Integration - Edexcel Past Exam Questions MARK SCHEME

Question 1 : Jan 05 Q2

Question number	Scheme	Marks
	(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
	(i) (a) A1: 2 terms correctly differentiated. A1: Fully correct. (ii) Allow any equivalent version of each term.	

Question 2 : Jan 05 Q9

Question number	Scheme	Marks
	(a) Gradient of tangent at P: $m=4$, Grad. of normal $=-\frac{1}{m}$ $\left(=-\frac{1}{4}\right)$	B1, M1
	Equation of normal: $y-4=-\frac{1}{4}(x-1)$ $(4y=-x+17)$	M1 A1 (4)
	(b) $(3x-1)^2=9x^2-6x+1$	B1
	Integrate: $\frac{9x^3}{3}-\frac{6x^2}{2}+x\ (+C)$	M1 A1ft
	Substitute (1, 4) to find $c=\ldots$, $c=3$ $(y=3x^3-3x^2+x+3)$	M1, A1 (5)
	(c) Gradient of (tangent to) C is ≥ 0	B1
	Gradient of given line is <0 (-2)	B1 (2)
		11
	(a) Using gradient of tangent is M0. (b) Alternative: $y=\frac{(3x-1)^3}{9}\ (+C)$ M1 A1 (numerator) A1 (denominator) Substitute (1, 4) to find $c=\ldots$, $c=\frac{28}{9}$ $\left(y=\frac{(3x-1)^3}{9}+\frac{28}{9}\right)$ M1, A1	

Question 3 : June 05 Q2

Question number	Scheme	Marks
	(a) $x\log 5 = \log 8$, $x = \dfrac{\log 8}{\log 5}$, $= 1.29$	M1, A1, A1 (3)
	(b) $\log_2 \dfrac{x+1}{x}$ (or $\log_2 7x$)	B1
	$\dfrac{x+1}{x} = 7$ $x = \ldots,$ $\dfrac{1}{6}$ (Allow 0.167 or better)	M1, A1 (3)
		6
	(a) Answer only 1.29 : Full marks. Answer only, which rounds to 1.29 (e.g. 1.292): M1 A1 A0 Answer only, which rounds to 1.3 : M1 A0 A0 Trial and improvement: Award marks as for "answer only". (b) M1: Form (by legitimate log work) and solve an equation in x. Answer only: No marks unless verified (then full marks are available).	

Question 4 : June 05 Q7

Question Number	Scheme	Marks
(a)	$(3-\sqrt{x})^2 = 9-6\sqrt{x}+x$	M1
	$\div by\sqrt{x} \quad \rightarrow 9x^{-\frac{1}{2}}-6+x^{\frac{1}{2}}$	A1 c.s.o.
		(2)
(b)	$\int(9x^{-\frac{1}{2}}-6+x^{\frac{1}{2}})dx = \frac{9x^{\frac{1}{2}}}{\frac{1}{2}}-6x+\frac{x^{\frac{3}{2}}}{\frac{3}{2}}(+c)$	M1 A2/1/0
	use $y=\frac{2}{3}$ and $x=1$: $\quad \frac{2}{3}=18-6+\frac{2}{3}+c$	M1
	$c = -12$	A1 c.s..o.
	So $\quad y=18x^{\frac{1}{2}}-6x+\frac{2}{3}x^{\frac{3}{2}}$ -12	A1f.t.
		(6)
		(8)
(a)	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 wrong working.	
(b)	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 $y=\ldots$ and a numerical value for c. Follow through their value of c but it must be a number.	

Question 5 : Jan 06 Q4

Question number	Scheme		Marks
	(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 $x^{-3} \to x^{-2}$ or $+C$	M1 A1 A1
			(3)
	$\left(= \frac{2x^3}{3} + 3x^{-2} + C\right)$	First A1: $\frac{2x^3}{3} + C$	
		Second A1: $-\frac{6x^{-2}}{-2}$	
			Total 5 marks
	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.		

