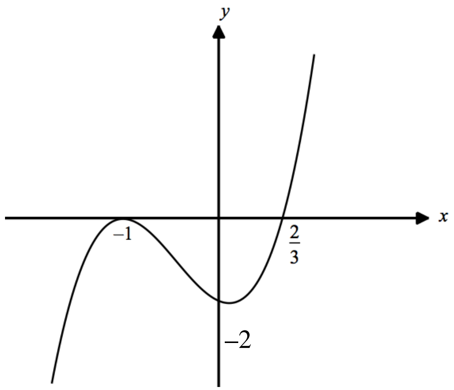
AS Level
Maths

Bronze Set B, Paper 2 (AQA version)

Question	Solution	Partial Marks	Guidance
1	$4\sqrt{6}$	B1 **[1]**	Correct answer circled (or indicated) unambiguously
2	–cos(*x*)	B1 **[1]**	Correct box ticked
3	$y = 8x + 3$	B1 **[1]**	Correct box ticked
4	$x^2 + (x+1)^2 = 1$ $\Rightarrow 2x^2 + 2x = 0$ $\Rightarrow x = 0,\ x = -1$ When $x = 0,\ \ 2y = 1 \Rightarrow y = \frac{1}{2}$ When $x = -1,\ \ 2y = 0 \Rightarrow y = 0$ so solutions are (0, 1/2) and (–1, 0)	M1* A1 M1(dep*) A1 **[4]**	Method to eliminate either *x* or *y* from equations Correct values of *x* or *y* Uses their *x* or *y* to find the values of *y* or *x* Obtains the correct solutions. ISW
5 (a)	$3(-1)^3 + a(-1)^2 - (-1) - 2 = 0$ $\Rightarrow -3 + a + 1 - 2 = 0$ $\Rightarrow a = 4$	M1 A1 **[2]**	Uses the factor theorem to form a correct equation in *a* Correct value of *a*

5 (b)	The other factor is $3x^2 + x - 2$ $3x^2 + x - 2 = 0$ $\Rightarrow (3x-2)(x+1) = 0$ $\Rightarrow x = -1, \frac{2}{3}$ so the solutions are $x = -1,\ x = \frac{2}{3}$	M1 A1 A1 **[3]**	Method to find the other quadratic factor Correct quadratic factor Correct solutions. Only one solution given is A0. Additional solutions given is A0. Answer only is 0/3.
5 (c)		B1 B1 B1 **[3]**	Correct shape: positive cubic and repeated root at –1 Correct x intersections ft their (b) Correct y intersection at –2
6 (a)	$14500\,e^{-0.37(0)} + 1500$ $= 14500 + 1500$ $= 16000$ **AG**	B1 **[1]**	Convincing proof. Need to see sight of using $t = 0$. This may be implied by seeing 14500 + 1500. NB: 14500 + 1500 = 16000 is B1 BOD

6 (b)	$8000 = 14500e^{-0.37t} + 1500$ $\ln\left(\frac{6500}{14500}\right) = \ln(e^{-0.37t})$ $t = \frac{-0.80234...}{-0.37} = 2.168...$	M1 M1 M1 A1 **[4]**	States correct equation Re-arranges and takes logs to both sides. Uses ln(e) = 1 and re-arranges for their t Correct answer and no errors seen. ISW [SC: sight of $\ln(6500) = \ln(14500\,e^{-0.37t})$ is OK for the 2nd M1, but need to see use of product rule, ln(e) = 1 and then re-arrangement for t for 3rd M1.]
6 (c)	Limiting value for the price of the car is £1500	B1 **[1]**	Correct answer. Condone 1500 with no units
7 (a)	Re-arranges to $x^2 + 2x + y^2 + 3y = 4$ Completes the square to give $(x+1)^2 - 1 + \left(y + \frac{3}{2}\right)^2 - \frac{9}{4} = 4$ Obtains final answer of $(x+1)^2 + \left(y + \frac{3}{2}\right)^2 = \frac{29}{4}$	M1 A1 **[2]**	Attempts to complete the square on their $x^2 + kx$ term. Must be working from the equation of a circle. Obtains correct final answer. No need to state values of a, b or k but this is OK for final answer if the equation is not written down. Answer only is 3/3.
7 (b)	Centre of the circle is (–1, –1.5)	B1ft **[1]**	Correct coordinates of centre ft their (a)
7 (c)	$(0+1)^2 + (1+1.5)^2 = 1 + \frac{25}{4} = \frac{29}{4}$ as required	B1 **[1]**	For a correct and convincing proof that (0, 1) lies on the curve with a concluding statement. There are many approaches to this: e.g. they may also use (a) to show that LHS – RHS = 0. Concluding statements such as ‘as required’, ‘therefore P lies on C’, etc. are sufficient

