January 2007

Answer **all** questions.

1 The polynomial $\mathrm{p}(x)$ is given by

$$\mathrm{p}(x) = x^3 - 4x^2 - 7x + k$$

where k is a constant.

(a) (i) Given that $x + 2$ is a factor of $\mathrm{p}(x)$, show that $k = 10$. *(2 marks)*

(ii) Express $\mathrm{p}(x)$ as the product of three linear factors. *(3 marks)*

(b) Use the Remainder Theorem to find the remainder when $\mathrm{p}(x)$ is divided by $x - 3$. *(2 marks)*

(c) Sketch the curve with equation $y = x^3 - 4x^2 - 7x + 10$, indicating the values where the curve crosses the x-axis and the y-axis. (You are **not** required to find the coordinates of the stationary points.) *(4 marks)*

2 The line AB has equation $3x + 5y = 8$ and the point A has coordinates $(6, -2)$.

(a) (i) Find the gradient of AB. *(2 marks)*

(ii) Hence find an equation of the straight line which is perpendicular to AB and which passes through A. *(3 marks)*

(b) The line AB intersects the line with equation $2x + 3y = 3$ at the point B. Find the coordinates of B. *(3 marks)*

(c) The point C has coordinates $(2, k)$ and the distance from A to C is 5. Find the **two** possible values of the constant k. *(3 marks)*

3 (a) Express $\dfrac{\sqrt{5}+3}{\sqrt{5}-2}$ in the form $p\sqrt{5} + q$, where p and q are integers. *(4 marks)*

(b) (i) Express $\sqrt{45}$ in the form $n\sqrt{5}$, where n is an integer. *(1 mark)*

(ii) Solve the equation

$$x\sqrt{20} = 7\sqrt{5} - \sqrt{45}$$

giving your answer in its simplest form. *(3 marks)*

4 A circle with centre C has equation $x^2 + y^2 + 2x - 12y + 12 = 0$.

(a) By completing the square, express this equation in the form

$$(x-a)^2 + (y-b)^2 = r^2$$ *(3 marks)*

(b) Write down:

(i) the coordinates of C; *(1 mark)*

(ii) the radius of the circle. *(1 mark)*

(c) Show that the circle does **not** intersect the x-axis. *(2 marks)*

(d) The line with equation $x + y = 4$ intersects the circle at the points P and Q.

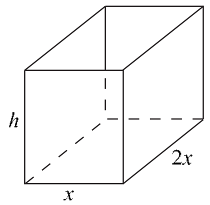
(i) Show that the x-coordinates of P and Q satisfy the equation

$$x^2 + 3x - 10 = 0$$ *(3 marks)*

(ii) Given that P has coordinates $(2, 2)$, find the coordinates of Q. *(2 marks)*

(iii) Hence find the coordinates of the midpoint of PQ. *(2 marks)*

5 The diagram shows an **open-topped** water tank with a horizontal rectangular base and four vertical faces. The base has width x metres and length $2x$ metres, and the height of the tank is h metres.



The combined internal surface area of the base and four vertical faces is 54 m^2.

(a) (i) Show that $x^2 + 3xh = 27$. *(2 marks)*

(ii) Hence express h in terms of x. *(1 mark)*

(iii) Hence show that the volume of water, $V\text{ m}^3$, that the tank can hold when full is given by

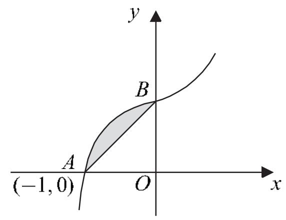
$$V = 18x - \frac{2x^3}{3}$$ *(1 mark)*

(b) (i) Find $\frac{\mathrm{d}V}{\mathrm{d}x}$. *(2 marks)*

(ii) Verify that V has a stationary value when $x = 3$. *(2 marks)*

(c) Find $\frac{\mathrm{d}^2V}{\mathrm{d}x^2}$ and hence determine whether V has a maximum value or a minimum value when $x = 3$. *(2 marks)*

6 The curve with equation $y = 3x^5 + 2x + 5$ is sketched below.



The curve cuts the x-axis at the point $A(-1, 0)$ and cuts the y-axis at the point B.

