# Pure Mathematics 1 Practice Paper M7 MARK SCHEME

**Q1.**

| Question number | Scheme | Marks |
|---|---|---|
| | (a) $2x^2 - x(x-4) = 8$ | M1 |
| | $x^2 + 4x - 8 = 0$ (*) | A1cso (2) |
| | (b) $x = \dfrac{-4 \pm \sqrt{4^2 - (4\times 1\times -8)}}{2}$ or $(x+2)^2 \pm 4 - 8 = 0$ | M1 |
| | $x = -2 \pm$ (any correct expression) | A1 |
| | $\sqrt{48} = \sqrt{16}\sqrt{3} = 4\sqrt{3}$ or $\sqrt{12} = \sqrt{4}\sqrt{3} = 2\sqrt{3}$ | B1 |
| | $y = \left(-2 \pm 2\sqrt{3}\right) - 4$ M: Attempt at least one $y$ value | M1 |
| | $\underline{x = -2 + 2\sqrt{3},\ y = -6 + 2\sqrt{3}}$ $\underline{x = -2 - 2\sqrt{3},\ y = -6 - 2\sqrt{3}}$ | A1 (5) |
| | | 7 |
| (a) | M1 for correct attempt to form an equation in $x$ only. Condone sign errors/slips but attempt at this line must be seen. E.g. $2x^2 - x^2 \pm 4x = 8$ is OK for M1.<br>A1cso for correctly simplifying to printed form. No incorrect working seen. The $= 0$ <u>is</u> required.<br>**These two marks can be scored in part (b). For multiple attempts pick best.** | |
| (b) | 1st M1 for use of correct formula. If formula is not quoted then a fully correct substitution is required. Condone missing $x =$ or just + or − instead of $\pm$ for M1.<br>For completing the square must have as printed or better.<br>If they have $x^2 - 4x - 8 = 0$ then M1 can be given for $(x-2)^2 \pm 4 - 8 = 0$.<br>1st A1 for -2 $\pm$ any correct expression. (The $\pm$ is required but $x =$ is not)<br>B1 for simplifying the surd e.g. $\sqrt{48} = 4\sqrt{3}$. Must reduce to $b\sqrt{3}$ so $\sqrt{16}\sqrt{3}$ or $\sqrt{4}\sqrt{3}$ are OK.<br>2nd M1 for attempting to find at least one $y$ value. Substitution into one of the given equations and an attempt to solve for $y$.<br>2nd A1 for correct $y$ answers. Pairings need <u>not</u> be explicit but they must say which is $x$ and which $y$.<br>Mis-labelling $x$ and $y$ loses final A1 only. | |

**Q2.**

| Question number | Scheme | Marks |
|---|---|---|
| | (a) Attempt to use discriminant $b^2-4ac$ | M1 |
| | $k^2-4(k+3)>0 \;\Rightarrow\; k^2-4k-12>0$ (*) | A1cso (2) |
| | (b) $k^2-4k-12=0 \;\Rightarrow$ | |
| | $(k\pm a)(k\pm b)$, with $ab=12$ or $(k=)\dfrac{4\pm\sqrt{4^2--4\times12}}{2}$ or $(k-2)^2\pm2^2-12$ | M1 |
| | $k=-2$ and $6$ (both) | A1 |
| | $\underline{k<-2,\;\; k>6}$ or $\underline{(-\infty,-2);(6,\infty)}$ M: choosing "outside" | M1 A1ft (4) |
| | | **6** |
| (a) | M1 for use of $b^2-4ac$, one of $b$ or $c$ must be correct.<br>Or full attempt using completing the square that leads to a 3TQ in $k$<br>e.g. $\left(\left[x+\dfrac{k}{2}\right]^2=\right)\dfrac{k^2}{4}-(k+3)$<br>A1cso Correct argument to printed result. Need to state (or imply) that $b^2-4ac>0$ and no incorrect working seen. Must have >0. If > 0 just appears with $k^2-4(k+3)>0$ that is OK.<br>If >0 appears on last line only with no explanation give A0.<br>$b^2-4ac$ followed by $k^2-4k-12>0$ only is insufficient so M0A0<br><br>e.g. $k^2-4\times1\times k+3$ (missing brackets) can get M1A0 but $k^2+4(k+3)$ is M0A0 (wrong formula)<br>Using $\sqrt{b^2-4ac}>0$ is M0. | |
| (b) | 1st M1 for attempting to find critical regions. Factors, formula or completing the square.<br>1st A1 for $k=6$ and $-2$ only<br>2nd M1 for choosing the outside regions<br>2nd A1f.t. as printed or f.t. their (non identical) critical values<br><br>$6<k<-2$ is M1A0 but ignore if it follows a correct version<br>$-2<k<6$ is M0A0 whatever their diagram looks like<br><br>Condone use of $x$ instead of $k$ for critical values and final answers in (b).<br><br>Treat this question as 3 two mark parts. If part (a) is seen in (b) or vice versa marks can be awarded. | |

