

# 4721 Core Mathematics 1

1 (i) $n = -2$	B1 <div>1</div>
(ii) $n = 3$	B1 <div>1</div>
(iii)	M1 $\sqrt{4^3}$ or $64^{\frac{1}{2}}$ or $\left(4^{\frac{1}{2}}\right)^3$ or $(4^3)^{\frac{1}{2}}$ or $4 \times \sqrt{4}$ with brackets correct if used A1 <div>2</div>
2 (i) $y = (x-2)^2$	M1 $y = (x \pm 2)^2$ A1 <div>2</div>
(ii) $y = -(x^3 - 4)$	B1 oe <div>1</div>
3 (i) $\sqrt{2 \times 100} = 10\sqrt{2}$	B1 <div>1</div>
(ii) $\frac{12}{\sqrt{2}} = \frac{12\sqrt{2}}{2} = 6\sqrt{2}$	B1 <div>1</div>
(iii) $10\sqrt{2} - 3\sqrt{2} = 7\sqrt{2}$	M1 Attempt to express $5\sqrt{8}$ in terms of $\sqrt{2}$ A1 <div>2</div>
4 $y = x^{\frac{1}{2}}$ $2y^2 - 7y + 3 = 0$ $(2y-1)(y-3) = 0$ $y = \frac{1}{2}, y = 3$ $x = \frac{1}{4}, x = 9$	M1* Use a substitution to obtain a quadratic or factorise into 2 brackets each containing $x^{\frac{1}{2}}$ M1dep Correct method to solve a quadratic A1 M1 Attempt to square to obtain $x$ A1 SR If first M1 not gained and 3 and $\frac{1}{2}$ given as final answers, award B1 <div>5</div>

5

$$\frac{dy}{dx} = 4x^{-\frac{1}{2}} + 1$$

$$= 4\left(\frac{1}{\sqrt{9}}\right) + 1$$

$$\frac{dy}{dx} = \frac{7}{3}$$

**M1** Attempt to differentiate

**A1**  $kx^{-\frac{1}{2}}$

**A1****M1** Correct substitution of  $x = 9$  into their

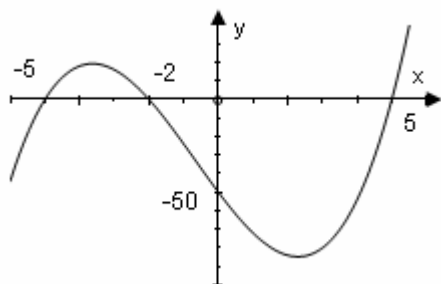
**A1**  $\frac{7}{3}$  only

**5**

**6 (i)**  $(x-5)(x+2)(x+5)$

$$= (x^2 - 3x - 10)(x+5)$$

$$= x^3 + 2x^2 - 25x - 50$$

**B1**  $x^2 - 3x - 10$  or  $x^2 + 7x + 10$  or  $x^2 - 25$  seen**M1** Attempt to multiply a quadratic by a linear factor**A1****3****(ii)****B1** +ve cubic with 3 roots (not 3 line segments)**B1✓** (0, -50) labelled or indicated on y-axis**B1** (-5, 0), (-2, 0), (5, 0) labelled or indicated on x-axis and no other x- intercepts**3**

**7 (i)**  $8 < 3x - 2 < 11$

$$10 < 3x < 13$$

$$\frac{10}{3} < x < \frac{13}{3}$$

**M1** 2 equations or inequalities both dealing with all 3 terms resulting in  $a < kx < b$ **A1** 10 and 13 seen**A1****3**

**(ii)**  $x(x+2) \geq 0$

$$x \geq 0, x \leq -2$$

**M1** Correct method to solve a quadratic**A1** 0, -2**M1** Correct method to solve inequality**A1****4**

8 (i)	$\frac{dy}{dx} = 3x^2 - 2kx + 1$	<b>B1</b> One term correct
		<b>B1</b> Fully correct
		<b>2</b>
(ii)	$3x^2 - 2kx + 1 = 0$ when $x = 1$	<b>M1</b> their $\frac{dy}{dx} = 0$ soi
	$3 - 2k + 1 = 0$	<b>M1</b> $x = 1$ substituted into their $\frac{dy}{dx} = 0$
	$k = 2$	<b>A1</b> ✓
		<b>3</b>
(iii)	$\frac{d^2y}{dx^2} = 6x - 4$	<b>M1</b> Substitutes $x = 1$ into their $\frac{d^2y}{dx^2}$ and looks at sign
	When $x = 1$ , $\frac{d^2y}{dx^2} > 0 \therefore$ min pt	<b>A1</b> States minimum <b>CWO</b>
		<b>2</b>
(iv)	$3x^2 - 4x + 1 = 0$	<b>M1</b> their $\frac{dy}{dx} = 0$
	$(3x - 1)(x - 1) = 0$	<b>M1</b> correct method to solve 3-term quadratic
	$x = \frac{1}{3}, x = 1$	
	$x = \frac{1}{3}$	<b>A1</b> <b>WWW</b> at any stage
		<b>3</b>