(a) (i) State the coordinates of the point B and hence find the area of the triangle AOB, where O is the origin. *(3 marks)*

(ii) Find $\int (3x^5 + 2x + 5)\,\mathrm{d}x$. *(3 marks)*

(iii) Hence find the area of the shaded region bounded by the curve and the line AB. *(4 marks)*

(b) (i) Find the gradient of the curve with equation $y = 3x^5 + 2x + 5$ at the point $A(-1, 0)$. *(3 marks)*

(ii) Hence find an equation of the tangent to the curve at the point A. *(1 mark)*

7 The quadratic equation $(k+1)x^2 + 12x + (k-4) = 0$ has real roots.

(a) Show that $k^2 - 3k - 40 \leqslant 0$. *(3 marks)*

(b) Hence find the possible values of k. *(4 marks)*

END OF QUESTIONS

AQA – Core 1 - – Jan 2007 – Answers

Question 1:

$$p(x) = x^3 - 4x^2 - 7x + k$$

$a)i)\ (x+2)$ is a factor of $p(x)$

This means that $p(-2) = 0$

$p(-2) = (-2)^3 - 4\times(-2)^2 - 7\times(-1) + k =$

$= -8 - 16 + 14 + k = 0$

$-10 + k = 0 \qquad k = 10$

$ii)\ x^3 - 4x^2 - 7x + 10 = (x+2)(x^2 - 6x + 5)$

$= (x+2)(x-5)(x-1)$

$b)$ The remainder of the division by $(x-3)$ *is* $p(3)$

$p(3) = 3^3 - 4\times 3^2 - 7\times 3 + 10$

$= 27 - 36 - 21 + 10 = -20$

$c)$ The graph crosses the x-axis at $(-2,0), (5,0)$ *and* $(1,0)$

crosses the y-axis at $(0,10)$

Exam report

Part (a)(i) Most candidates found p(-2) but often failed to convince examiners that they had really shown that k = 10. Many substituted
k = 10 from the outset and then drew no conclusion from the fact that p(-2) = 0. Those using long division often made sign errors.
Part (a)(ii) Factorisation of a cubic seems well understood and, apart from those who could not factorise $x^2 - 6x + 5$, candidates usually scored full marks. Some still confuse factors and roots.
Part (b) Many ignored the request to use the Remainder Theorem and scored no marks for long division. A few who correctly found that p(3) = -20 concluded that the remainder was +20.
Part (c) The sketch was generously marked with regard to the position of the stationary points but it was expected that candidates would indicate the values where the curve crossed the coordinate axes and often these values, particularly the 10 on the *y*-axis, were omitted.

Question 2:

$a)i)\ 3x + 5y = 8 \qquad A(6,-2)$

Make y the subject: $y = -\dfrac{3}{5}x + \dfrac{8}{5}$

The gradient is $m_{AB} = -\dfrac{3}{5}$

$ii)$ The gradient of the line

perpendicular to AB is $-\dfrac{1}{m_{AB}} = \dfrac{5}{3}$

The equation of the line is : $y - (-2) = \dfrac{5}{3}(x-6)$

$3y + 6 = 5x - 30$

$5x - 3y = 36$

$b)$Solve simultaneously $\begin{cases} 3x + 5y = 8 & (\times 2) \\ 2x + 3y = 3 & (\times -3) \end{cases}$

This gives $\begin{cases} 6x + 10y = 16 \\ -6x - 9y = -9 \end{cases}$ *by adding*, $y = 7$

then $3x + 5y = 8 \qquad 3x + 35 = 8 \qquad x = -9$

$B(-9,7)$

$c)\ C(2,k)$ *and* $A(6,-2)$

$AC = \sqrt{(2-6)^2 + (k+2)^2} = 5$

so $AC^2 = 16 + (k+2)^2 = 25$

$(k+2)^2 = 9$

$k + 2 = 3 \quad or \quad k + 2 = -3$

$k = 1 \quad or \quad k = -5$

Exam report

Part (a)(i) It was disappointing to see many candidates unable to rearrange 3x + 5y = 8 to make y the subject in order to find the gradient. Some were successful in finding a second point on the line such as (1, 1) and then using the coordinates of A to find the gradient of AB.

