

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS**

**Advanced Subsidiary General Certificate of Education  
Advanced General Certificate of Education**

**MATHEMATICS**

**4721**

**Core Mathematics 1**

**MARK SCHEME**

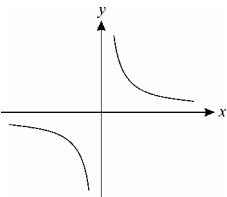
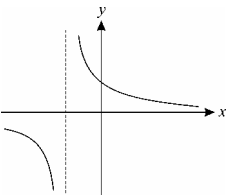
**Specimen Paper**

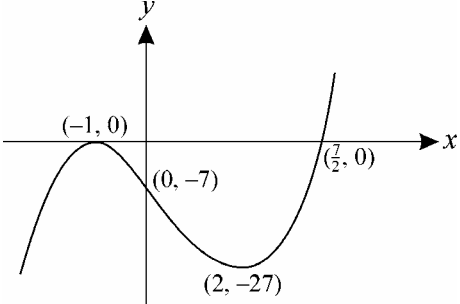
<b>MAXIMUM MARK</b>	<b>72</b>
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**This mark scheme consists of 4 printed pages.**

1	(i) $\frac{1}{16}$	B1	1	For correct value (fraction or exact decimal)
	(ii) 8	B1	1	For correct value 8 only
	(iii) 6	M1 A1	2 <div>4</div>	For $1^3 + 2^3 + 3^3 = 36$ seen or implied For correct value 6 only
2	(i) $x^2 - 8x + 3 = (x - 4)^2 - 13$ i.e. $a = -4, b = -13$	B1 M1 A1	 3	For $(x - 4)^2$ seen, or statement $a = -4$ For use of (implied) relation $a^2 + b = 3$ For correct value of $b$ stated or implied
	(ii) Minimum point is $(4, -13)$	B1✓ B1✓	2 <div>5</div>	For $x$ -coordinate equal to their $(-a)$ For $y$ -coordinate equal to their $b$
3	(i) Discriminant is $k^2 - 4k$	M1 A1	2	For attempted use of the discriminant For correct expression (in any form)
	(ii) For no real roots, $k^2 - 4k < 0$ Hence $k(k - 4) < 0$ So $0 < k < 4$	M1 M1 A1 A1	 4 <div>6</div>	For stating their $\Delta < 0$ For factorising attempt (or other soln method) For both correct critical values 0 and 4 seen For correct pair of inequalities
4	(i) $\frac{dy}{dx} = 12x^2$	M1 A1	 2	For clear attempt at $nx^{n-1}$ For completely correct answer
	(ii) $y = x^4 + 2x^2$ Hence $\frac{dy}{dx} = 4x^3 + 4x$	B1 M1 A1✓	 3	For correct expansion For correct differentiation of at least one term For correct differentiation of their 2 terms
	(iii) $\frac{dy}{dx} = \frac{1}{2}x^{-\frac{1}{2}}$	M1 A1	2 <div>7</div>	For clear differentiation attempt of $x^{\frac{1}{2}}$ For correct answer, in any form
5	(i) $x^2 - 3x + 2 = 3x - 7 \Rightarrow x^2 - 6x + 9 = 0$  Hence $(x - 3)^2 = 0$ So $x = 3$ and $y = 2$	M1 A1 M1 A1 A1	 5	For equating two expressions for $y$ For correct 3-term quadratic in $x$ For factorising, or other solution method For correct value of $x$ For correct value of $y$
	(ii) The line $y = 3x - 7$ is the tangent to the curve $y = x^2 - 3x + 2$ at the point $(3, 2)$	B1 B1	2	For stating tangency For identifying $x = 3, y = 2$ as coordinates
	(iii) Gradient of tangent is 3 Hence gradient of normal is $-\frac{1}{3}$ Equation of normal is $y - 2 = -\frac{1}{3}(x - 3)$ i.e. $x + 3y - 9 = 0$	B1 B1✓ M1 A1	4 <div>11</div>	For stating correct gradient of given line For stating corresponding perpendicular grad For appropriate use of straight line equation For correct equation in required form

