Revision Paper 3 - Answers

Question			Answer	Marks	Guidance	
1	(i)		1	1 [1]		
1	(ii)		27	2 [2]	condone ± 27; **B1** for $[\pm]3^3$ or $\sqrt{729}$ or for $\left[9^{\frac{1}{2}}=\right]3$ or ± 3 soi	
1	(iii)		$\frac{25}{16}$ or $1\frac{9}{16}$ isw	2 [2]	**B1** for $\frac{5}{4}$ or $\frac{1}{\frac{16}{25}}$ or $\frac{16}{25}$ oe	B0 for 1.5625 without fractions seen; if this is found, check for possible use of calculator throughout the paper
2			substitution to eliminate one variable simplification to $ax = b$ or $ax - b = 0$ form, or equivalent for y (9/7, 22/7) oe or $x = 9/7$ $y = 22/7$ oe isw	M1 M1 A2 [4]	or multiplication or division to make one pair of coefficients the same; condone one error in either method or appropriate subtraction / addition; condone one further error in either method **A1** each	 independent of first M1 A0 for just rounded decimals or for $-9/-7$ oe
3	(i)		$x < -11/2$ oe www as final answer	2 [2]	**M1** for $-2x > 11$ oe or $x < 11/-2$	if working with equals throughout, give 2 for correct final answer, 0 otherwise

Question			Answer	Marks	Guidance	
3	(ii)		$250c^{10}d^{-2}$ or $\frac{250c^{10}}{d^2}$ as final answer	2 [2]	**B1** for two correct elements; must be multiplied if B0, allow **SC1** for $125c^6d^3$ obtained from numerator or for all elements correct but added	
4			$a(2c-5) = 3c + 2a$ or $2ac - 5a = 3c + 2a$ $a(2c-5) - 2a = 3c$ or $2ac - 7a = 3c$ or ft $a(2c-7) = 3c$ or ft $[a =]\frac{3c}{2c-7}$ or simplified equivalent or ft as final answer	M1 M1 M1 M1 [4]	for multiplying up correctly (may also expand brackets) for collecting a terms on one side, remaining term[s] on other [need not be simplified] for factorising a terms, need not be simplified; may be implied by final answer for division by their two-term factor (accept a 3 term factor that would simplify to 2 terms); for all 4 marks to be earned, work must be fully correct and simplified and not have a triple-or quadruple-decker answer	annotate this question if partially correct ft only if two or more a terms ft only if two or more a terms, needing factorising may be earned before 2nd M1 candidates whose final answer expresses c in terms of a: treat as MR after the first common M and mark equivalently, applying MR−1 if they gain further Ms. So that a final answer, correctly obtained, of $[c =]\frac{7a}{2a-3}$ or simplified equivalent earns 3 marks in total
5	(i)		$11\sqrt{2}$	2 [2]	**M1** for $\left[\sqrt{50} =\right]5\sqrt{2}$ or $\left[3\sqrt{8} =\right]6\sqrt{2}$	

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5	(ii)		attempting to multiply numerator and denominator of fraction by $4+\sqrt{3}$ $2+\sqrt{3}$ or $2+1\sqrt{3}$ or $c = 2$ and $d = 1$ **or** cross-multiplying by $4-\sqrt{3}$ and forming a pair of simultaneous equations in c and d, with at most one error $c = 2$ and $d = 1$	M1 A2 M1 A2 [3]	 or **B1** for denominator = 13 soi or numerator = $26+13\sqrt{3}$ soi **A1** for one correct	

Question			Answer	Marks	Guidance	
6			$1 - 20x + 150x^2 - 500x^3 + 625x^4$ as final answer	4 [4]	part marks can be awarded for earlier stages if final answer incorrect or not fully simplified: **M3** for 4 terms correct or for all coefficients correct except for sign errors or for correct answer seen then further 'simplified' or for all terms correct eg seen in table but not combined (condone eg $+(-20x)$ or $+-20x$ instead of $-20x$) **M2** for 3 terms correct or for correct expansion seen without correct evaluation of coefficients [if brackets missing in elements such as $(-5x)^2$ there must be evidence from calculation that $25x^2$ has been used] binomial coefficients such as ${}^4C_2$ are not sufficient – must show understanding of these symbols by at least partial evaluation; or **M1** for 1 4 6 4 1 soi, eg in Pascal's triangle or in expansion where powers of 5 have been ignored	for binomial coefficients, ${}^4C_2$ or factorial notation is not sufficient but accept $\frac{4\times3\times2\times1}{2\times1\times2\times1}$ oe etc any who multiply out instead of using binomial coeffts: look at their final answer and mark as per main scheme if 3 or more terms are correct, otherwise M0

