For the integration:
M1 requires evidence from just one term (e.g. $3 \to 3x$), but not just "+C".
A1ft requires correct integration of at least 3 terms, with at least one of these terms having a fractional power.

For the final A1, follow through on C only.

19. (a) $(3 - \sqrt{x})^2 = 9 - 6\sqrt{x} + x$ M1

$\div$ by $\sqrt{x} \rightarrow 9x^{-\frac{1}{2}} - 6 + x^{\frac{1}{2}}$ A1 c.s.o. 2

M1 Attempt to multiply out $(3 - \sqrt{x})^2$. Must have 3 or 4 terms, allow one sign error
A1 cso Fully correct solution to printed answer. Penalise invisible brackets or wrong working

(b) $\int (9x^{-\frac{1}{2}} - 6 + x^{\frac{1}{2}})\mathrm{d}x = \frac{9x^{\frac{1}{2}}}{\frac{1}{2}} - 6x + \frac{x^{\frac{3}{2}}}{\frac{3}{2}} (+c)$ M1 A2/1/0

use $y = \frac{2}{3}$ and $x = 1$: $\frac{2}{3} = 18 \ - 6 + \frac{2}{3} + c$ M1

$c = -12$ A1 c.s.o.

So $y = 18x^{\frac{1}{2}} - 6x + \frac{2}{3}x^{\frac{3}{2}} - 12$ A1f.t. 6

1st M1 Some correct integration: $x^n \rightarrow x^{n+1}$
A1 At least 2 correct unsimplified terms
Ignore + c
A2 All 3 terms correct (unsimplified)
2nd M1 Use of $y = \frac{2}{3}$ and $x = 1$ to find c. No + c is M0.
A1c.s.o. for –12. (o.e.) Award this mark if "c = –12" stated i.e. not as part of an expression for y
A1f.t. for 3 simplified x terms with y = … and a numerical value for c. Follow through their value of c but it must be a number.

[8]

20. (i) (a) $15x^2 + 7$ M1 A1 A1 3

(i) (b) $30x$ B1ft 1

(ii) $x + 2x^{\frac{3}{2}} + x^{-1} + C$ A1: $x + C$, A1: $+2x^{\frac{3}{2}}$, A1: $+x^{-1}$ M1 A1 A1 A1 4

[8]

21. (a) $\sqrt{8} = 2\sqrt{2}$ seen or used somewhere (possibly implied). B1

$\frac{12}{\sqrt{8}} = \frac{12\sqrt{8}}{8}$ or $\frac{12}{2\sqrt{2}} = \frac{12\sqrt{2}}{4}$

Direct statement, e.g. $\frac{6}{\sqrt{2}} = 3\sqrt{2}$ (no indication of method) is M0. M1

At $x = 8$, $\frac{dy}{dx} = 3\sqrt{8} + \frac{12}{\sqrt{8}} = 6\sqrt{2} + 3\sqrt{2} = 9\sqrt{2}$ (*) A1 3

(b) Integrating: $\frac{3x^{3/2}}{(3/2)} + \frac{12x^{1/2}}{(1/2)} (+C)$ (C not required) M1 A1 A1

At (4, 30), $\frac{3 \times 4^{3/2}}{(3/2)} + \frac{12 \times 4^{1/2}}{(1/2)} + C = 30$ (C required) M1

(f(x) =) $2x^{3/2} + 24x^{1/2}$, –34 A1, A1 6

[9]

22. (a) $y = 5x - x^{-1} + C$ M1 A2 (1,0) 3

(b) $7 = 5 - 1 + C$, $C = 3$ M1 A1 ft

$x = 2$: $y = 10 - \frac{1}{2} + 3 = 12\frac{1}{2}$ M1 A1 4

[7]

23. (a) $\frac{dy}{dx} = 10 \times \frac{3}{2}x^{\frac{1}{2}} \left(= 15x^{\frac{1}{2}} \right)$ M1 A1

(b) $7x + 4x^{\frac{5}{2}} + C$ M1 A2 (1, 0)

[5]

24. $\int \frac{2}{x^2}\,dx = \frac{k}{x}$ M1

$k = -2$ A1

$\left[\frac{k}{x}\right]_1^4 \to \left|\frac{k}{4} - \frac{k}{1}\right|$ M1

$= 1\frac{1}{2}$ A1 4

[4]

