

Question 1 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
		M1	This mark is given for an attempt to integrate (for any correct power)
	$\frac{2}{3}x^{\frac{4}{4}} + \frac{6x^{\frac{3}{2}}}{\frac{3}{2}} + x$	A1	This mark is given for finding $\frac{x^4}{6}$ (may be unsimplified at this stage) and x
		A1	This mark is given for all three terms (may be unsimplified at this stage)
	$\frac{x^4}{6} - 4x^{\frac{3}{2}} + x + c$	A1	This mark is given for a completely correct, simplified expression, including the constant of integration.

Question 2 (Total 5 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(i)	$x^2 - 8x + 17 = (x - 4)^2 - 16 + 17$	M1	This mark is given for an attempt to complete the square
	$= (x - 4)^2 + 1$	A1	This mark is given for completing the square correctly
	$(x - 4)^2 \geq 0,$ hence $x^2 - 8x + 17 > 0$ for all x	A1	This mark is given for a complete explanation.
(ii)	For example, $x = -5$: $(-5 + 3)^2 = 4$, whereas $(-5)^2 = 25$	M1	This mark is given for an example showing that it may not always be true
	Sometimes true. For example: For $x = -5$, $(-5 + 3)^2 = 4$, whereas $(-5)^2 = 25$ (False) For $x = 5$ $(5 + 3)^2 = 64$, whereas $5^2 = 25$ (True)	A1	This mark is given for stating that it is sometimes true, giving reasons

Question 3 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	$\vec{AB} = \vec{OB} - \vec{OA}$	M1	This mark is given for an attempt at subtraction either way around (this may be implied by one correct component)
	$\vec{AB} = (-5\mathbf{i} - 2\mathbf{j}) - (4\mathbf{i} - 5\mathbf{j})$ $= -9\mathbf{i} + 3\mathbf{j}$	M1	This mark is given for the correct answer only (allowing for column notation)
(b)	$ AB = \sqrt{(-9)^2 + 3^2}$	A1	This mark is given for the correct use of Pythagoras theorem or modulus formula
	$= 3\sqrt{10}$	A1	This mark is given for the correct answer as a simplified surd only

Question 4 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	Gradient of l_1 is $\frac{3}{4}$	B1	This mark is given for finding the gradient of l_1
	Gradient of l_2 is $\frac{-1-8}{5-(-1)}$	M1	This mark is given for an attempt to find the gradient of l_2 , the line joining (5, -1) and (-1, 8)
	$= -\frac{3}{2}$	A1	This mark is given for finding the gradient of l_2
	Lines l_1 and l_2 are neither parallel (since the gradients are not equal) nor perpendicular (since $\frac{3}{4} \times -\frac{3}{2} \neq -1$)	A1	This mark is given for stating a correct conclusion with suitable reasons given

Question 5 (Total 5 marks)

Part	Working or answer an examiner might expect to see		Mark	Notes
(a)	Between lines 1 and 2: “Student cannot use the subtraction law without dealing with the 2” or $\log_2\left(\frac{x^2}{\sqrt{x}}\right)$		B1	This mark is awarded for finding one error
	“Line 2 should be $\log_2\left(\frac{x^2}{\sqrt{x}}\right)$ Between lines 4 and 5: “Student undoes the logs incorrectly” or “Line 5 should be $x = 2^3 = 8$ ”		B1	This mark is awarded for finding a second error
(b)	Version 1	Version 2		
	$\log_2\left(\frac{x^2}{\sqrt{x}}\right) = 3$	$\frac{3}{2} \log_2 x = 3$	M1	This mark is given for a correct method to combine the log terms
	$x^{\frac{3}{2}} = 2^3$	$x = 2^2$	M1	This mark is given for correct index work to give an expression in the form $Ax^n = 2^b$
	$x = (2^3)^{\frac{2}{3}} = 4$	$x = 4$	A1	This mark is given for a correct answer with all steps shown

Question 6 (Total 7 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	$P = 100 - 6.25(15 - 9)^2$	M1	This mark is given for substituting a value of 15 into the equation
	$= -125$ This is not a sensible selling price because the company would make an annual loss of £125,000	A1	This mark is given for finding -125 and a complete explanation
(b)	$P > 80 \Rightarrow (x - 9)^2 < \frac{6.25}{20} = 3.2$	M1	This mark is given for finding an expression in the form $(x - 9)^2 < k$
	$9 - \sqrt{3.2} < x < 9 + \sqrt{3.2}$	M1	This mark is given for solving to find two possible positive values for x
	$x > 7.21$, so minimum price = £7.22	A1	This mark is given for correctly finding the minimum price
(c)	Maximum $P = 100,000$	B1	This mark is given for finding the maximum possible profit of the company
	Maximum profit when $x = 9$	B1	This mark is given for the corresponding selling price of the toy

