Questions taken from the AQA Specimen Paper 2

NOTE: JACK BROWN HAS A FULL SET OF VIDEO SOLUTIONS FOR THIS PAPER ON YOUTUBE

3	Correctly applies a single law of logs with either term	AO1.1a	M1	$\log_a(a^3) + \log_a\left(\frac{1}{a}\right) = 3 + (-1)$ $= 3 - 1$ $= 2$
	States correct final answer (NMS scores full marks)	AO1.1b	A1	
	Total		**2**	

4	Selects an appropriate method – **either** differentiates, at least as far as: $\frac{dy}{dx} = 2x....$ **or** commences completion of the square: $\left(x - \frac{5}{2}\right)^2 + ...$	AO1.1a	M1	$y = \left(x - \frac{5}{2}\right)^2 - \frac{25}{4} + a$ y minimised when squared bracket is 0 $\left(\frac{5}{2}, a - \frac{25}{4}\right)$ **ALT** $\frac{dy}{dx} = 2x - 5$ so $2x - 5 = 0$ for minimum $x = \frac{5}{2}$ $y = \left(\frac{5}{2}\right)^2 - 5\left(\frac{5}{2}\right) + a = a - \frac{25}{4}$
	Fully differentiates **and** sets derivative equal to zero **or** fully completes square Allow one error	AO1.1a	M1	
	Obtains both coordinates	AO1.1b	A1	
	Total		**3**	

6	States a correct integral expression (ignore limits at this stage)	AO1.1a	M1	Area = $\int_a^{2a}\left(6x^2+\frac{8}{x^2}\right)\mathrm{d}x$
	Integrates at least one term correctly	AO1.1b	A1	$=\left[2x^3-\frac{8}{x}\right]_a^{2a}$
	Substitutes $2a$ and a into 'their' integrated expression	AO1.1a	M1	$=(16a^3-\frac{4}{a})-(2a^3-\frac{8}{a})$
	States correct final answer with terms collected FT correct substitution into incorrect integral provided both M1 marks awarded	AO1.1b	A1F	$=14a^3+\frac{4}{a}$
	Total		**4**	

Q	Marking Instructions	AO	Marks	Typical Solution
8	Explains clearly that $\mathrm{f}(x)$ is increasing $\Leftrightarrow \mathrm{f}'(x)>0$ (for all values of x) or Explains $\Rightarrow \mathrm{f}(x)$ is increasing $\mathrm{f}'(x)>0$ for all values of x This may appear at any appropriate point in their argument	AO2.4	E1	For all x, $\mathrm{f}'(x)>0 \Rightarrow \mathrm{f}(x)$ is an increasing function $\mathrm{f}(x)=x^3-3x^2+15x-1$ $\Rightarrow \mathrm{f}'(x)=3x^2-6x+15$ $\Rightarrow \mathrm{f}'(x)=3(x-1)^2+12$ $\therefore \mathrm{f}'(x)$ has a minimum value of 12 therefore $\mathrm{f}'(x)>0$ for all values of x OR for $\mathrm{f}'(x)$, $b^2-4ac=-144$ $\therefore \mathrm{f}'(x)\neq 0$ for any real x, so $\mathrm{f}'(x)$ is either always positive or always negative. $\mathrm{f}'(0)=15$ therefore $\mathrm{f}'(x)>0$ for all values of x OR $\mathrm{f}''(x)=6x-6$, which $=0$ when $x=1$ so min $\mathrm{f}'(x)$ is $\mathrm{f}'(1)=12$ therefore $\mathrm{f}'(x)>0$ for all values of x Thus, since, $\mathrm{f}'(x)>0$ for all values of x it is proven that $\mathrm{f}(x)$ is an increasing function.
	Differentiates – at least two correct terms	AO1.1a	M1	
	All terms correct	AO1.1b	A1	
	Attempts a correct method which could lead to $\mathrm{f}'(x)>0$	AO3.1a	M1	
	Correctly deduces $\mathrm{f}'(x)>0$ (for all values of x)	AO2.2a	A1	
	Writes a clear statement that links the steps in the argument together, the deduction about a positive gradient for all values of x proves that the given function is increasing for all values of x	AO2.1	R1	
	Total		6	