25. $\frac{x^3}{3} - \frac{x^{-1}}{-1} + \frac{x^{\frac{4}{3}}}{\frac{4}{3}}$

(A1 for 2 terms correct, A1 for all correct) M1 A1 A1

$= \frac{x^3}{3} + x^{-1} + \frac{3x^{\frac{4}{3}}}{4} + C$ B1 (for C) 4

[4]

26. (a) $\frac{d^2y}{dx^2} = 3x^2 + 2$ M1 A1 2

(b) Since x^2 is always positive, $\frac{d^2y}{dx^2} \geq 2$ for all x. B1 1

(c) $y = \frac{x^4}{4} + x^2 - 7x + (k)$ [k not required here] M1 A2 (1, 0)

$4 = \frac{2^4}{4} + 2^2 - 14 + k$ $k = 10$ $y = \frac{x^4}{4} + x^2 - 7x + 10$ M1 A1 5

(d) $x = 2$: $\frac{dy}{dx} = 8 + 4 - 7 = 5$ M1 A1

Gradient of normal $= -\frac{1}{5}$ M1

$y - 4 = -\frac{1}{5}(x - 2)$ $x + 5y - 22 = 0$ M1 A1 5

[13]

1. This question was answered very well. Most knew and applied the integration rule successfully although the simplification of $\frac{6}{\frac{3}{2}}$ proved too difficult for some with 9 being a common incorrect answer. Very few differentiated throughout but sometimes the 5 was "integrated" to zero although the other terms were correct. Only a few omitted the constant.

2. In part (a) most integrated correctly although the fractional power caused a few problems: some thought $\frac{5}{\sqrt{x}} = 5x^{\frac{1}{2}}$ and obtained $\frac{10}{3}x^{\frac{3}{2}}$ whilst others divided by 2 instead of $\frac{1}{2}$. The +*c* was usually included and $x = 4$ was often substituted but sometimes the expression was set equal to 0 rather than 5.

In part (b) the majority attempted to find the gradient using f′(4) and most went on to find the equation of a tangent although some had mistakes with the arithmetic. A few found the equation of a normal and a handful still did not know how to find the gradient of the tangent and used one of the coefficients from the given expression or their integration in part (a).

3. In this question the main problem for candidates was the integration of $x\sqrt{x}$, for which a common result was $\frac{x^2}{2} \times \frac{2x^{\frac{3}{2}}}{3}$. Those who replaced $x\sqrt{x}$ by $x^{\frac{3}{2}}$ generally made good progress, although the fractional indices tended to cause problems. Some differentiated instead of integrating. Most candidates used the given point (4, 35) in an attempt to find the value of the integration constant, but mistakes in calculation were very common. A significant minority of candidates failed to include the integration constant or failed to use the value of *y* in their working, and for those the last three marks in the question were unavailable.

4. This question was answered very well with most candidates knowing and applying the rules for differentiation and integration correctly although the use of the notation for this topic, especially the integration sign, is still poor.

Most differentiated $2x^3$ correctly in part (a) and although many wrote $\frac{3}{x^2}$ as $3x^{-2}$, some still thought the derivative was $-6x^{-1}$ or $+6x^{-3}$. Similar problems arose with the integration in part (b) and some lost marks through failing to simplify their expressions and of course others forgot the +*c*.

5. This question was generally answered very well, with most candidates scoring at least 3 marks out of 4. Omission of the integration constant occurred less frequently than usual and the terms were usually simplified correctly. Just a few candidates differentiated, and a few thought that the integral of x^n was $\frac{x^{n+1}}{n}$.

6. Most candidates coped well with the integration, usually scoring the first two or three marks in this question. The majority then used the given point (4, 22) appropriately in an attempt to find the value of the integration constant, but mistakes in calculation were very common. The evaluation of $2x^{\frac{3}{2}}$ at $x = 4$ was a particular problem.
A significant minority of candidates failed to include the integration constant or failed to use the value of y in their working, and for those the last two marks in the question were unavailable.

7. Most candidates showed a clear understanding of basic integration and many achieved full marks. Omitting the constant of integration was a common error as was a failure to integrate the 2. Some integrated $5x^2$ and obtained $\frac{5x^3}{2}$ or $10x^3$ and a few differentiated thereby obtaining $10x$.