Part (a)(ii) Most candidates knew how to find the gradient of a perpendicular line, but those using y = mx + c made more arithmetic slips than those using the more appropriate form $y - y_1 = m(x - x_1)$.

Part (b) Apart from those who used the wrong pair of equations, this part was usually answered correctly.

Part (c) Although this part was meant to be challenging, there were many successful attempts, particularly by those who used a sketch and reasoned on a 3, 4, 5 triangle. It had been intended that candidates would have formed an equation such as $16 + (k + 2)^2 = 25$, but more commonly something such as $16 + y^2 = 25$ was seen, resulting in the incorrect values of ±3 .

Question 3:	Exam report
a) $\frac{\sqrt{5}+3}{\sqrt{5}-2}=\frac{\sqrt{5}+3}{\sqrt{5}-2}\times\frac{\sqrt{5}+2}{\sqrt{5}+2}=\frac{5+2\sqrt{5}+3\sqrt{5}+6}{5-4}=11+5\sqrt{5}$ b) i) $\sqrt{45}=\sqrt{9\times5}=3\sqrt{5}$ ii) $x\sqrt{20}=7\sqrt{5}-\sqrt{45}$ $x\times2\sqrt{5}=7\sqrt{5}-3\sqrt{5}$ $x=\frac{4\sqrt{5}}{2\sqrt{5}}=\frac{4}{2}=2$	Part (a) It was not uncommon to see the denominator and numerator multiplied by different surds and the usual errors occurred as candidates tried to multiply out brackets. This part of the question did not seem to be answered as well as in previous years. Part (b)(i) was usually correct but very few were successful in solving the equation in part (b)(ii), even though they reached forms of the correct equation such as $2\sqrt{5}x=4\sqrt{5}$ or $x=\frac{4\sqrt{5}}{2\sqrt{5}}$.

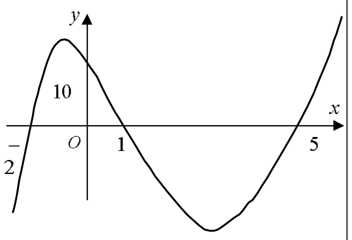
Question 4:	Exam report
$x^2+y^2+2x-12y+12=0$ a) $(x+1)^2-1+(y-6)^2-36+12=0$ $(x+1)^2+(y-6)^2=25$ b) i) The centre $C(-1,6)$ ii) $r=\sqrt{25}=5$ c) On the x-axis, $y=0$, The equation becomes $(x+1)^2+36=25$ $(x+1)^2=-11$ No solution as $(x+1)^2>0$ for all x. d) Consider simultaneously $\begin{cases}x^2+y^2+2x-12y+12=0\\y=4-x\end{cases}$ by substitution, we have $x^2+(4-x)^2+2x-12(4-x)+12=0$ $x^2+16+x^2-8x+2x-48+12x+12=0$ $2x^2+6x-20=0$ $x^2+3x-10=0$ ii) $x^2+3x-10=0$ $(x-2)(x+5)=0$ $\quad x=2$ or $x=-5$ and $y=4-x$: $\quad y=2$ or $y=9$ $P(2,2)$ and $Q(-5,9)$ iii) The mid-point of PQ is $\left(\frac{x_P+x_Q}{2},\frac{y_P+y_Q}{2}\right)=\left(-\frac{3}{2},\frac{11}{2}\right)$	Part (a) The + 2x term was ignored by many who wrote the left hand side of the circle equation as $(x-1)^2+(y-6)^2$ but most candidates were able to complete the square correctly. The right hand side was often seen as 49 and since this was a perfect square it did not cause candidates to doubt their poor arithmetic. Part (b) Many who had the correct circle equation in part (a) wrote the coordinates of the centre with incorrect signs. Generous follow through marks were awarded in this part provided the right hand side of the equation had a positive value. Part (c) Almost all candidates reasoned correctly by considering the y-coordinate of the centre and the radius of the circle, although a number were successful in showing that the quadratic resulting from substituting y = 0 into the circle equation does not have real roots. Some simply drew a diagram and this alone was not regarded as sufficient to prove that the circle did not intersect the x-axis. Others using an algebraic approach found a quadratic that they said did not factorise and concluded incorrectly that the equation had no real roots. Part (d) The algebra proved too difficult for the weaker candidates and many who had shown good algebraic skills rather casually forgot to include "= 0" on their final line of working. Sadly, many were unable to factorise the quadratic or wrote the coordinates of Q as (-(-5, 2). It was good, however, to see more candidates being able to find the correct mid-point, where in previous years too many had found the difference of the coordinates before dividing by 2.