**Q3.**

| Question number | Scheme | Marks | |
|---|---|---|---|
| | (a)  | | |
| | Translation parallel to $x$-axis | M1 | |
| | Top branch intersects +ve $y$-axis<br>Lower branch has no intersections<br>No obvious overlap | A1 | |
| | $\left(0, \frac{3}{2}\right)$ or $\frac{3}{2}$ marked on $y$- axis | B1 | (3) |
| | (b) $x = -2, \quad y = 0$ | B1, B1 | (2) |
| S.C. | [Allow ft on first B1 for $x = 2$ when translated "the wrong way" but must be compatible with their sketch.] | | |
| | | | 5 |
| (a) | M1 for a horizontal translation – two branches with one branch cutting $y$ – axis only.<br>If one of the branches cuts both axes (translation up and across) this is M0.<br>A1 for a horizontal translation to left. Ignore any figures on axes for this mark.<br>B1 for correct intersection on positive $y$-axis. More than 1 intersection is B0.<br>$x$=0 and $y$ = 1.5 in a table alone is insufficient unless intersection of their sketch is with +ve $y$-axis.<br>A point marked on the graph overrides a point given elsewhere. | | |
| (b) | 1st B1 for $x = -2$. NB $x \neq -2$ is B0.<br>Can accept $x = +2$ if this is compatible with their sketch.<br>Usually they will have M1A0 in part (a) (and usually B0 too)<br>2nd B1 for $y = 0$. | | |
| S.C. | If $x$ = -2 and $y$ =0 and some other asymptotes are also given award B1B0<br><br>The asymptote equations should be clearly stated in part (b). Simply marking $x$ =-2 or $y$ =0 on the sketch is insufficient <u>unless</u> they are clearly marked "asymptote $x$ = -2" etc. | | |

**Q4.**

| Question number | Scheme | Marks |
|---|---|---|
| | (a) $y = -\frac{3}{2}x(+4)$ Gradient $= -\frac{3}{2}$ | M1 A1 (2) |
| | (b) $3x + 2 = -\frac{3}{2}x + 4$ $x = \ldots,\ \underline{\frac{4}{9}}$ | M1, A1 |
| | $y = 3\left(\frac{4}{9}\right) + 2 = \underline{\frac{10}{3}}\ \left(= 3\frac{1}{3}\right)$ | A1 (3) |
| | (c) Where $y = 1$, $l_1 : x_A = -\frac{1}{3}$ $l_2 : x_B = 2$ M: Attempt one of these | M1 A1 |
| | Area $= \frac{1}{2}(x_B - x_A)(y_P - 1)$ | M1 |
| | $= \frac{1}{2} \times \frac{7}{3} \times \frac{7}{3} = \underline{\frac{49}{18} = 2\frac{13}{18}}$ o.e. | A1 (4) |
| | | **9** |
| (a) | M1 for an attempt to write $3x + 2y - 8 = 0$ in the form $y = mx + c$<br>or a full method that leads to $m =$ , e.g find 2 points, and attempt gradient using $\frac{y_2 - y_1}{x_2 - x_1}$<br>e.g. finding $y = -1.5x + 4$ alone can score M1 (even if they go on to say $m = 4$)<br>A1 for $m = -\frac{3}{2}$ (can ignore the $+c$) or $\frac{dy}{dx} = -\frac{3}{2}$ | |
| (b) | M1 for forming a suitable equation in one variable and attempting to solve leading to $x=$ ..or $y=$<br>1st A1 for any exact correct value for $x$<br>2nd A1 for any exact correct value for $y$<br>(These 3 marks can be scored anywhere, they may treat (a) and (b) as a single part) | |
| (c) | 1st M1 for attempting the $x$ coordinate of $A$ or $B$. One correct value seen scores M1.<br>1st A1 for $x_A = -\frac{1}{3}$ and $x_B = 2$<br>2nd M1 for a full method for the area of the triangle – follow through their $x_A, x_B, y_P$.<br>e.g. determinant approach $\frac{1}{2}\begin{vmatrix} 2 & -\frac{1}{3} & \frac{4}{9} & 2 \\ 1 & 1 & \frac{10}{3} & 1 \end{vmatrix} = \frac{1}{2}\left\lvert 2 - \ldots - (-\frac{1}{3}\ldots) \right\rvert$<br>2nd A1 for $\frac{49}{18}$ or an exact equivalent.<br><br>All accuracy marks require answers as single fractions or mixed numbers not necessarily in lowest terms. | |