8. Part (a) was usually answered correctly although there were a few errors seen: $x^4 + 9$ for the expansion and partial or incorrect division being the common ones.

Part (b) was less well done. Some failed to realise that integration was required and others found the equation of a tangent. Those who did integrate sometimes struggled with the negative index and $9x^{-3}$ appeared. Those who successfully integrated sometimes forgot the $+c$ (and lost the final 3 marks) and others couldn't simplify $9x^{-1}$ as it later became $\frac{1}{9x}$. Simple arithmetic let down a few too with $3^3 = 9$ or $9 \times 3^{-1} = 27$ spoiling otherwise promising solutions.

9. Candidates answered this question well, with almost all of them recognising that integration was needed. A few were unable to integrate the 7 correctly and some omitted the constant of integration, but otherwise it was common to see full marks.

10. Most candidates realised that integration was required in part (a) of this question and although much of the integration was correct, mistakes in simplification were common. Not all candidates used the (4, 1) to find the constant of integration, and of those who did, many lost accuracy through mistakes in evaluation of negative and fractional quantities. Occasionally $x = 4$ was used without $y = 1$, losing the method mark. Evaluation of the constant was sometimes seen in part (b) from those who confused this constant with the constant c in $y = mx + c$. Those who used differentiation instead of integration in part (a) rarely recovered.

In part (b), while some candidates had no idea what to do, many scored well. Some, however, failed to use the given $f'(x)$ to evaluate the gradient, and others found the equation of the tangent instead of the normal.

11. Most candidates were able to integrate correctly to obtain $2x^3 - 5x^2 - 12x$ but many forgot to include a +C and never used the point (5, 65) to establish that C = 0. The majority of those who did attempt to find C went on to complete part (b) correctly but a few, who made arithmetic slips and had a non-zero C, were clearly stuck in part (b) although some did try and multiply out the given expression and gained some credit.

The sketch in part (c) was answered well. Few tried plotting points and there were many correct answers. Sometimes a "negative" cubic was drawn and occasionally the curve passed through (1.5, 0) instead of (– 1.5, 0). There were very few quadratic or linear graphs drawn.

12. Many candidates scored full marks on this question, or perhaps lost just one mark in part (b). Most established $k = 24$ in part (a), but occasional wrong values seen here included 12, 6 and 2.

Although a few candidates started again in part (b) with the expansion of $(4 + 3\sqrt{x})^2$, the vast majority integrated the expression from part (a). The constant of integration was often omitted, but most other mistakes were minor.
Sometimes 3/(24/ 2) was wrongly simplified.

13. In part (a) of this question, many candidates were able to integrate the expression successfully.

Most errors came in the integration of $8x^{-2}$, where $\frac{8x^{-3}}{-3}$ was a popular suggestion.

Some candidates, perhaps unsure about the notation, differentiated $f'(x)$ instead of integrating it. A significant number, even those who correctly included a constant of integration C, omitted to use (2, 1) to find the value of C.
Those few candidates who attempted to find the value of C in part (b) were usually confusing this constant with the constant c for the straight line equation.
In part (b) most candidates knew that they were required to evaluate $f'(2)$ to find the gradient of the tangent at (2, 1), but some were unable to do this accurately.
Some, having correctly obtained 4 for the gradient of the tangent, went on to find an equation for the normal through the point. Most candidates attempted to express their equation in the required form.

14. This was a successful starter to the paper and nearly all the candidates were able to make some progress. Most were able to integrate the first two terms successfully but some treated the third term as x^2 rather than x^{-2} Simplifying the terms did cause some difficulties though and $\frac{6}{3} = 3$ or $\frac{1}{½} = \frac{1}{2}$ were common errors. Most remembered to include the $+c$. Only a small minority of candidates tried differentiating the expression which suggests that the notation was understood well.

15. This question was not always answered well. Most candidates knew that integration was required in part (a) and usually they scored both the marks but many forgot to include a constant of integration. Many still did not realize their error even when they obtained f(–2)=5.5 and this proved to be a costly mistake. The candidates could still complete part (c) even if they had made mistakes in part (a) and most attempted this part. The most common error was to find the equation of the chord between the points (–2, 5) and (3, 7.5). Those who realized that f'(–2) was required often had trouble with the arithmetic and some thought that the gradient of the normal was required. A few candidates used (3, 7.5) instead of (–2, 5) in part (c). Those candidates who successfully negotiated these pitfalls usually gave their answer in the required form but there were few fully correct solutions to this part.