Question 5:	**Exam report**
$a)\,i)\,Surface\ area: x\times 2x + 2hx + 2h\times 2x = 54$ $2x^2 + 2h(x+2x) = 54 \quad (\div 2)$ $x^2 + 3xh = 27$ $ii)\,h = \frac{27-x^2}{3x} = \frac{9}{x} - \frac{x}{3}$ $iii)\,V = x\times 2x\times h = 2x^2\left(\frac{9}{x}-\frac{x}{3}\right) = 18x - \frac{2x^3}{3}$ $b)\,i)\,\frac{dV}{dx} = 18 - \frac{2}{3}\times 3x^2 = 18 - 2x^2$ $ii)\,\frac{dV}{dx} = 0 \ \ means\ \ 18 - 2x^2 = 0$ $x^2 = 9$ $x = 3\,or\ \ x = -3\,(x\,must\ \ be\ \ positive)$ $c)\,\frac{d^2V}{dx^2} = -4x \ \ and\ \ for\ \ x = 3,\ \frac{d^2V}{dx^2} = -12 < 0$ This point is a maximum.	Part (a) Candidates did not seem confident at working on this kind of problem and algebraic weaknesses were evident. Many worked backwards from the result in part (a)(i) and did not always convince the examiner that they were considering the surface area of four faces and the base. The inability of most candidates to rearrange the formula to make h the subject in part (a)(ii) was alarming. Consequently few, without considerable fudging, could establish the printed formula for the volume. Part (b) Basic differentiation is well understood and most candidates found $\frac{dV}{dx}$ correctly. Some tried to substitute x = 3 into the expression for V in order to show there was a stationary point, but usually this part was answered well. Part (c) It was not uncommon to see the second derivative as 4x even though the first derivative was correct. A generous follow through was given here provided candidates could interpret the value of their second derivative.