**Q5.**

| Question number | Scheme | Marks | |
|---|---|---|---|
| | (a) Gradient of $AM$: $\dfrac{1-(-2)}{3-1}=\dfrac{3}{2}$ or $\dfrac{-3}{-2}$ | B1 | |
| | Gradient of $l$: $=-\dfrac{2}{3}$ M: use of $m_1m_2=-1$, or equiv. | M1 | |
| | $y-1=-\dfrac{2}{3}(x-3)$ or $\dfrac{y-1}{x-3}=-\dfrac{2}{3}$ $[3y=-2x+9]$ (Any equiv. form) | M1 A1 | (4) |
| | (b) $x=6$: $3y=-12+9=-3$ $y=-1$ (or show that for $y=-1$, $x=6$) (*) (A conclusion is not required). | B1 | (1) |
| | (c) $(r^2=)$ $(6-1)^2+(-1-(-2))^2$ M: Attempt $r^2$ or $r$ | M1 A1 | |
| | N.B. Simplification is not required to score M1 A1 | | |
| | $(x\pm6)^2+(y\pm1)^2=k$, $k\neq0$ (Value for $k$ not needed, could be $r^2$ or $r$) | M1 | |
| | $(x-6)^2+(y+1)^2=26$ (or equiv.) | A1 | (4) |
| | Allow $(\sqrt{26})^2$ or other exact equivalents for 26. (But… $(x-6)^2+(y--1)^2=26$ scores M1 A0) | | |
| | (Correct answer with no working scores full marks) | | |
| | | | 9 |
| | (a) 2nd M1: eqn. of a straight line through (3, 1) with any gradient except 0 or ∞.<br>Alternative: Using (3, 1) in $y=mx+c$ to find a value of $c$ scores M1, but an equation (general or specific) must be seen.<br>Having coords the wrong way round, e.g. $y-3=-\dfrac{2}{3}(x-1)$, loses the 2nd M mark unless a correct general formula is seen, e.g. $y-y_1=m(x-x_1)$.<br>If the point $P(6,-1)$ is used to find the gradient of $MP$, maximum marks are (a) B0 M0 M1 A1 (b) B0.<br>(c) 1st M1: Condone one slip, numerical or sign, inside a bracket.<br>Must be attempting to use points $P(6,-1)$ and $A(1,-2)$, or perhaps $P$ and $B$. (Correct coordinates for $B$ are (5, 4)).<br>1st M alternative is to use a complete Pythag. method on triangle $MAP$, n.b. $MP=MA=\sqrt{13}$.<br>Special case:<br>If candidate persists in using their value for the $y$-coordinate of $P$ instead of the given $-1$, allow the M marks in part (c) if earned. | | |