Question 6 : Jan 06 Q8

Question number	Scheme		Marks
	$\dfrac{5x^2+2}{x^{\frac{1}{2}}} = 5x^{\frac{3}{2}} + 2x^{-\frac{1}{2}}$	M1: One term correct.	M1 A1
		A1: Both terms correct, and no extra terms.	
	$\mathrm{f}(x) = 3x + \dfrac{5x^{\frac{5}{2}}}{\left(\frac{5}{2}\right)} + \dfrac{2x^{\frac{1}{2}}}{\left(\frac{1}{2}\right)}$ $(+C)$	(+ 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)
			(7)
	[or: $3x + 2\sqrt{x^5} + 4\sqrt{x} - 3$ or equiv.]		
			Total 7 marks
	For the integration: M1 requires evidence from just one term (e.g. $3 \rightarrow 3x$), 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.		

Question 7 : June 06 Q1

Question number	Scheme	Marks
	$\frac{6x^3}{3} + 2x + \frac{x^{\frac{1}{2}}}{\frac{1}{2}} \quad (+c)$	M1
		A1
	$= 2x^3 + 2x + 2x^{\frac{1}{2}}$	A1
	$+c$	B1
		4
	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.	

Question 8 : June 06 Q10

Question number	Scheme	Marks
(a)	$\text{f}(x) = \frac{2x^2}{2} + \frac{3x^{-1}}{-1} (+c)$ $\qquad -\frac{3}{x}$ is OK	M1A1
	$(3, 7\frac{1}{2})$ gives $\frac{15}{2} = 9 - \frac{3}{3} + c$ $\qquad 3^2$ or 3^{-1} are OK instead of 9 or $\frac{1}{3}$	M1A1f.t.
	$c = -\frac{1}{2}$	A1 (5)
(b)	$\text{f}(-2) = 4 + \frac{3}{2} - \frac{1}{2}$ (*)	B1c.s.o. (1)
(c)	$m = -4 + \frac{3}{4}$, $= -3.25$	M1,A1
	Equation of tangent is: $y - 5 = -3.25(x + 2)$	M1
	$\underline{4y + 13x + 6 = 0}$ $\qquad$ o.e.	A1 (4)
		10

(a)	1^{st} M1	for some attempt to integrate $x^n \to x^{n+1}$
	1^{st} A1	for 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)	B1cso	If (-2, 5) is used to find c in (a) B0 here unless they verify f(3)=7.5.
(c)	1^{st} M1	for attempting $m = \text{f}'(\pm 2)$
	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.

Question 9 : Jan 07 Q6

Question number	Scheme	Marks
	(a) $(4+3\sqrt{x})(4+3\sqrt{x})$ seen, or a numerical value of k seen, $(k \neq 0)$. (The k value need not be explicitly stated… see below). $16+24\sqrt{x}+9x$, or $k=24$ (b) $16 \to cx$ or $kx^{1/2} \to cx^{3/2}$ or $9x \to cx^2$ $\int\left(16+24\sqrt{x}+9x\right)\mathrm{d}x = 16x + \frac{9x^2}{2} + C, \ +16x^{3/2}$	M1 A1cso (2) M1 A1, A1ft (3) **5**
	(a) 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) 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).	