7 (d)	Gradient of normal is $\frac{1--1.5}{0--1}=\frac{5}{2}$ So equation of normal is given by $y=\frac{5}{2}x+1$	M1 A1ft A1 oe **[3]**	Method to find the gradient of normal Correct gradient of normal stated and identified. Ft their (b) is allowed. Correct equation of the normal oe. ISW
7 (e)	Distance is the diameter of the circle so $\sqrt{29}$	B1ft **[1]**	Correct distance ft their (a). ISW
8 (i) (a)	$\frac{dy}{dx}=4x-4-\frac{5}{2}x^{\frac{3}{2}}$	B1 M1 A1 oe	Obtains terms 4*x* or –4 Correct method to differentiate the $x\sqrt{x}$ term Completely correct derivative oe. ISW
8 (i) (b)	$\frac{d^2y}{dx^2}=4-\frac{15}{4}\sqrt{x}$ so $\left(4-\frac{15}{4}\sqrt{x}\right)-4=-\frac{15}{4}\sqrt{x}$ Hence $k=\frac{15}{4}$	M1* M1(dep*) A1 **[3]**	Attempts to differentiate their (a) a second term Method to find the value of *k* using their second derivative. Their second derivative must be of the form $4+p\sqrt{x}$ Obtains correct value of *k*

8 (ii)	$\frac{dy}{dx}=9x^2-4x$ $\left.\frac{dy}{dx}\right\|_{x=-1}=9(-1)^2-4(-1)=13$, so normal gradient is $-\frac{1}{13}$ At $x=-1$, $y=-5$ So equation of normal is $y--5=-\frac{1}{13}(x--1)$ $\Rightarrow x+13y+66=0$	M1* A1 B1 M1(dep*) A1 **[5]**	Differentiates and substitutes $x=-1$ into their derivative Correct gradient of the normal identified or used to obtain final answer Correct y coordinate at $x=-1$ Method to find equation of the normal using their coordinates and a gradient they have identified as the gradient of the normal. Correct equation of the normal in the required form. Coefficients must be integers so accept integer multiples of this but not non-integer multiples. ISW
9 (a)	$A(0, 0)$, $B(4, 0)$	B1 **[1]**	Correct coordinates identified. Condone coordinates just stated and not labelled A or B or even the wrong labels. Condone just $x=0$, $x=4$. ISW
9 (b)	$\mathrm{f}(x)=\frac{1}{4}x^2(16-8x+x^2)$ $=4x^2-2x^3+\frac{1}{4}x^4$	B1 **[1]**	Correct expression, final answer.
9 (c) (i)	$\mathrm{f}'(x)=8x-6x^2+x^3$ $\mathrm{f}'(2)=8(2)-6(2)^2+2^3$ $=16-24+8$ $=0$ therefore, the point $x=2$ is a stationary point on C	M1 A1 **[2]**	Computes derivative and substitutes 2 into their derivative (or any other method to show 2 is a factor of f \`(x) = 0 Convincingly shows the derivative at 2 is 0 and conclusion, ‘i.e. qed, shown, as required, therefore, the point is a stationary point, etc.’