**Q6.**

| Question number | Scheme | | Marks |
|---|---|---|---|
| | (a) $x=1:\ y=-5+4=\underline{-1}$, $x=2:\ y=-16+2=\underline{-14}$ | (can be given in (b) or (c)) | 1st B1 for – 1<br>2nd B1 for - 14 |
| | $PQ=\sqrt{(2-1)^2+(-14-(-1))^2}=\sqrt{170}$ | (*) | M1 A1cso (4) |
| | (b) $y=x^3-6x^2+4x^{-1}$ | | M1 |
| | $\frac{dy}{dx}=3x^2-12x-4x^{-2}$ | | M1 A1 |
| | $x=1:\ \frac{dy}{dx}=3-12-4=-13$ | M: Evaluate at one of the points | M1 |
| | $x=2:\ \frac{dy}{dx}=12-24-1=-13$ $\therefore$ Parallel | A: Both correct + conclusion | A1 (5) |
| | (c) Finding gradient of normal $\left(m=\frac{1}{13}\right)$ | | M1 |
| | $y--1=\frac{1}{13}(x-1)$ | | M1 A1ft |
| | $\underline{x-13y-14=0}$ | o.e. | A1cso (4) |
| | | | **13** |

| | |
|---|---|
| (a) | M1 for attempting $PQ$ or $PQ^2$ using their $P$ and their $Q$. Usual rules about quoting formulae.<br>We must see attempt at $1^2 + (y_P - y_Q)^2$ for M1. $PQ^2 = \sqrt{\ldots}$ etc could be M1A0.<br>A1cso for proceeding to the correct answer with no incorrect working seen. |
| (b) | 1st M1 for multiplying by $x^2$, the $x^3$ or $-6x^2$ must be correct.<br>2nd M1 for some correct differentiation, at least one term must be correct as printed.<br>1st A1 for a fully correct derivative.<br>**These 3 marks can be awarded anywhere when first seen.**<br>3rd M1 for attempting to substitute $x = 1$ or $x = 2$ in their derivative. Substituting in $y$ is M0.<br>2nd A1 for -13 from both substitutions <u>and</u> a brief comment.<br>The $-13$ must come from their derivative. |
| (c) | 1st M1 for use of the perpendicular gradient rule. Follow through their $-13$.<br>2nd M1 for full method to find the equation of the normal or tangent at $P$. If formula is quoted allow slips in substitution, otherwise a correct substitution is required.<br>1st A1ft for a correct expression. Follow through their $-1$ and their changed gradient.<br>2nd A1cso for a correct equation with $= 0$ and integer coefficients.<br>This mark is dependent upon the $-13$ coming from their derivative in (b) hence cso.<br>Tangent can get M0M1A0A0, changed gradient can get M0M1A1A0orM1M1A1A0. |
| MR | Condone confusion over terminology of tangent and normal, mark gradient and equation.<br>Allow for $-\frac{4}{x}$ or $(x+6)$ but not omitting $4x^{-1}$ or treating it as $4x$. |

**Q7.**

| Question number | Scheme | Marks |
|---|---|---|
| | (a) $4x^2 + 6xy = 600$ | M1 A1 |
| | $V = 2x^2y = 2x^2\left(\frac{600-4x^2}{6x}\right)$ $\quad V = 200x - \frac{4x^3}{3}$ (*) | M1 A1cso (4) |
| | (b) $\frac{dV}{dx} = 200 - 4x^2$ | B1 |
| | Equate their $\frac{dV}{dx}$ to 0 and solve for $x^2$ or $x$: $x^2 = 50$ or $x = \sqrt{50}$ (7.07…) | M1 A1 |
| | Evaluate $V$: $\quad V = 200(\sqrt{50}) - \frac{4}{3}(50\sqrt{50}) = 943\ \text{cm}^3$ $\quad$ Allow awrt | M1 A1 (5) |
| | (c) $\frac{d^2V}{dx^2} = -8x$ Negative, $\quad \therefore$ Maximum | M1, A1ft (2) |
| | | **11** |
| | (a) 1st M: Attempting an expression in terms of $x$ and $y$ for the total surface area (the expression should be dimensionally correct).<br>1st A: Correct expression (not necessarily simplified), equated to 600.<br>2nd M: Substituting their $y$ into $2x^2y$ to form an expression in terms of $x$ only. (Or substituting $y$ from $2x^2y$ into their area equation).<br>(b) 1st A: Ignore $x = -\sqrt{50}$, if seen.<br>The 2nd M mark (for substituting their $x$ value into the given expression for $V$) is dependent on the 1st M.<br>Final A: Allow also exact value $\frac{400\sqrt{50}}{3}$ or $\frac{2000\sqrt{2}}{3}$ or equiv. single term.<br>(c) Allow marks if the work for (c) is seen in (b) (or vice-versa).<br>M: Find second derivative and consider its sign.<br>A: Second derivative following through correctly from their $\frac{dV}{dx}$, and correct reason/conclusion (it must be a maximum, not a minimum).<br>An actual value of $x$ does not have to be used… this mark can still be awarded if no $x$ value has been found or if a wrong $x$ value is used.<br>Alternative:<br>M: Find value of $\frac{dV}{dx}$ on each side of "$x = \sqrt{50}$" and consider sign.<br>A: Indicate sign change of positive to negative for $\frac{dV}{dx}$, and conclude max.<br>Alternative:<br>M: Find value of $V$ on each side of "$x = \sqrt{50}$" and compare with "943".<br>A: Indicate that both values are less than 943, and conclude max. | |