Question 10 : Jan 07 Q7

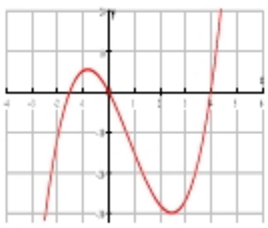
Question number	Scheme	Marks
	(a) $3x^2 \to cx^3$ or $-6 \to cx$ or $-8x^{-2} \to cx^{-1}$	M1
	$\text{f}(x) = \dfrac{3x^3}{3} - 6x - \dfrac{8x^{-1}}{-1}$ $\quad (+C) \quad$ $\left(x^3 - 6x + \dfrac{8}{x}\right)$	A1 A1
	Substitute $x = 2$ <u>and</u> $y = 1$ into a 'changed function' to form an equation in C.	M1
	$1 = 8 - 12 + 4 + C \qquad C = 1$	A1cso (5)
	(b) $3 \times 2^2 - 6 - \dfrac{8}{2^2}$	M1
	$= 4$	A1
	Eqn. of tangent: $y - 1 = 4(x - 2)$	M1
	$y = 4x - 7$ (Must be in this form)	A1 (4)
		9
	(a) First 2 A marks: $+ C$ is not required, and coefficients need <u>not</u> 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) 1st M: Substituting $x = 2$ into $3x^2 - 6 - \dfrac{8}{x^2}$ (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 <u>find a value</u> for c. If calculation for the gradient value is seen in part (a), it must be <u>used</u> in part (b) to score the first M1 A1 in (b). <u>Using (1, 2) instead of (2, 1)</u>: Loses the 2nd method mark in (a). Gains the 2nd method mark in (b).	

Question 11 : June 07 Q3

Question number	Scheme	Marks
	(c) $x^3 + \frac{8}{3}x^{\frac{3}{2}} + C$ A1: $\frac{3}{3}x^3$ or $\frac{4x^{\frac{3}{2}}}{\left(\frac{3}{2}\right)}$ A1: both, simplified and $+C$	M1 A1 A1 (3)

(c)	M1	for some attempt to integrate: $x^n \to x^{n+1}$. Condone misreading $\frac{dy}{dx}$ or $\frac{d^2y}{dx^2}$ for y. ($+C$ alone is not sufficient)
	1st A1	for either $\frac{3}{3}x^3$ or $\frac{4x^{\frac{3}{2}}}{\left(\frac{3}{2}\right)}$ (or better) $\frac{2}{3}\times 4x^{\frac{3}{2}}$ is OK here too but not for 2nd A1.
	2nd A1	for both x^3 and $\frac{8}{3}x^{\frac{3}{2}}$ or $\frac{8}{3}x\sqrt{x}$ i.e. simplified terms and $+C$ all on one line. $2\frac{2}{3}$ instead of $\frac{8}{3}$ is OK

Question 12 : June 07 Q9

Question number	Scheme	Marks
	(a) $f(x) = \frac{6x^3}{3} - \frac{10x^2}{2} - 12x \ (+C)$	M1 A1
	$x = 5$: $\quad 250 - 125 - 60 + C = 65 \qquad C = 0$	M1 A1 (4)
	(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)
	(c)  Shape	B1
	Through origin	B1
	$\left(-\frac{3}{2}, 0\right)$ and $(4,0)$	B1 (3)
		9
(a)	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)	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)	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 stop (i.e. not pass through) at (-1.5, 0) and (4, 0). A point on the graph overrides coordinates given elsewhere.	

Question 13: Jan 08 Q1

Question number	Scheme	Marks
	$3x^2 \to kx^3$ 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)
		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.	

Question 14 : Jan 08 Q9

Question number	Scheme	Marks	
	(a) $4x \to kx^2$ or $6\sqrt{x} \to kx^{3/2}$ or $\dfrac{8}{x^2} \to kx^{-1}$ (k a non-zero constant)	M1	
	$\text{f}(x) = 2x^2$, $-4x^{3/2}$, $-8x^{-1}$ (+ C) (+ C not required)	A1, A1, A1	
	At $x = 4$, $y = 1$: $1 = (2\times16) - \left(4\times4^{3/2}\right) - \left(8\times4^{-1}\right) + C$ <u>Must be in part (a)</u>	M1	
	$C = 3$	A1	(6)
	(b) $\text{f}'(4) = 16-(6\times2)+\dfrac{8}{16} = \dfrac{9}{2}\ (= m)$ [M: Attempt $\text{f}'(4)$ with the <u>given</u> f'. <u>Must be in part (b)</u>]	M1	
	Gradient of normal is $-\dfrac{2}{9}\left(= -\dfrac{1}{m}\right)$ [M: Attempt perp. grad. rule. Dependent on the use of their $\text{f}'(x)$]	M1	
	Eqn. of normal: $y-1 = -\dfrac{2}{9}(x-4)$ (or any equiv. form, e.g. $\dfrac{y-1}{x-4} = -\dfrac{2}{9}$)	M1 A1	(4)
	Typical answers for A1: $\left(y = -\dfrac{2}{9}x+\dfrac{17}{9}\right)$ $(2x+9y-17=0)$ $(y = -0.\dot{2}x + 1.\dot{8})$		
	Final answer: gradient $-\dfrac{1}{(9/2)}$ or $-\dfrac{1}{4.5}$ is A0 (but all M marks are available).		
			10