Question			Answer	Marks	Guidance	
7	(i)		$[x =]$ 5, $[x =] -1$ www	2 [2]	**M1** for $x - 2 = \pm3$ or for $(x - 5)(x + 1)$ [=0]	0 for just $x = 5$ or for $x - 2 = 3$
7	(ii)		parabola shape curve the correct way up	1	must extend beyond x-axis;	condone 'U' shape or very slight curving back in/out; condone some doubling / feathering – deleted work sometimes still shows up in rm assessor; must not be ruled; condone fairly straight with clear attempt at curve at minimum; be reasonably generous on attempt at symmetry e.g. condone minimum on y-axis for this mark
			intersecting x-axis at 5 and -1 or ft from (i) and y-axis at -5	1		
			turning point $(2, -9)$	1 [3]	seen on graph or identified as tp elsewhere in this part	may be implied by 2 and -9 marked on axes 'opposite' turning point
8			$8 + 2a + c = 11$	B1	accept 2^3 instead of 8	
			$-1 - a + c = 8$	B1	or $c - (a + 1) = 8$ oe (often from division) accept $(-1)^3$ instead of -1	
			Correct method for eliminating one variable, condoning one further error	M1	dep on two equations in a and c and at least B1 earned	
			$a = -2$, $c = 7$	A2 [5]	**A1** for one correct	
9	(i)		-5.7 to -5.8, -2.2 to -2.3, -1 isw	2 [2]	**B1** for 2 correct or for all 3 only stated in coordinate form, ignoring y coordinates	

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9	(ii)		$1=(x+2)(x^2+7x+7)$	M1	condone missing brackets if expanded correctly; or **M1** for correct expansion of $(x+2)(x^2+7x+7)$	
			correct completion with at least one interim stage of working to given answer: $x^3+9x^2+21x+13=0$	A1		
			[$x=-1$ is root so] $(x+1)$ is factor soi	M1	implied by division of cubic by $x+1$	condone some confusion of root/factor for this mark if division of cubic by $x+1$ seen
			correctly finding other factor as $x^2+8x+13$	M2	**M1** for correct division of cubic by $(x+1)$ as far as obtaining x^2+8x (may be in grid) or for two correct terms of $x^2+8x+13$ obtained by inspection	allow seen in grid without + signs
			$\frac{-8\pm\sqrt{8^2-4\times13}}{2}$ oe	M1	for use of formula, condoning one error, for $x^2+8x+13=0$	or **M1** for $(x+4)^2=4^2-13$ oe or further stage, condoning one error
			$\frac{-8\pm\sqrt{12}}{2}$ isw or $-4\pm\sqrt{3}$ isw and $x=-1$	A1 [7]	$x=-1$ may be stated earlier	isw wrong simplification or giving as coordinates

Question			Answer	Marks	Guidance	
9	(iii)	A	drawing the translated quadratic or showing that the horizontal gap between the relevant parts of the curve is always less than 3	B1	must be a reasonable translation of given quadratic, only intersecting given curve once; intersections with x axis -3 to -2.5 and 1.5 to 2; ignore above $y=1$	
			estimated coordinates of the point of intersection (1.8 to 2, 0.2 to 0.3)	B1 [2]		
9	(iii)	B	$y=x^2+x-5$ or $y=\left(x+\frac{1}{2}\right)^2-\frac{21}{4}$	2 [2]	**M1** for $[y=](x-3)^2+7(x-3)+7$ oe or for simplified equation with '$y=$' omitted or for $y=(x-a)(x-b)$ where a and b are the values $3+\frac{-7\pm\sqrt{21}}{2}$ oe (may have been wrongly simplified)	M0 for use of estimated roots in (*A*)

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10	(i)		[Grad AB =] $\frac{7-3}{2-0}$ or $\frac{4}{2}$	M1		
			[Grad BC =] $\frac{-1-3}{8-0}$ or $\frac{-4}{8}$	M1		allow just a simplified version of 2 or $-½$ for one method mark, but for both to be gained, there must be evidence that the gradients have been obtained independently
			product of gradients = -1 [when lines are at right angles]	A1	or 'negative reciprocal [so perpendicular]' oe; may be implied by correct calculation	may be seen earlier, but correct working must support the statement
			or	**or**		
			$AB^2=2^2+4^2$ [=20] , $BC^2=8^2+4^2$ [=80] and $AC^2=6^2+8^2$ [= 100]	M2	or equiv for AB etc; allow at unsimplified stage; or **M1** for just one correct expression for one of the sides	allow just a simplified version of eg $AB^2=20$ for one method mark, but for both to be gained, there must be evidence that the lengths or their squares have been obtained independently
			$AB^2+BC^2=AC^2$ [so by Pythagoras, angle ABC = 90°] oe	A1	may be implied by correct calculation	may be seen earlier, but correct working must support the statement
						another possible method: M1 for finding midpt ofAC as (5, 3), M1 for showing dist from midpt to A, B and C is 5 and M1 for using angle in a semicircle to show that ABC = 90°
				[3]		