<p>9 (i)</p> $(x-2)^2 + (y-1)^2 = 100$ $x^2 + y^2 - 4x - 2y - 95 = 0$	<p><b>B1</b> <math>(x-2)^2</math> and <math>(y-1)^2</math> seen</p> <p><b>B1</b> <math>(x \pm 2)^2 + (y \pm 1)^2 = 100</math></p> <p><b>B1</b> correct form</p> <p><b>3</b></p>
<p>(ii)</p> $(5-2)^2 + (k-1)^2 = 100$ $(k-1)^2 = 91 \quad \text{or} \quad k^2 - 2k - 90 = 0$ $k = 1 + \sqrt{91}$	<p><b>M1</b> <math>x = 5</math> substituted into their equation</p> <p><b>A1</b> correct, simplified quadratic in <math>k</math> (or <math>y</math>) obtained</p> <p><b>A1</b> cao</p> <p><b>3</b></p>
<p>(iii) distance from <math>(-3, 9)</math> to <math>(2, 1)</math></p> $= \sqrt{(2 - -3)^2 + (1 - 9)^2}$ $= \sqrt{25 + 64}$ $= \sqrt{89}$ $\sqrt{89} < 10 \quad \text{so point is inside}$	<p><b>M1</b> Uses <math>(x_2 - x_1)^2 + (y_2 - y_1)^2</math></p> <p><b>A1</b></p> <p><b>B1</b> compares their distance with 10 and makes consistent conclusion</p> <p><b>3</b></p>
<p>(iv) gradient of radius <math>= \frac{9-1}{8-2}</math></p> $= \frac{4}{3}$ <p>gradient of tangent <math>= -\frac{3}{4}</math></p> $y - 9 = -\frac{3}{4}(x - 8)$ $y - 9 = -\frac{3}{4}x + 6$ $y = -\frac{3}{4}x + 15$	<p><b>M1</b> uses <math>\frac{y_2 - y_1}{x_2 - x_1}</math></p> <p><b>A1</b> oe</p> <p><b>B1✓</b> oe</p> <p><b>M1</b> correct equation of straight line through <math>(8, 9)</math>, any non-zero gradient</p> <p><b>A1</b> oe 3 term equation</p> <p><b>5</b></p>

<b>10 (i)</b> $2(x^2 - 3x) + 11$ $= 2\left[\left(x - \frac{3}{2}\right)^2 - \frac{9}{4}\right] + 11$ $= 2\left(x - \frac{3}{2}\right)^2 + \frac{13}{2}$	<b>B1</b> $p = 2$ <b>B1</b> $q = -\frac{3}{2}$ <b>M1</b> $r = 11 - 2q^2$ or $\frac{11}{2} - q^2$ <b>A1</b> $r = \frac{13}{2}$
<b>(ii)</b> $\left(\frac{3}{2}, \frac{13}{2}\right)$	<div style="border: 1px solid black; width: 20px; height: 20px; margin: 0 auto; text-align: center; line-height: 20px;">4</div> <hr style="border-top: 1px dashed black;"/> <b>B1√</b> <b>B1√</b> <div style="border: 1px solid black; width: 20px; height: 20px; margin: 0 auto; text-align: center; line-height: 20px;">2</div>
<b>(iii)</b> $36 - 4 \times 2 \times 11$ $= -52$	<b>M1</b> uses $b^2 - 4ac$ <b>A1</b> <div style="border: 1px solid black; width: 20px; height: 20px; margin: 0 auto; text-align: center; line-height: 20px;">2</div>
<b>(iv)</b> 0 real roots	<b>B1</b> cao <div style="border: 1px solid black; width: 20px; height: 20px; margin: 0 auto; text-align: center; line-height: 20px;">1</div>
<b>(v)</b> $2x^2 - 6x + 11 = 14 - 7x$ $2x^2 + x - 3 = 0$ $(2x + 3)(x - 1) = 0$ $x = -\frac{3}{2}, x = 1$ $y = \frac{49}{2}, y = 7$	<b>M1*</b> substitute for $x/y$ or attempt to get an equation in 1 variable only <b>A1</b> obtain correct 3 term quadratic <b>M1dep</b> correct method to solve 3 term quadratic <b>A1</b> <b>A1</b> <b>SR</b> If A0 A0, one correct pair of values, spotted or from correct factorisation <b>www B1</b> <div style="border: 1px solid black; width: 20px; height: 20px; margin: 0 auto; text-align: center; line-height: 20px;">5</div>