Q	Marking Instructions	AO	Marks	Typical Solution
9	States the correct gradient of the curve	AO1.2	B1	Grad of curve = $2e^{2x}$
	Forms an equation using 'their' gradient of the curve and puts it equal to $\frac{1}{2}$	AO1.1a	M1	= grad of tangent so $2e^{2x} = \frac{1}{2}$
	Takes a log of each side of 'their' equation and uses law of logs to obtain equation in x	AO1.1a	M1	$e^{2x} = \frac{1}{4} \Rightarrow 2x = \ln\left(\frac{1}{4}\right)$
	Obtains a correct exact value for x	AO1.1b	A1	$\Rightarrow x = \frac{1}{2}\ln\left(\frac{1}{4}\right) = \ln\left(\frac{1}{2}\right) = -\ln 2$
	Substitutes 'their' value of x and obtains y value and hence the coordinates (follow through provided values are exact)	AO1.1b	A1F	$y = e^{2x} = \frac{1}{4}$ $\left(-\ln 2, \frac{1}{4}\right)$
	Total		5	

10(a)(i)	States correct value CAO	AO3.4	B1	50
(a)(ii)	States correct integer value CAO	AO3.4	B1	609
(b)	Forms correct equation and rearranges to obtain $e^{0.5t} = \ldots$	AO3.4	M1	$150 = 50e^{0.5t}$ so $e^{0.5t} = 3$
	Obtains the correct solution. Must give answer to 3 sf	AO1.1b	A1	$t = 2\ln 3 = 2.20$
(c)	1 mark for any clear valid reason, must be set in context of the question	AO3.5b	E1	No constraint on the number of rabbits (ie could go off to infinity) **OR** Model is only based on the 3 years of the study. Things may change **OR** Continuous model but number of rabbits is discrete **OR** Ignores extraneous factors such as disease, predation, limited food supply
(d)	Forms an equation with exponentials by letting $R = C$ PI	AO3.4	M1	$1000e^{0.1t} = 50e^{0.5t}$ $20 = e^{0.4t}$ $t = \ln 20 \div 0.4$ $= 7.49$ 2023
	Solves 'their' equation correctly	AO1.1a	M1	
	States correct answer as the year 2023 CAO NMS scores full marks for 2023	AO3.2a	A1	
	Total		**8**	

Q	Marking Instructions	AO	Marks	Typical Solution
19(a)(i)	Obtains probability from calculator	AO3.4	B1	$P(X \le 2) = 0.678$
(a)(ii)	Obtains either of these figures (0.8791, 0.1074) PI	AO3.4	M1	$P(X \le 3) = 0.8791$ $P(X = 0) = 0.1074$
	Obtains correct probability	AO1.1b	A1	$P(1 \le X \le 3) = 0.8791 - 0.1074$ $= 0.772$

If you just found the correct answer to 19(a)(ii) from your calculator without showing any working out, this is fine.

(b)(iii)	States both hypotheses using correct notation	AO2.5	B1	H_0: $p = 0.2$ H_1: $p > 0.2$
	States or uses B(25, 0.2) PI	AO3.3	M1	Under H_0, use $X \sim B(25, 0.2)$ (where X represents number of students eating 5 or more portions)
	Obtains correct probability	AO1.1b	A1	$P(X \ge 8) = 0.109$
	Evaluates model by comparing $P(X \ge 8)$ with 0.05 (condone 0.0468/0.047 used instead of 0.109)	AO3.5a	M1	$0.109 > 0.05$ Hence accept H_0
	Infers H_0 accepted	AO2.2b	A1	No significant evidence that more than 20% eat at least five a day
	States correct conclusion in given context	AO3.2a	E1	