**Q8.**

| Question number | Scheme | Marks |
|---|---|---|
| | (a) $\left(\frac{dy}{dx}\right) = \underline{6x^1 + \frac{4}{2}x^{-\frac{1}{2}}}$ or $\left(6x + 2x^{-\frac{1}{2}}\right)$ | M1 A1 (2) |
| | (b) $\underline{6 + -x^{-\frac{3}{2}}}$ or $\underline{6 + -1 \times x^{-\frac{3}{2}}}$ | M1 A1ft (2) |
| | (c) $\underline{x^3 + \frac{8}{3}x^{\frac{3}{2}} + C}$ A1: $\frac{3}{3}x^3$ or $\frac{4x^{\frac{3}{2}}}{\left(\frac{3}{2}\right)}$ A1: both, simplified and + $C$ | M1 A1 A1 (3) |
| | | 7 |

| | | |
|---|---|---|
| (a) | M1 | for <u>some</u> attempt to differentiate: $x^n \to x^{n-1}$ <br> Condone missing $\frac{dy}{dx}$ or $y = \ldots$ |
| | A1 | for both terms correct, as written or better. No + $C$ here. Of course $\frac{2}{\sqrt{x}}$ is acceptable. |
| (b) | M1 | for some attempt to differentiate again. Follow through their $\frac{dy}{dx}$, at least one term correct or correct follow through. |
| | A1f.t. | as written or better, follow through must have 2 <u>distinct</u> terms and simplified e.g. $\frac{4}{4} = 1$. |
| (c) | M1 | for some attempt to integrate: $x^n \to x^{n+1}$. Condone misreading $\frac{dy}{dx}$ or $\frac{d^2y}{dx^2}$ for $y$. <br> (+$C$ alone is not sufficient) |
| | 1st A1 | for either $\frac{3}{3}x^3$ or $\frac{4x^{\frac{3}{2}}}{\left(\frac{3}{2}\right)}$ (or better) $\frac{2}{3} \times 4x^{\frac{3}{2}}$ is OK here too but not for 2nd A1. |
| | 2nd A1 | for <u>both</u> $x^3$ and $\frac{8}{3}x^{\frac{3}{2}}$ or $\frac{8}{3}x\sqrt{x}$ i.e. simplified terms <u>and</u> $+C$ all on one line. <br> $2\frac{2}{3}$ instead of $\frac{8}{3}$ is OK |