Question 6:	**Exam report**
$a)\,i)\,B(0,y_B)$ belongs to the curve so $y_B = 3\times 0^5 + 2\times 0 + 5 = 5$ $B(0,5)$ $Area\ AOB = \frac{1}{2}\times 1\times 5 = \frac{5}{2}$ $ii)\int (3x^5+2x+5)dx = \frac{3}{6}x^6 + \frac{2}{2}x^2 + 5x + c$ $= \frac{1}{2}x^6 + x^2 + 5x + c$ $iii)\,Area\ \ of\ \ shaded\ \ region = \int_{-1}^{0}(3x^5+2x+5)dx - \frac{5}{2}$ $= \left[\frac{1}{2}x^6 + x^2 + 5x\right]_{-1}^{0} - \frac{5}{2} = (0) - \left(\frac{1}{2}+1-5\right) - \frac{5}{2}$ $= \frac{7}{2} - \frac{5}{2} = 1$ $b)\,i)$ the gradient of the curve at A is $\frac{dy}{dx}(x=-1)$ $\frac{dy}{dx} = 15x^4 + 2 \qquad and\ \ for\ \ x = -1,\ m = 17$ $ii)$ The equation of the tangent at A is $y - 0 = 17(x+1)$ $y = 17x + 17$	Part (a)(i) Some candidates ignored the request to state the coordinates of B even though they were using the height of the triangle as 5. The negative x-coordinate of A caused quite a few to feel that the triangle had a negative area. Far too many when finding $\frac{1}{2}\times 1\times 5$ wrote the answer as 3. Part (a)(ii) Practically every candidate found the correct integral although some made errors when cancelling fractions. Part (a)(iii) It was necessary here to have the lower limit as .1 and the upper limit as 0. Many reversed the order and by some trickery arrived at a positive value. This was penalised and so very few, even though many had an answer of 1 for the area, scored full marks for this part of the question. Part (b) Most candidates differentiated correctly but, because of poor understanding of negative signs, many wrong values of -13 were seen for the gradient. There is obviously confusion for many between tangents and normals and several thought the gradient of the tangent was $-\frac{1}{17}$.

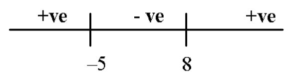
Question 7:	**Exam report**
$(k+1)x^2+12x+(k-4)=0$ *has real roots* *means* the discriminant ≥ 0 a) $12^2-4\times(k+1)\times(k-4)\geq 0$ $144-4k^2+12k+16\geq 0$ $-4k^2+12k+160\geq 0 \quad (\div -4)$ $k^2-3k-40\leq 0$ b) $(k-8)(k+5)\leq 0$ $-5\leq k\leq 8$	Part (a) The condition for real roots was not widely known and the form of the printed answer caused many to write the condition as $b^2 - 4ac \leq 0$. Part (b) It was disappointing to see many unable to factorise the quadratic correctly. Far too many guessed at answers and an approach using a sign diagram or sketch is recommended. Candidates also need to realise that the final form of the answer cannot be written as "$k\geq -5$" *or* "$k\leq 8$"

GRADE BOUNDARIES						
Component title	Max mark	A	B	C	D	E
Core 1 – Unit PC1	75	59	51	43	35	28

Q	Solution	Marks	Total	Comments
1(a)(i)	$p(-2) = -8 - 16 + 14 + k$ $p(-2) = 0 \Rightarrow -10 + k = 0 \quad \Rightarrow k = 10$ Must have statement if k=10 substitute	M1 A1	 2	or long division or $(x+2)(x^2-6x+5)$ **AG** likely withhold if $p(-2) = 0$ not seen
(ii)	$p(x) = (x+2)(x^2 + ... \quad 5)$ $p(x) = (x+2)(x^2-6x+5)$ $\Rightarrow p(x) = (x+2)(x-1)(x-5)$	M1 A1 A1	 3	Attempt at quadratic or second linear factor $(x-1)$ or $(x-5)$ <u>from factor theorem</u> Must be written as product
(b)	$p(3) = 27 - 36 - 21 + k$ (Remainder) $= k - 30 = \underline{-20}$	M1 A1	 2	long division scores M0 Condone $k - 30$
(c)		B1 B1√ M1 A1	 4	Curve thro' 10 marked on y-axis **FT** their 3 roots marked on x-axis Cubic shape with a max and min Correct graph (roughly as on left) going beyond -2 and 5 (condone max anywhere between $x = -2$ and 1 and min between 1 and 5)
	Total		11	
2(a)(i)	$y = -\frac{3}{5}x + ...;$ Gradient $AB = -\frac{3}{5}$	M1 A1	 2	**Attempt** to find $y =$ or $\Delta y / \Delta x$ or $\frac{3}{5}$ or $3x/5$ Gradient correct – condone slip in $y = ...$
(ii)	$m_1 m_2 = -1$ Gradient of perpendicular $= \frac{5}{3}$ $\Rightarrow y + 2 = \frac{5}{3}(x-6)$	M1 A1√ A1	 3	Stated or used correctly **ft** gradient of AB **CSO** Any correct form eg $y = \frac{5}{3}x - 12$, $5x - 3y = 36$ etc
(b)	Eliminating x or y (unsimplified) $x = -9$ $y = 7$	M1 A1 A1	 3	Must use $3x + 5y = 8;\ 2x + 3y = 3$ $B\ (-9,7)$
(c)	$4^2 + (k+2)^2 \ (=25)$ or $16 + d^2 = 25$ $k = 1$ or $k = -5$	M1 A1 A1	 3	Diagram with 3,4, 5 triangle Condone slip in one term (or $k + 2 = 3$) **SC1** with no working for spotting one correct value of k. Full marks if both values spotted with no contradictory work
	Total		11	