	(a) The first 3 A marks are awarded in the order shown, and the terms must be simplified. 'Simplified' coefficient means $\dfrac{a}{b}$ 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 $x = 4$ <u>and</u> $y = 1$ (<u>not</u> $y = 0$) to form an eqn in C. (No C is M0) (b) 2nd M: Dependent upon use of their $\text{f}'(x)$. 3rd M: eqn. of a straight line through (4, 1) with any gradient except 0 or ∞. <u>Alternative for 3rd M:</u> Using (4, 1) in $y = mx + c$ to <u>find a value</u> of c, but an equation (general or specific) must be seen. Having coords the <u>wrong way round</u>, e.g. $y-4 = -\dfrac{2}{9}(x-1)$, loses the 3rd M mark <u>unless</u> a correct general formula is seen, e.g. $y - y_1 = m(x - x_1)$. N.B. The A mark is scored for <u>any</u> form of the correct equation… be prepared to apply isw if necessary.	

Question 15 : June 08 Q1

Question Number	Scheme	Marks
	$2x+\frac{5}{3}x^3+c$	M1 A1 A1 (3)
		(3 marks)

Question 16 : June 08 Q11

Question Number	Scheme	Marks
(a)	$\left(x^2+3\right)^2=x^4+3x^2+3x^2+3^2$	M1
	$\frac{\left(x^2+3\right)^2}{x^2}=\frac{x^4+6x^2+9}{x^2}=x^2+6+9x^{-2}$ (*)	A1 cso (2)
(b)	$y=\frac{x^3}{3}+6x+\frac{9}{-1}x^{-1}(+c)$	M1 A1 A1
	$20=\frac{27}{3}+6\times3-\frac{9}{3}+c$	M1
	$c=-4$	A1
	$[y=]\frac{x^3}{3}+6x-9x^{-1}-4$	A1 ft (6)
		(8 marks)

Question 17 : Jan 09 Q2

Question Number	Scheme	Marks
	$(I=)\frac{12}{6}x^6-\frac{8}{4}x^4+3x+c$ $=2x^6-2x^4+3x+c$	M1 A1A1A1 **[4]**
	M1 for an attempt to integrate $x^n \to x^{n+1}$ (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 $\int 2x^6-2x^4+3x+c\,dx$.	

Question 18 : Jan 09 Q4

Question Number	Scheme	Marks
	$(\text{f}(x) =)\dfrac{3x^3}{3} - \dfrac{3x^{\frac{3}{2}}}{\frac{3}{2}} - 7x(+c)$	M1
	$= x^3 - 2x^{\frac{3}{2}} - 7x \quad (+c)$	A1A1
	$\text{f}(4) = 22 \quad \Rightarrow \quad 22 = 64 - 16 - 28 + c$	M1
	$c = 2$	A1cso (5)
		[5]
	1st M1 for an attempt to integrate (x^3 or $x^{\frac{3}{2}}$ seen). The x term is insufficient for this mark and similarly the $+ c$ is insufficient. 1st A1 for $\dfrac{3}{3}x^3$ or $-\dfrac{3x^{\frac{3}{2}}}{\frac{3}{2}}$ (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> $-\dfrac{7x^1}{1}$. 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).	

Question 19 : June 09 Q3

Question Number	Scheme	Marks
	$\frac{2x^4}{4}+\frac{3x^{-1}}{-1}(+C)$	M1 A1
	$\frac{x^4}{2}-3x^{-1}+C$	A1 (3)

M1 for some attempt to integrate an x term of the given y. $x^n \to x^{n+1}$ 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 <u>NOT</u> $+-3x^{-1}$ 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).	