<b>6</b> (i) 	B1 B1	<b>2</b> For correct 1st quadrant branch For both branches correct and nothing else
(ii) Translation of 2 units in the negative $x$ -direction  	B1 B1 B1  B1✓ B1	For translation parallel to the $x$ -axis For correct magnitude For correct direction  For correct sketch of new curve <b>5</b> For some indication of location, e.g. $\frac{1}{2}$ at $y$ -intersection or $-2$ at asymptote
(iii) Derivative is $-x^{-2}$	M1 A1	<b>2</b> For correct power $-2$ in answer For correct coefficient $-1$
(iv) Gradient of $y = \frac{1}{x}$ at $x = 2$ is required This is $-2^{-2}$ , which is $-\frac{1}{4}$	B1  M1 A1	For correctly using the translation  For substituting $x = 2$ in their (iii) <b>3</b> For correct answer  <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 0 auto;">12</div>
<b>7</b> (i) $AB^2 = (10-2)^2 + (3-9)^2 = 100$ Hence the radius is 5 Mid-point of $AB$ is $\left(\frac{2+10}{2}, \frac{9+3}{2}\right)$ Hence centre is $(6, 6)$  (ii) Equation is $(x-6)^2 + (y-6)^2 = 5^2$ This is $x^2 - 12x + 36 + y^2 - 12y + 36 = 25$ i.e. $x^2 + y^2 - 12x - 12y + 47 = 0$ , as required  (iii) Gradient of $AB$ is $\frac{3-9}{10-2} = -\frac{3}{4}$  Hence perpendicular gradient is $\frac{4}{3}$ Equation of tangent is $y - 3 = \frac{4}{3}(x - 10)$ Hence $C$ is the point $(\frac{31}{4}, 0)$	M1 A1 M1 A1  M1 A1 A1  M1✓ M1 M1 A1	For correct calculation method for $AB^2$ For correct value for radius For correct calculation method for mid-point <b>4</b> For both coordinates correct  For using correct basic form of circle equn For expanding at least one bracket correctly <b>3</b> For showing given answer correctly  For finding the gradient of $AB$ For correct value $-\frac{3}{4}$ or equivalent For relevant perpendicular gradient For using their perp grad and $B$ correctly For substituting $y = 0$ in their tangent eqn <b>6</b> For correct value $x = \frac{31}{4}$  <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 0 auto;">13</div>

<p>8 (i) <math>\frac{dy}{dx} = 6x^2 - 6x - 12</math></p> <p>Hence <math>x^2 - x - 2 = 0</math>  <math>(x-2)(x+1) = 0 \Rightarrow x = 2</math> or <math>-1</math></p> <p>Stationary points are <math>(2, -27)</math> and <math>(-1, 0)</math></p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>A1</p>	<p>For differentiation with at least 1 term OK</p> <p>For completely correct derivative</p> <p>For equating their derivative to zero</p> <p>For factorising or other solution method</p> <p>For both correct <math>x</math>-coordinates</p> <p>For both correct <math>y</math>-coordinates</p>
<p>(ii) <math>\frac{d^2y}{dx^2} = 12x - 6 = \begin{cases} +18 &amp; \text{when } x = 2 \\ -18 &amp; \text{when } x = -1 \end{cases}</math></p> <p>Hence <math>(2, -27)</math> is a min and <math>(-1, 0)</math> is a max</p>	<p>M1</p> <p>A1</p> <p>A1</p>	<p>For attempt at second derivative and at least one relevant evaluation</p> <p>For either one correctly identified</p> <p>For both correctly identified (Alternative methods, e.g. based on gradients either side, are equally acceptable)</p>
<p>(iii) <math>\text{RHS} = (x^2 + 2x + 1)(2x - 7)</math>  <math>= 2x^3 - 7x^2 + 4x^2 - 14x + 2x - 7</math>  <math>= 2x^3 - 3x^2 - 12x - 7</math>, as required</p>	<p>M1</p> <p>A1</p>	<p>For squaring correctly and attempting complete expansion process</p> <p>For obtaining given answer correctly</p>
<p>(iv)</p> 	<p>B1</p> <p>B1</p> <p>B1</p>	<p>For correct cubic shape</p> <p>For maximum point lying on <math>x</math>-axis</p> <p>For <math>x = \frac{7}{2}</math> and <math>y = -7</math> at intersections</p>