Q	Solution	Marks	Total	Comments
3(a)	$\frac{\sqrt{5}+3}{\sqrt{5}-2} \times \frac{\sqrt{5}+2}{\sqrt{5}+2}$	M1		Multiplying top & bottom by $\pm(\sqrt{5}+2)$
	Numerator $= 5 + 3\sqrt{5} + 2\sqrt{5} + 6$	M1		Multiplying out (condone one slip) $\pm(\sqrt{5}+3)(\sqrt{5}+2)$
	$= 5\sqrt{5} + 11$	A1		
	Final answer $= 5\sqrt{5} + 11$	A1	4	With clear evidence that denominator =1
(b)(i)	$\sqrt{45} = 3\sqrt{5}$	B1	1	
(ii)	$\sqrt{20} = \sqrt{4}\sqrt{5}$ or $4\sqrt{5} = \sqrt{4} \times \sqrt{20}$ or attempt to have equation with $\sqrt{5}$ or $\sqrt{20}$ only	M1		Both sides
	$\left[x\,2\sqrt{5} = 7\sqrt{5} - 3\sqrt{5}\right]$ or $x\sqrt{20} = 2\sqrt{20}$	A1		or $x = \sqrt{4}$
	$x = 2$	A1	3	**CSO**
	Total		8	
4(a)	$(x+1)^2 + (y-6)^2$ $(1 + 36 - 12 = 25)$ RHS $= 5^2$	B2 B1	 3	B1 for one term correct or missing + sign Condone 25
(b)(i)	Centre $(-1, 6)$	B1√	1	**FT** their a and b from part (a) or correct
(ii)	Radius = 5	B1√	1	**FT** their r from part (a) RHS must be > 0
(c)	Attempt to solve "their" $x^2 + 2x + 12 = 0$	M1		Or comparing "their" $y_c = 6$ and their $r = 5$ may use a diagram with values shown
	(all working correct) so no real roots or statement that does not intersect	A1	2	$r < y_c$ so does not intersect condone $\pm$ 1 or $\pm$ 6 in centre for A1
(d)(i)	$(4-x)^2 = 16 - 8x + x^2$	B1		Or $(-2-x)^2 = 4 + 4x + x^2$
	$x^2 + (4-x)^2 + 2x - 12(4-x) + 12 = 0$ or $(x+1)^2 + (-2-x)^2 = 25$	M1		Sub $y = 4 - x$ in circle eqn (condone slip) or "their" circle equation
	$\Rightarrow 2x^2 + 6x - 20 = 0 \quad \Rightarrow x^2 + 3x - 10 = 0$	A1	3	**AG CSO** (must have = 0)
(ii)	$(x+5)(x-2) = 0 \quad \Rightarrow x = -5, x = 2$ Q has coordinates $(-5, 9)$	M1 A1	 2	Correct factors or unsimplified solution to quadratic (give credit if factorised in part (i)) <u>SC2</u> if Q correct. Allow x = –5 $y = 9$
(iii)	Mid point of 'their' $(-5, 9)$ and (2,2) $\left(-1\frac{1}{2}, 5\frac{1}{2}\right)$	M1 A1	 2	Arithmetic mean of **either** x or y coords Must follow from correct value in (ii)
	Total		14	