Question 20 : Jan 10 Q4

Question number	Scheme	Marks
	$x\sqrt{x} = x^{\frac{3}{2}}$ (Seen, or implied by correct integration)	B1
	$x^{-1/2} \to kx^{1/2}$ or $x^{3/2} \to kx^{5/2}$ (k a non-zero constant)	M1
	$(y =)\ \dfrac{5x^{1/2}}{1/2}\ldots + \dfrac{x^{5/2}}{5/2}\ (+C)$ ("$y =$" and "$+C$" are not required for these marks)	A1... A1
	$35 = \dfrac{5\times 4^{1/2}}{1/2} + \dfrac{4^{5/2}}{5/2} + C$ An equation in C is required (see conditions below). (With their terms simplified or unsimplified).	M1
	$C = \dfrac{11}{5}$ or equivalent $2\dfrac{1}{5}$, 2.2	A1
	$y = 10x^{1/2} + \dfrac{2x^{5/2}}{5} + \dfrac{11}{5}$ (Or equivalent <u>simplified</u>)	A1 ft
	I.s.w. if necessary, e.g. $y = 10x^{1/2} + \dfrac{2x^{5/2}}{5} + \dfrac{11}{5} = 50x^{1/2} + 2x^{5/2} + 11$ The final A mark requires an <u>equation</u> "$y = \ldots$" with correct x terms (see below).	[7]
	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. $\dfrac{x^2\sqrt{x}}{2.5}$, $\dfrac{2\left(\sqrt{x}\right)^5}{5}$. 2nd M: Attempting to use $x = 4$ <u>and</u> $y = 35$ 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 <u>only</u> the value of C (i.e. the other terms must be correct). Accept equivalent <u>simplified</u> terms such as $10\sqrt{x} + 0.4x^2\sqrt{x}$ ...	

Question 21 : June 10 Q2

Question Number	Scheme	Marks
	$\frac{8x^4}{4}+\frac{6x^{\frac{3}{2}}}{\frac{3}{2}}-5x+c$	M1 A1
	$=2x^4+4x^{\frac{3}{2}},-5x+c$	A1 A1
		4
	Notes	
	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.	

Question 22 : June 10 Q11

Question Number	Scheme	Marks
(a)	$(y=)\dfrac{3x^2}{2}-\dfrac{5x^{\frac{1}{2}}}{\frac{1}{2}}-2x \quad (+c)$	M1A1A1
	$f(4)=5 \quad \Rightarrow 5=\frac{3}{2}\times 16-10\times 2-8+c$	M1
	$\underline{c=9}$	A1 (5)
	$\left[f(x)=\frac{3}{2}x^2-10x^{\frac{1}{2}}-2x+9\right]$	
(b)	$m=3\times 4-\dfrac{5}{2}-2 \quad \left(=7.5 \text{ or } \dfrac{15}{2}\right)$	M1
	Equation is: $y-5=\dfrac{15}{2}(x-4)$	M1A1
	$\underline{2y-15x+50=0}$ o.e.	A1 (4) **(9marks)**
(a)	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)	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 $-\dfrac{1}{m}$] (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	

Question 23 : Jan 11 Q2

Question Number	Scheme	Marks
	$\left(\int =\right)\dfrac{12x^6}{6}, -\dfrac{3x^3}{3}, +\dfrac{4x^{\frac{4}{3}}}{\frac{4}{3}}, (+c)$	M1A1,A1,A1
	$= \underline{2x^6 - x^3 + 3x^{\frac{4}{3}} + c}$	A1
		5
	Notes	
	M1 for some attempt to integrate: $x^n \to x^{n+1}$ i.e ax^6 or ax^3 or $ax^{\frac{4}{3}}$ or $ax^{1\frac{1}{3}}$, where a is a non zero constant 1st A1 for $\dfrac{12x^6}{6}$ or better 2nd A1 for $-\dfrac{3x^3}{3}$ or better 3rd A1 for $\dfrac{4x^{\frac{4}{3}}}{\frac{4}{3}}$ or better 4th A1 for each term correct and simplified and the $+c$ occurring in the final answer	

