# 6671 Pure Mathematics P1

## Mark Scheme

| Question Number | Scheme | Marks |
|---|---|---|
| 1. | Forming equation in $x$ or $y$ by attempt to eliminate one variable | |
| | $(3-y)^2 + y = 15$ *or* $x^2 + (3-x) = 15$ | M1 |
| | $y^2 - 5y - 6 = 0$ *or* $x^2 - x - 12 = 0$ (Correct 3 term version) | A1 |
| | Attempt at solution i.e. solving 3 term quadratic: $(y-6)(y+1) = 0$, $y = \ldots$ or $(x-4)(x+3) = 0$, $x = \ldots$ or correct use of formula or correct use of completing the square | M1 |
| | $x = 4$ and $x = -3$ **or** $y = -1$ and $y = 6$ | A1 |
| | Finding the values of the other coordinates (M attempt one, A both) | M1 A1 ft |
| | | (6) |
| 2. | Using $\sin^2\theta + \cos^2\theta = 1$ to give a quadratic in $\cos\theta$. | M1 |
| | Attempt to solve $\cos^2\theta + \cos\theta = 0$ | M1 |
| | ( $\cos\theta = 0$ ) $\Rightarrow \theta = \frac{\pi}{2}, \frac{3\pi}{2}$ | B1, B1 |
| | ( $\cos\theta = -1$ ) $\Rightarrow \theta = \pi$ | B1 |
| | ( Candidate who writes down 3 answers only with no working scores a maximum of 3 ) | (5) |
| 3. (a) | Attempt f ( 2 ) ; = 16 – 4 + 4 - 16 = 0 $\Rightarrow$ ( $x$ – 2) is a factor    must be statement for A1 | M1; A1 |
| | | (2) |
| (b) | $c = 8$ | B1 |
| | A complete method to find $b$ | |
| | Either compare coefficients of $x$ or $x^2$: $-2b + 8 = 2$, or $-4 + b = -1$ | M1 |
| | Or substitute value of $x$ (may be implied) : e.g.($x = 1$) $\Rightarrow$ $-13 = (-1)(10 + b)$ | |
| | $b = 3$ | A1 |
| | | (3) |
| (c) | Checking $b^2 - 8c$ ; -55 $\Rightarrow$ no real roots to the quadratic | M1; A1 |
| | $\Rightarrow$ $x = 2$ is the only solution | A1 |
| | | (3) |

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| 4 (a) | Correct strategy for differentiation e.g. $y = 4x^2 + (5x-1)x^{-1}$ multiplied out with correct differentiation method, or product or quotient rules applied correctly to $\frac{5x-1}{x}$. | M1 |
| | $\frac{dy}{dx} = 8x, \quad +\frac{1}{x^2}$ B1 for $8x$ seen anywhere. | B1, A1 (3) |
| (b) | Putting $\frac{dy}{dx} = 0$ | M1 |
| | So $8x^3 + 1 = 0 \quad \Rightarrow x = -\frac{1}{2}$. M1 requires multiplication by denominator and use of a root in the solution | M1 A1 (3) |
| (c) | Complete method: Either $\frac{d^2y}{dx^2} = 8 - \frac{2}{x^3}$, with $x$ value substituted, or gradient either side checked | M1 |
| | Completely correct argument, either > 0 with no error seen,( 24)or –ve to +ve gradient, then **minimum** stated | A1 (2) |
| 5(a) | $p$ = 15, $q$ = -3 Special case if B0 B0, allow M1 for method, e.g. $8 = \frac{1+p}{2}$ | B1, B1 (2) |
| (b) | Gradient of line $ADC$ = $-\frac{5}{7}$, gradient of perpendicular line = $-\frac{1}{\text{gradient } ADC}$ $\left(\frac{7}{5}\right)$ | B1, M1 |
| | Equation of $l$ : $y - 2 = (\frac{7}{5})(x-8)$ | M1 A1ft |
| | $\Rightarrow 7x - 5y - 46 = 0$ (Allow rearrangements of this) | A1cao (5) |
| (c) | Substituting $y$ = 7 and finding value for $x$, | M1 |
| | $x = \frac{81}{7}$ or $11\frac{4}{7}$ | A1 (2) |