Q	Solution	Marks	Total	Comments
5(a)(i)	$2x^2 + 2xh + 4xh \quad (= 54)$	M1		Attempt at surface area (one slip)
	$\Rightarrow x^2 + 3xh = 27$	A1	2	**AG CSO**
(ii)	$h = \dfrac{27 - x^2}{3x}$ or $h = \dfrac{9}{x} - \dfrac{x}{3}$ etc	B1	1	Any correct form
(iii)	$V = 2x^2h \quad - \; 18x - \dfrac{2x^3}{3}$	B1	1	**AG** (watch fudging) condone omission of brackets
(b)(i)	$\dfrac{dV}{dx} = 18 - 2x^2$	M1 A1	2	One term correct "their" V All correct unsimplified $18 - 6x^2/3$
(ii)	Sub $x = 3$ into their $\dfrac{dV}{dx}$	M1		Or attempt to solve their $\dfrac{dV}{dx} = 0$
	Shown to equal 0 plus **statement** that this implies a stationary point if verifying	A1	2	**CSO** Condone $x = \pm 3$ or $x = 3$ if solving
(c)	$\dfrac{d^2V}{dx^2} = -4x$ $\quad (= -12)$	B1√		**FT** their $\dfrac{dV}{dx}$
	$\dfrac{d^2V}{dx^2} < 0$ at stationary point $\Rightarrow$ maximum	E1√	2	**FT** their second derivative conclusion If "their" $\dfrac{d^2y}{dx^2} > 0 \Rightarrow$ minimum etc
	Total		**10**	

Q	Solution	Marks	Total	Comments
6(a)(i)	$B\ (0,5)$	B1		
	Area $AOB = \frac{1}{2} \times 1 \times 5$	M1		Condone slip in number or a minus sign
	$= 2\frac{1}{2}$	A1	3	
(ii)	$\dfrac{3x^6}{6} + \dfrac{2x^2}{2} + 5x$ or $\dfrac{x^6}{2} + x^2 + 5x$ (may have $+ c$ or not)	M1 A1 A1	3	Raise one power by 1 One term correct All correct unsimplified
(iii)	Area under curve $= \displaystyle\int_{-1}^{0} f(x)\,dx$	B1		Correctly written or $F(0) - F(-1)$ correct
	$[0] - \left[\dfrac{1}{2} + 1 - 5\right]$	M1		Attempt to sub limit(s) of -1 (and 0) Must have integrated
	Area under curve $= 3\frac{1}{2}$	A1		**CSO** (no fudging)
	Area of shaded region $= 3\frac{1}{2} - 2\frac{1}{2} = 1$	B1√	4	**FT** their integral and triangle (very generous)
(b)(i)	$\dfrac{dy}{dx} = 15x^4 + 2$	M1 A1		One term correct All correct (no +c etc)
	when $x = -1$, gradient = 17	A1	3	**cso**
(ii)	$y =$ "their gradient"$(x + 1)$	B1√	1	Must be finding **tangent** – not normal any form e.g. $y = 17x + 17$
	Total		**14**	
7(a)	$b^2 - 4ac \quad = \quad 144 - 4(k+1)(k-4)$	M1		Clear attempt at $b^2 - 4ac$ Condone slip in one term of expression
	Real roots when $b^2 - 4ac \geqslant 0$	B1		Not just a statement, must involve k
	$36 - (k^2 - 3k - 4) \geqslant 0$ $\Rightarrow k^2 - 3k - 40 \leqslant 0$	A1	3	**AG** (watch signs carefully)
(b)	$(k - 8)(k + 5)$	M1		Factors attempt or formula
	Critical points 8 and –5	A1		
	Sketch or sign diagram **correct,** must have 8 and –5 $-5 \leqslant k \leqslant 8$	M1 A1	4	
	A0 for $-5 < k < 8$ or two separate inequalities unless word AND used			
	Total		**7**	
	TOTAL		**75**	