9 (c) (ii)	$f''(x) = 8 - 12x + 3x^2$ $f''(2) = 8 - 12(2) + 3(2)^2$ $= 8 - 24 + 12$ $= -4 < 0$ since the second derivative is negative at $x = 2$, $x = 2$ is a maximum and so it is therefore the point P	B1 M1 A1 **[3]**	Obtains correct second derivative Substitutes 2 into their second derivative Shows second derivative is negative and gives some brief explanation why $x = 2$ corresponds to P/ is a maximum (< 0 is sufficient argument) NB: candidates need not compute the second derivative for the A1, they just need to give sufficient evidence that it is negative, i.e. '8 – 24 + 12 < 0' is OK for A1.
9 (d)	$\int_0^2 f(x)\,dx = \left[\frac{4}{3}x^3 - \frac{1}{2}x^4 + \frac{1}{20}x^5\right]_0^2$ $= \frac{4}{3}(2)^3 - \frac{1}{2}(2)^4 + \frac{1}{20}(2)^5 - 0 = \frac{64}{15}$ Area of rectangle = $2 \times 4 = 8$ So area of R is $8 - \frac{64}{15} = \frac{56}{15}$	M1* M1**(dep*) B1 M1(dep**) A1 **[5]**	Method to integrate f(x) with respect to x Substitutes correct limits into their integral in the correct way Correct area of rectangle Uses area of R = area of rectangle – their area under curve Correct exact area of R oe
10	Opportunity	B1 **[1]**	Correct box ticked
11	Ford	B1 **[1]**	Correct box ticked
12	Total frequency is 53, so median is the 26.5th value. Hence the median lies in the 2nd class $\frac{4-2}{m-2} = \frac{36-11}{26.5-11}$ $m = 3.24$	B1 M1 A1 **[3]**	Identifies that the median lies in the 2nd class (can be implied) Complete method to use interpolation to find the median Allow use of 1.5, 2, 2.5, 3.5, 4, 4.5 for class boundaries Correct median **NB: use of (n + 1) gives m = 3.28 and scores 3/3**

13 (a)	Mean $\bar{m} = \dfrac{80789}{60} = 1346.48..$ Standard deviation is $\sigma_m = \sqrt{\dfrac{113666365}{60} - (1346.48...)^2} = 285.34...$	B1 M1 A1 **[3]**	Obtains the correct mean Attempts to find the standard deviation using their mean Allow omission of √ for the M1 Correct standard deviation
13 (b)	If M is the true mass of the car, then data in the LDS is coded according to $m = M + 75$ So $\bar{M} = 1271.48...$	B1 B1ft **[2]**	Correct coding relationship between mass of vehicles and mass given in LDS (can be implied) Uses their coding relationship to find the mean mass of a vehicle
13 (c)	Any **one** from: • Only contains data for 5 models • Only contains information on cars • Data is coded using the average mass of a person (which may vary)	B1 **[1]**	Correct limitation
14	0.58 is the most likely value because since the variables show a **moderate** positive correlation	B1 **[1]**	Correct value + some reasoning Allow e.g. 'it can't be 0.09 since that is too small and it can't be 0.99 since the correlation isn't perfect'
15	Let X be the number of disconnected calls from 200 calls, then $X \sim \text{B}(200, 0.03)$ $\text{H}_0 : p = 0.03,\ \text{H}_1 : p < 0.03$ $\text{P}(X \leq 4 \mid X \sim \text{B}(200, 0.03)) = 0.281\ldots$ $0.281 > 0.1$, so insufficient evidence to reject H_0 or 4 lies outside the critical region There is insufficient evidence to suggest that the **manager's** meeting was effective / the **number** of **calls** that are disconnected has been **reduced**	B1 B1 M1 A1ft A1 **[5]**	Uses correct binomial model, seen or implied Explicitly states the hypotheses Attempts to find $\text{P}(X \leq 4)$ or find the CR (trial and error is a suitable method). CR ix $X \leq 2$ Comparison and comment ft their 0.281 or CR Conclusion in context

16 (a)	Data is continuous	B1 **[1]**	Justification
16 (b)	Area (of the bars) is **proportional** to the frequency	B1 **[1]**	Correct feature
16 (c)	Width is 3 cm $\frac{40}{8}=\frac{80}{3h}\Rightarrow h=\frac{16}{3}$ cm	B1 M1 A1 **[3]**	Correct width Correct method to find height using area prop. to frequency Correct height
16 (d)	$\frac{8}{40}=\frac{1}{5}\Rightarrow$ 1 person per 0.2 cm^2 52/0.2 = 260 people Total money raised is approximately $260\times 102=£26520$	M1 M1 A1 **[3]**	Complete method to find total number of people in the competition Their total number of people $\times$ 102 Correct estimate
17	$\frac{(-1)^2+1}{k}+\frac{0^2+1}{k}+\frac{1^2+1}{k}+\frac{2^2+1}{k}=1$ $\Rightarrow k=10$ $P(-3<2X-1\leq 2)=P\left(-1<X\leq\frac{3}{2}\right)$ $=\frac{1}{10}+\frac{2}{10}$ $=\frac{3}{10}$	M1* M1**(dep*) M1(dep**) A1 **[4]**	Method to find the value of k Attempts to identify the values of x that are of interest Correct method to find probability of their $P(-1<X\leq 3/2)$ using their k Correct probability