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| 6 (a) | $P = r\theta + 2r,\qquad A = \frac{1}{2}r^2\theta$ | B1, B1 (2) |
| (b) | Substituting value for *r* and equating *P* to *A*. $[2\sqrt{2}(2+\theta) = \frac{1}{2}(2\sqrt{2})^2\theta]$ | M1 |
| | Correct process to find $\theta$ $[\theta(\sqrt{2}-1) = 2]$ | M1 |
| | $\theta = \dfrac{2}{\sqrt{2}-1}$ * often see $\theta = \dfrac{4\sqrt{2}}{4-2\sqrt{2}}$ | A1 c.s.o. (3) |
| (c) | Multiply numerator and denominator by $(\sqrt{2}+1)$ | M1 |
| | $2, +2\sqrt{2}$ | A1, A1 (3) |
| 7 (a) | Applying correct formula [325 = 120 +5(n-1)] | M1 |
| | Solving to give $n$ =42 * (or verifying in correct equation) | A1 (2) |
| (b) | Using formula for sum of AP: S = $\frac{42}{2}\{240+5(42-1)\}$ or use $\frac{n}{2}\{a+l\}$ | M1 A1 |
| | = 9345 | A1 (3) |
| (c) | Recognising GP with $r = 0.98$ | M1 |
| | Value ( in £ ) = 7200 ( 0.98) $^{24}$ | M1 |
| | = 4434 ( only this value) | A1 (3) |

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| 8 (a) | Substitute $x$ =0, $y = \sqrt{3}$ to give $\sqrt{3} = k\frac{\sqrt{3}}{2} \Rightarrow k = 2$ ( or verify result) must see $\frac{\sqrt{3}}{2}$ | B1 (1) |
| (b) | $p$ = 120, $q$ = 300 (f.t. on $p$ +180) | B1, B1ft (2) |
| (c) | $arc\sin(-0.8) = -53.1$ or $arc\sin(0.8) = 53.1$ | B1 |
| | ( $x$ + 60) = 180 – arcsin( -0.8) or equivalent 180 + arcsin 0.8 | M1 |
| | First value of $x$ = 233.1 – 60, i.e. $x$ = 173.1 | A1 |
| | OR ( $x$ + 60) =360 + arcsin(-0.8) or equivalent 360 –arcsin 0.8, i.e. $x$ = 246.9 | M1, A1 (5) |
| 9 (a) | $(x-3)^2, +9$ isw . $a$ = 3 and $b$ = 9 may just be written down with no method shown. | B1, M1 A1 (3) |
| (b) | $P$ is (3, 9) | B1 ft, B1ft (2) |
| (c) | $A$ = (0, 18) | B1 |
| | $\frac{dy}{dx} = 2x - 6$, at $A$ $m$ = -6 | M1 A1 |
| | Equation of tangent is $y$ – 18 = -6$x$ ( in any form) | A1ft (4) |
| (d) | Showing that line meets $x$ axis directly below $P$ , i.e. at $x$ = 3. | A1cso (1) |
| (e) | $A = \int x^2 - 6x + 18 dx = [\frac{1}{3}x^3 - 3x^2 + 18x]$ | M1 A1 |
| | Substituting $x$ =3 to find area $A$ under curve $A$ [=36] | M1 |
| | Area of $R$ = $A$ – area of triangle= $A - \frac{1}{2} \times 18 \times 3, = 9$ | M1 A1 (5) |
| | Alternative: $\int x^2 - 6x + 18 - (18 - 6x) dx$ M1 | |
| | = $\frac{1}{3}x^3$ M1 A1 ft | |
| | Use $x$ = 3 to give answer 9 M1 A1 | |