16. The general standard of calculus displayed throughout the paper was excellent and full marks were common on this question. A few candidates took the negative index in the wrong direction, differentiating x^{-3} to obtain $-2x^{-2}$ and integrating x^{-3} to obtain $-\frac{x^{-4}}{4}$.

17. This was a standard test of candidates' ability to differentiate and integrate, and many completely correct solutions were seen. Answers to part (a) were usually correct, although

$18x^{-2}$ appeared occasionally as the derivative of $-6x^{-3}$. Mistakes in the integration in part (b) were more common, particularly with the negative power, and inevitably the integration constant was frequently omitted. Sometimes the answer to part (a) was integrated, rather than the original function.

18. Candidates often had difficulty with this question. The first step, before integration, should have been division to express $\frac{5x^2+2}{x^{1/2}}$ as two separate terms. Although $2x^{-1/2}$ was commonly seen, some candidates had trouble with the other term. Sometimes f′ (x) was multiplied by $x^{1/2}$ before integration. Other mistakes included separate integration of numerator and denominator, and differentiation.

Integration techniques were, however, usually sound, but then for some candidates the lack of an integration constant prevented any further progress. Some attempts to find the value of the constant failed because candidates used only $x = 1$ and not $y = 6$ in their expression for f(x).

19. Most candidates could square the bracket though sometimes the examiners saw a – x or an $x^{\frac{1}{4}}$. The division by $\sqrt{x}$ was usually carried out correctly but occasionally the first term was given as $9x^{\frac{1}{2}}$ instead of $9\,x^{-\frac{1}{2}}$.

In part (b) the fractional powers created few problems for the integration, but division by fractions caused errors to appear for a number of candidates with $\frac{9}{\frac{1}{2}}$ often being simplified to 4.5. Most candidates knew that they had to include a "+c" and then use the given values of x and y to find its value. About 30% of the candidates failed to include the constant and automatically denied themselves access to the last 3 marks. The fact that a number of these students still tried to substitute the given values in their expression shows that there is some misunderstanding surrounding this topic.

20. This was a standard test of candidates' ability to differentiate and integrate. Answers to part (i)(a) were almost always correct, but in (i)(b) a few candidates seemed unfamiliar with the idea of a second derivative. Before integrating in part (ii), it was necessary to consider $\sqrt{x}$ as $x^{\frac{1}{2}}$ and $\frac{1}{x^2}$ as x^{-2}, and this step defeated some candidates. Apart from this, other common mistakes were to integrate x^{-2} to give $\frac{x^{-3}}{-3}$, to interpret $3\sqrt{x}$ as $x^{\frac{1}{3}}$ and to omit the constant of integration.

21. The manipulation of surds in part (a) was often disappointing in this question. While most candidates appreciated the significance of the "exact value" demand and were not tempted to use decimals from their calculators, the inability to rationalise the denominator was a common problem. Various alternative methods were seen, but for all of these, since the answer was given, it was necessary to show the relevant steps in the working to obtain full marks.

Integration techniques in part (b) were usually correct, despite some problems with fractional indices, but the lack of an integration constant limited candidates to 3 marks out of 6. Sometimes the (4, 30) coordinates were used as limits for an attempted "definite integration".

22. Methods of integration in part (a) were usually sound, although weaker candidates tended to have difficulty with the negative power. The most common mistake, however, was the omission of the constant of integration, so that in part (b) candidates were surprised to find that the given information did not fit their expression for y. This problem was usually ignored and they proceeded to substitute $x = 2$ into their expression to achieve a wrong answer. Some candidates found the equation of a straight line through (1, 7), and others simply offered $y = 14$ (doubling both x and y).

23. Most candidates were proficient in the techniques of differentiation and integration, gaining good marks in this question. Answers to part (a) were nearly always correct, but in part (b) it was very common for the constant of integration to be omitted. Also in (b), many candidates were unwilling or unable to simplify $\frac{10x^{\frac{5}{2}}}{\frac{5}{2}}$. Just a few candidates integrated their answer to part (a) rather than the given function.

24. No Report available for this question.

25. No Report available for this question.

26. No Report available for this question.