**Q9.**

| Question number | Scheme | Marks |
|---|---|---|
| | (a) $x = \dfrac{\log 0.8}{\log 8}$ or $\log_8 0.8$, $= -0.107$ Allow awrt | M1, A1 (2) |
| | (b) $2\log x = \log x^2$ | B1 |
| | $\log x^2 - \log 7x = \log \dfrac{x^2}{7x}$ | M1 |
| | "Remove logs" to form equation in $x$, using the base correctly: $\dfrac{x^2}{7x} = 3$ | M1 |
| | $x = 21$ (Ignore $x = 0$, if seen) | A1cso (4) **6** |
| | (a) Allow also the 'implicit' answer $8^{-0.107}$ (M1 A1).<br>Answer only: $-0.107$ or awrt: Full marks.<br>Answer only: $-0.11$ or awrt (insufficient accuracy): M1 A0<br>Trial and improvement: Award marks as for "answer only".<br>(b) <u>Alternative:</u><br>$2\log x = \log x^2$ B1<br>$\log 7x + 1 = \log 7x + \log 3 = \log 21x$ M1<br>"Remove logs" to form equation in $x$: $x^2 = 21x$ M1<br>$x = 21$ (Ignore $x = 0$, if seen) A1<br><u>Alternative:</u><br>$\log 7x = \log 7 + \log x$ B1<br>$2\log x - (\log 7 + \log x) = 1$<br>$\log_3 x = 1 + \log_3 7$ M1<br>$x = 3^{(1+\log_3 7)}$ $\left(= 3^{2.771..}\right)$ or $\log_3 x = \log_3 3 + \log_3 7$ M1<br>$x = 21$ A1<br>Attempts using change of base will usually require the same steps as in the main scheme or alternatives, so can be marked equivalently.<br><u>A common mistake:</u><br>$\log x^2 - \log 7x = \dfrac{\log x^2}{\log 7x}$ B1 M0<br>$\dfrac{x^2}{7x} = 3$ $x = 21$ M1('Recovery'), but A0 | |

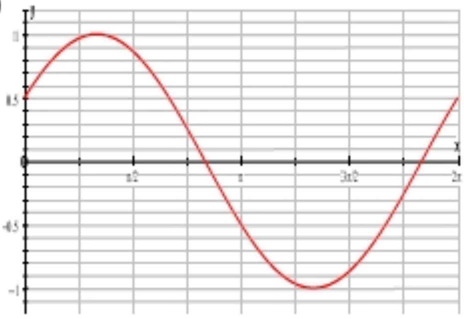
**Q10.**

| Question number | Scheme | Marks |
|---|---|---|
| | (a) $\mathrm{f}(x) = \frac{6x^3}{3} - \frac{10x^2}{2} - 12x \ (+C)$ | M1 A1 |
| | $x = 5$: $\quad 250 - 125 - 60 + C = 65 \quad C = 0$ | M1 A1 (4) |
| | (b) $x(2x^2 - 5x - 12)$ or $(2x^2 + 3x)(x - 4)$ or $(2x + 3)(x^2 - 4x)$ | M1 |
| | $= x(2x + 3)(x - 4)$ (*) | A1cso (2) |
| | (c)  Shape | B1 |
| | Through origin | B1 |
| | $\left(-\frac{3}{2}, 0\right)$ and (4,0) | B1 (3) |
| | | **9** |
| (a) | $1^{st}$ M1 for attempting to integrate, $x^n \to x^{n+1}$<br>$1^{st}$ A1 for all $x$ terms correct, need not be simplified. Ignore + $C$ here.<br>$2^{nd}$ M1 for some use of $x = 5$ and f(5)=65 to form an equation in $C$ based on their integration.<br>There must be some visible attempt to use $x = 5$ and f(5)=65. No +$C$ is M0.<br>$2^{nd}$ A1 for $C = 0$. This mark cannot be scored unless a suitable equation is seen. | |
| (b) | M1 for attempting to take out a correct factor or to verify. Allow usual errors on signs.<br>They must get to the equivalent of one of the given partially factorised expressions or, if verifying, $x(2x^2 + 3x - 8x - 12)$ i.e. with no errors in signs.<br>A1cso for proceeding to printed answer with no incorrect working seen. Comment <u>not</u> required.<br>This mark is <u>dependent upon a fully correct solution to part (a)</u> so M1A1M0A0M1A0 for (a) & (b).<br>Will be common or M1A1M1A0M1A0. To score 2 in (b) they must score 4 in (a). | |
| (c) | $1^{st}$ B1 for positive $x^3$ shaped curve (with a max and a min) positioned anywhere.<br>$2^{nd}$ B1 for any curve that passes through the origin (B0 if it only touches at the origin)<br>$3^{rd}$ B1 for the two points <u>clearly</u> given as coords or values marked in appropriate places on $x$ axis.<br>Ignore any extra crossing points (they should have lost first B1).<br>Condone (1.5, 0) if clearly marked on –ve $x$-axis. Condone (0, 4) etc if marked on +ve $x$ axis.<br>Curve can <u>stop</u> (i.e. not pass through) at (-1.5, 0) and (4, 0).<br>A point on the graph overrides coordinates given elsewhere. | |