Question 7 (Total 6 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$15 = \frac{1}{2} \times 5 \times 10 \sin \theta$	M1	This mark is given for using the equation for the area of a triangle to find $\sin \theta$
	$\sin \theta = \frac{3}{5}$	A1	This mark is given for finding the value of $\sin \theta$
	$\cos^2 \theta = 1 - \sin^2 \theta$ $\Rightarrow \cos^2 \theta = 1 - \frac{9}{25}$	M1	This mark is given for using a valid method to find the values of $\cos \theta$
	$\cos \theta = \pm \frac{4}{5}$	A1	This mark is given for finding two values of $\cos \theta$
	$BC^2 = 10^2 + 5^2 - 2 \times 10 \times 5 \times \frac{4}{5}$	M1	This mark is given for using the cosine rule to find a value for the length of BC
	$BC = \sqrt{205}$	M1	This mark is given for finding the exact value of the length of BC

Question 8 (Total 9 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)(i)	$C = 1500v^{-1} + \frac{2}{11}v + 60$	M1	This mark is given for an attempt to differentiate (dealing with powers of v correctly)
	$\frac{dC}{dv} = -\frac{1500}{v^2} + \frac{2}{11}$	A1	This mark is given for differentiating correctly
	$\frac{dC}{dv} = 0 \Rightarrow v^2 = 8250$	M1	This mark is given for setting $\frac{dC}{dv} = 0$ and rearranging to find a value for v^2
	$v = \sqrt{8250} = 90.8 \text{ kmh}^{-1}$	A1	This mark is given for finding a correct value of v
(a)(ii)	$C = \frac{1500}{90.8} + \frac{2}{11} + 60$	M1	This mark is given for substitution of 90.8 into the equation for the model
	$= \text{£}93.03$	A1	This mark is given for finding the cost of the journey (accept answers which round to £93)
(b)	$\frac{d^2C}{dv^2} = +\frac{3000}{v^3}$	M1	This mark is given for finding the second derivative of C
	At $v = 90.8$, $\frac{d^2C}{dv^2} = 0.004$ $0.004 > 0$, hence it is a minimum cost	A1	This mark is given for a correct calculation, statement and conclusion.
(c)	For example: It would be impossible to drive at this speed over the whole journey It would be impossible to drive at a constant speed over the whole journey	B1	This mark is given for stating a sensible limitation of the model

Question 9 (Total 9 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	$gf(-2) = (4 \times -8) - (12 \times 4) - (15 \times -2) + 50$	M1	This mark is given for an attempt to find $gf(-2)$
	$gf(-2) = 0$, thus $(x + 2)$ is a factor	A1	This mark is given for finding that $gf(-2) = 0$ and stating a correct conclusion
(b)	$4x^3 - 12x^2 - 15x + 50$	M1	This mark is given for an attempt to divide $4x^3 - 12x^2 - 15x + 50$ by $(x + 2)$
	$= (x + 2)(4x^2 - 20x + 25)$	A1	This mark is given for correctly dividing $4x^3 - 12x^2 - 15x + 50$ by $(x + 2)$
	$= (x + 2)(2x \pm \dots)(2x \pm \dots)$	M1	This mark is given for an attempt to factorise $(4x^2 - 20x + 25)$
	$= (x + 2)(2x - 5)^2$	A1	This mark is given for a correct answer
(c)(i)	To find x when $(x + 2)(2x - 5)^2 \leq 0$	M1	This mark is given for deducing that the solution will be where the curve is on or below the axis
	$x \leq -2$ or $x = 2.5$	A1	This mark is given for two correct solutions
(c)(ii)	Since $gf(-2) = 0$ and $gf(2.5) = 0$, $gf(2x) = 0 \Rightarrow x = -1$ or $x = 1.25$	B1	This mark is given for deducing that $gf(2x) = 0$ at the values shown

Question 10 (Total 4 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\frac{(x + h)^3 - x^3}{h}$	B1	This mark is given for sight of $\frac{(x + h)^3 - x^3}{h}$
	$(x + h)^3 = x^3 + 3x^2h + 3xh^2 + h^3$	M1	This mark is given for a correct expansion of $(x + h)^3$
	Thus gradient = $\frac{3x^2h + 3xh^2 + h^3}{h}$ $= 3x^2 + 3xh + h^2$	M1	This mark is given for substituting and simplifying
	As $h \rightarrow 0$, gradient $\rightarrow 3x^2$ Thus $\frac{d}{dx} x^3 = 3x^2$	A1	This mark is given for a complete proof with a consideration of the limit

Question 11 (Total 8 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	$\left(2 - \frac{x}{16}\right)^9$ $= 2^9 + \binom{9}{1} \times 2^8 + \binom{9}{2} \times 2^7 \times \left(-\frac{x}{16}\right)^2 + \dots$	M1	This mark is given for an attempt at a binomial expansion
	$\left(2 - \frac{x}{16}\right)^9 = 512 + \dots$	B1	This mark is given for evaluating the first term
	$\dots -144x + \dots$	A1	This mark is given for evaluating the second term
	$\dots + 18x^2 + \dots$	A1	This mark is given for evaluating the third term
(b)	$512a = 128$	M1	This mark is given for an attempt to find a
	$a = \frac{1}{4}$	A1	This mark is given for the correct answer only
(c)	$512b - 144a = 36$	M1	This mark is given for an attempt to find b
	$b = \frac{9}{64}$	A1	This mark is given for the correct answer only