Question			Answer	Marks	Guidance	
10	(ii)		centre D $= \left(\frac{2+8}{2}, \frac{7+-1}{2}\right)$ or (5, 3) soi	B1	may be implied by circle eqn	if already found in (i), must be used in (ii) to get the mark here
			radius = 5 or $r^2 = 25$ or for finding dist between A, B or C and their centre D oe	B1	may be implied by circle eqn	if already found in (i), must be used in (ii) to get the mark here
			$(x-a)^2 + (y-b)^2 = r^2$ soi	M1	general formula may be quoted or implied by eqn using their values, but it must be clear that they are using their r^2 rather than their r or their d or d^2	for this method mark, allow use of their values, even if obtained from AB or BC as diameter
			$(x-5)^2 + (y-3)^2 = 25$ or 5^2 isw	A1	alternative method: allow B4 for $(y-7)(y+1)+(x-2)(x-8)=0$	
				[4]		
10	(iii)		[grad AD =] $\frac{7-3}{2-5}$ isw or $-\frac{4}{3}$ oe	B1	or may use CD $\left(\frac{-1-3}{8-5}\right)$, AC $\left(\frac{7-(-1)}{2-8}\right)$ or ft their D from (ii) or **B1** for correct differentiation: $2x + 2y\frac{dy}{dx} - 10 - 6\frac{dy}{dx} = 0$ oe	if D wrong, check back to (ii) for any ft NB: A(2, 7) B(0, 3) and C(8, –1)
			grad tgt = ¾ oe www or –1/ their grad AD oe	M1		
			$y - 7 =$ their ¾ $(x - 2)$ or $7 =$ their $\frac{3}{4} \times 2 + c$	M1	**M0** if grad AD used; **M0** for a spurious gradient used	perp gradient to AB or BC used: may earn 2nd M1 only
			$4y = 3x + 22$ oe where a, b, c are integers, isw	A1	allow correct answer to imply 3rd M1, provided first two Ms have been earned	
				[4]		

Question			Answer	Marks	Guidance	
11	(i)		(0, –3)	B1	condone $y = -3$, isw	if not coordinates, must be clear which is x and which is y
			(– ½ , 0) and (3, 0) www	B2	condone $x = -½$ and 3; **B1** for one correct www or **M1** for $(2x + 1)(x - 3)$ or correct use of formula or reversed coordinates	
				[3]		
11	(ii)		$2x^2 - 6x - 6[= 0]$ isw or $x^2 - 3x - 3$ [= 0] or $2y^2 - 18y + 30$ [=0]	M1	for equating curve and line, and rearrangement to zero, condoning one error	allow rearranging to constant if they go on to attempt completing the square
			use of formula or completing the square, with at most one error	M1	no ft from $2x^2 - 6x = 0$ or other factorisable equations	if completing the square must get to the stage of complete square only on lhs as in 9(ii)
			$\left(\frac{6 \pm \sqrt{84}}{4}, \frac{18 \pm \sqrt{84}}{4}\right)$ or $\left(\frac{3 \pm \sqrt{21}}{2}, \frac{9 \pm \sqrt{21}}{2}\right)$ oe isw	A2	**A1** for one set of coords or for x values correct (or ys from quadratic in y); need not be written as coordinates	A0 for unsimplified y coords eg $\frac{3+\sqrt{21}}{2} + 3$
				[4]		

Question			Answer	Marks	Guidance	
11	(iii)		$2x^2 - 5x - 3 = x + k$	M1	for equating curve and line	
			$2x^2 - 6x - 3 - k$ [= 0]	M1	for rearrangement to zero, condoning one error, but must include k ;this second M1 implies the first, eg it may be obtained by subtracting the given equations	
			$b^2 - 4ac < 0$ oe for non-intersecting lines	M1	eg allow for just quoting this condition; may be earned near end with correct inequality sign used there allow 'discriminant is negative' if further work implies $b^2 - 4ac$	some may use condition for intersecting lines or for a tangent and then swap condition at the end; only award this M1 and the final A mark if the work is completely clear
			$36 - 8 \times -(3 + k)$ [< 0] oe	A1	for correct substitution into $b^2 - 4ac$; no ft from wrong equation; if brackets missing or misplaced, must be followed by a correct simplified version	can be earned with equality or wrong inequality, or in formula – this mark is not dependent on the 3rd M mark;
			$k < -\frac{15}{2}$ oe	A1	isw if 3rd M1 not earned, allow **B1** for $-\frac{15}{2}$ obtained for k with any symbol	

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11	(iii) cont		or, for those using a tangent condition with trials to find the boundary value			mark one mark scheme or another, to the advantage of the candidate, but not a mixture of schemes
			rearrangement with correct boundary value of k eg $2x^2 - 6x + 4.5$ [= 0] or $2x^2 - 6x - (3 - 7.5)$ [= 0]	M2	**M1** for $2x^2 - 5x - 3 = x - 7.5$	M0 for trials with wrong values without further progress, though may still earn an M1 for $b^2 - 4ac < 0$
			showing $36 - 8 \times -(3 - 7.5) = 0$ or $36 - 8 \times 4.5 = 0$ oe	M1	may be in formula implies previous M2	
			$k < -\frac{15}{2}$ oe	A2	**B1** for $-\frac{15}{2}$ obtained for k as final answer with any symbol	
			or, for using tangent with differentiation			
			$y' = 4x - 5$	M1		
			[when $y = x + k$ is tgt] $4x - 5 = 1$	M1		
			$x = 1.5, y = -6$	A1		
			$-6 = 1.5 + k$ or $k = -7.5$ oe	A1		
			$k < -7.5$ oe	A1		
				[5]		