**Q11.**

| Question number | Scheme | Marks |
|---|---|---|
| | (a) $4^2 = 5^2 + 6^2 - (2\times5\times6\cos\theta)$ | M1 |
| | $\cos\theta = \dfrac{5^2+6^2-4^2}{2\times5\times6}$ | A1 |
| | $\left(=\dfrac{45}{60}\right) = \dfrac{3}{4}$ (*) | A1cso (3) |
| | (b) $\sin^2 A + \left(\dfrac{3}{4}\right)^2 = 1$ (or equiv. Pythag. method) | M1 |
| | $\left(\sin^2 A = \dfrac{7}{16}\right)$ $\sin A = \dfrac{1}{4}\sqrt{7}$ or equivalent exact form, e.g. $\sqrt{\dfrac{7}{16}}$, $\sqrt{0.4375}$ | A1 (2) |
| | | **5** |
| | (a) M: Is also scored for $5^2 = 4^2 + 6^2 - (2\times4\times6\cos\theta)$<br>or $6^2 = 5^2 + 4^2 - (2\times5\times4\cos\theta)$<br>or $\cos\theta = \dfrac{4^2+6^2-5^2}{2\times4\times6}$ or $\cos\theta = \dfrac{5^2+4^2-6^2}{2\times5\times4}$ .<br>1st A: Rearranged correctly and numerically correct (possibly unsimplified), in the form $\cos\theta = \ldots$ or $60\cos\theta = 45$ (or equiv. in the form $p\cos\theta = q$).<br><br><u>Alternative</u> (verification):<br>$4^2 = 5^2 + 6^2 - \left(2\times5\times6\times\dfrac{3}{4}\right)$ [M1]<br>Evaluate correctly, at least to $16 = 25 + 36 - 45$ [A1]<br>Conclusion (perhaps as simple as a tick). [A1cso]<br>(Just achieving 16 = 16 is insufficient without at least a tick).<br><br>(b) M: Using a correct method to find an equation in $\sin^2 A$ or $\sin A$ which would give an exact value.<br><u>Correct answer without working</u> (or with unclear working or decimals): Still scores both marks. | |

**Q12.**

| Question number | Scheme | Marks |
| --- | --- | --- |
| | (a)  Sine wave (anywhere) with at least 2 turning points.<br>Starting on positive $y$-axis, going up to a max., then min. below $x$-axis, no further turning points in range, finishing above $x$-axis at $x = 2\pi$ or $360°$. There must be <u>some</u> indication of scale on the $y$-axis… (e.g. 1, $-1$ or 0.5)<br>Ignore parts of graph outside 0 to $2\pi$.<br>n.b. Give credit if necessary for what is seen on an initial sketch (before any transformation has been performed). | M1<br><br>A1 (2) |
| | (b) $(0, \frac{1}{2})$, $(150^0, 0)$, $(330^0, 0)$ | B1, B1, B1 (3) |
| | (c)<br>$180^0 - 40.54^0 = 139.46^0$<br>Subtract $30^0$ from all values<br>$10.54^0$, $109.45^0$ | B1<br>M1<br>M1<br>A1, A1 (5) |
| | | **10** |

**Q13.**

| Question number | Scheme | Marks |
| --- | --- | --- |
| (a) | $\frac{dT}{dt} = -7.5e^{\frac{-t}{6}}$<br>Sub t =15 $\quad \frac{dT}{dt} = -7.5e^{\frac{-15}{6}} = -0.616\ C^0/min$ | M1<br>A1 |
| (b) | As $\rightarrow \infty$ , T $\rightarrow$ 25 Hence T will never falls below $25^0$ | A1 |