Question 24 : Jan 11 Q7

Question Number	Scheme	Marks
	$\left(\mathrm{f}(x)=\right)\dfrac{12x^3}{3}-\dfrac{8x^2}{2}+x(+c)$	M1 A1 A1
	$\left(\mathrm{f}(-1)=0\Rightarrow\right)\ 0=4\times(-1)-4\times1-1+c$	M1
	$c=\underline{9}$	A1
	$\left[\mathrm{f}(x)=4x^3-4x^2+x+9\right]$	5
	Notes	
	1^{st} M1 for an attempt to integrate $x^n\to x^{n+1}$ 1^{st} A1 for at least 2 terms in x correct - needn't be simplified, ignore $+c$ 2^{nd} A1 for all the terms in x correct but they need not be simplified. No need for $+c$ 2^{nd} M1 for using $x=-1$ and $y=0$ to form a linear equation in c. No $+c$ gets M0A0 3^{rd} A1 for $c=9$. Final form of f(x) is not required.	

Question 25 : June 11 Q2

Question Number	Scheme	Marks
	$\dfrac{6x^{\frac{3}{2}}}{\left(\frac{3}{2}\right)}+\dfrac{3x^3}{3}\quad\left(=4x^{\frac{3}{2}}+x^3\right)$	M1 A1ft
	$x=4,\ y=90:\ 32+64+C=90\ \Rightarrow\ C=-6$	M1 A1
	$y=4x^{\frac{3}{2}}+x^3+\text{"their}-6\text{"}$	A1
		(5)

	Notes	
	(b) 1^{st} M: Attempt to integrate $x^n\to x^{n+1}$ (for either term) 1^{st} A: ft their p and q, but terms need not be simplified ($+C$ not required for this mark) 2^{nd} M: Using $x=4$ <u>and</u> $y=90$ to form an equation in C. 2^{nd} A: cao 3^{rd} A: answer as shown with simplified correct coefficients and powers – but follow through their value for C If there is a 'restart' in part (b) it can be marked independently of part (a), but marks for part (a) cannot be scored for work seen in (b). <u>Numerator and denominator integrated separately:</u> First M mark **cannot** be awarded so only mark available is second M mark. So 1 out of 5 marks.	

Question 26 : June 11 Q6

Question Number	Scheme	Marks
(a)	$\frac{dy}{dx} = 10x^4 - 3x^{-4}$ or $10x^4 - \frac{3}{x^4}$	M1 A1 A1 (3)
(b)	$\left(\int =\right) \frac{2x^6}{6} + 7x + \frac{x^{-2}}{-2} = \frac{x^6}{3} + 7x - \frac{x^{-2}}{2}$ $+ C$	M1 A1 A1 B1 (4) 7

Notes

(a) M1: Attempt to differentiate $x^n \to x^{n-1}$ (for any of the 3 terms)
i.e. ax^4 or ax^{-4}, where a is any non-zero constant or
the 7 differentiated to give 0 is sufficient evidence for M1

1st A1: One correct (non-zero) term, possibly unsimplified.

2nd A1: Fully correct **simplified** answer.

(b) M1: Attempt to integrate $x^n \to x^{n+1}$
(i.e. ax^6 or ax or ax^{-2}, where a is any non-zero constant).

1st A1: Two correct terms, possibly unsimplified.

2nd A1: All three terms correct and **simplified**.

Allow correct equivalents to printed answer , e.g. $\frac{x^6}{3} + 7x - \frac{1}{2x^2}$ or $\frac{1}{3}x^6 + 7x - \frac{1}{2}x^{-2}$

Allow $\frac{1x^6}{3}$ or $7x^1$

B1: $+ C$ appearing at any stage in part (b) (independent of previous work)