Question 12 (Total 8 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	$4 \cos \theta - 1 = 2 \sin \theta \times \frac{\sin \theta}{\cos \theta}$	M1	This mark is given for recall and use of the identity $\tan \theta = \frac{\sin \theta}{\cos \theta}$
	$4 \cos^2 \theta - \cos \theta = 2 \sin^2 \theta$	M1	This mark is given for multiplying both sides by $\cos \theta$
	$4 \cos^2 \theta - \cos \theta = 2(1 - \cos^2 \theta)$	M1	This mark is given for use of the identity $1 - \cos^2 \theta = \sin^2 \theta$
	$6 \cos^2 \theta - \cos \theta - 2 = 0$	A1	This mark is given for fully correct reasoning with no errors
(b)	Set $\cos 3x = a$ and $6a^2 - a - 2 = 0$ $(3a - 2)(2a + 1) = 0$	M1	This mark is given for attempting to solve the quadratic in $\cos 3x$
	$\cos 3x = \frac{2}{3}, -\frac{1}{2}$	B1	This mark is given for finding two values for $\cos 3x$
	$x = \frac{1}{3} \arccos \frac{2}{3}$ or $\frac{1}{3} \arccos -\frac{1}{2}$	M1	This mark is given for expressions for x
	$x = 16.1^\circ, 40^\circ, 80^\circ$	A1	This mark is given for three correct answers only

Question 13 (Total 8 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)	$V = 10^{\frac{1}{20}t+4.8}$	M1	This mark is awarded for a method to find V
	$V = 10^{\frac{1}{20}t} + 10^{4.8}$	M1	This mark is awarded for a method for forming an equation in the form $V = pq^t$
	$p = 10^{4.8} = 63100$	A1	This mark is given for an evaluation of p to 4 significant figures
	$q = 10^{\frac{1}{20}} = 1.222$	A1	This mark is given for an evaluation of q to 4 significant figures
(b)	The value of the painting on 1 January 1980	B1	This mark is given for a correct statement
	The proportional increase in the value of the painting each year	B1	This mark is given for a correct statement
(c)	$V = 63100 \times 1.122^{30}$	M1	This mark is given for finding an expression for V
	= £1.99 million	A1	This mark is given for a correct answer only

Question 14 (Total 9 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
(a)(i)	$(x - 3)^2 + (y + 5)^2 - 25 = 0$	M1	This mark is given for attempting to complete the square
	Centre $(3, -5)$	A1	This mark is given for find the coordinates of the centre of the circle
(a)(ii)	Radius 5	A1	This mark is given for finding the radius of the circle
(b)	$k < 0$	B1	This mark is given for deducing (by a sketch or otherwise) that $k < 0$
	$x^2 + kx^2 - 6x + 10kx + 9 = 0$	M1	This mark is given for an attempt to substitute $y = kx$ into the equation for C
	$(1 + k)^2x^2 + (10k - 6)x + 9 = 0$	A1	This mark is given forming a quadratic in x
	For $b^2 - 4ac > 0$, $(10k - 6)^2 - 4 \times (1 + k^2) \times 9 > 0$ $(10k - 6)^2 - 36(1 + k^2) > 0$	M1	This mark is given for an attempt to find k equation with has two distinct roots
	$(10k - 6)^2 - 36(1 + k^2) = 0$ for $k = 0, \frac{15}{8}$	M1	This mark is given for solving to find critical values
	$k < 0, k > \frac{15}{8}$	A1	This mark is given for finding the range of values for k

Question 15 (Total 10 marks)

Part	Working or answer an examiner might expect to see	Mark	Notes
	$\frac{dy}{dx} =$	M1	This mark is given for an attempt to differentiate the equation for the curve C
	$\frac{dy}{dx} = -\frac{64}{x^3} + 3$	A1	This mark is given for correctly differentiating y
	$\frac{dy}{dx}$ at $x = 4 = 2$	M1	This mark is given for substituting $x = 4$ into $\frac{dy}{dx}$
	$y - 6 = -\frac{1}{2}(x - 4)$	M1	This mark is given for finding an equation of the normal
	The normal cuts the x -axis at $x = 16$	A1	This mark is given for substituting $y = 0$ to find where the normal at $(4, 6)$ cuts the x -axis
	$\frac{1}{2}(6 \times 12) = 36$	M1	This mark is given for finding the triangular area under l from $x = 4$ to $x = 16$
	$\int \frac{32}{x^2} + 3x - 8 \, dx = -\frac{32}{x} + \frac{3}{2}x^2 - 8x$	M1	This mark is given attempting to integrate the equation for the curve C
	$= -\frac{32}{x} + \frac{3}{2}x^2 - 8x$	A1	This mark is given for correctly integrating the equation for the curve C
	$\left[-\frac{32}{x} + \frac{3}{2}x^2 - 8x\right]_2^4 = -16 + 26 = 10$	M1	This mark is given for finding the area under the curve
	$10 + 36 = 46$	A1	This mark is given for showing the total area of the region R is 46