Mark Scheme 4751
June 2006

Section A

1	$[r] = [\pm]\sqrt{\frac{3V}{\pi h}}$ o.e. 'double-decker'	3	2 for $r^2 = \frac{3V}{\pi h}$ or $r = \sqrt{\frac{V}{\frac{1}{3}\pi h}}$ o.e. or M1 for correct constructive first step or for $r = \sqrt{k}$ ft their $r^2 = k$	3
2	a = ¼	2	M1 for subst of −2 or for −8 + 4a + 7 = 0 o.e. obtained eg by division by (x + 2)	2
3	3x + 2y = 26 or y = −1.5x + 13 isw	3	M1 for 3x + 2y = c or y = −1.5x + c M1 for subst (2, 10) to find c or for or for y − 10 = their gradient × (x − 2)	3
4	(i) P ⇐ Q (ii) P ⇔ Q	1 1	condone omission of P and Q	2
5	x + 3(3x + 1) = 6 o.e. 10x = 3 or 10y = 19 o.e. (0.3, 1.9) or x = 0.3 and y = 1.9 o.e.	M1 A1 A1	for subst or for rearrangement and multn to make one pair of coefficients the same or for both eqns in form 'y =' (condone one error) graphical soln: (must be on graph paper) M1 for each line, A1 for (0.3, 1.9) o.e cao; allow B3 for (0.3, 1.9) o.e.	3
6	−3 < x < 1 [condone x < 1, x > −3]	4	B3 for −3 and 1 or M1 for x^2 + 2x − 3 [< 0]or (x + 1)^2 < / = 4 and M1 for (x + 3)(x − 1) or x= (−2 ±4)/2 or for (x + 1) and ±2 on opp. sides of eqn or inequality; if 0, then SC1 for one of x < 1, x > −3	4
7	(i) 28√6 (ii) 49 − 12√5 isw	2 3	1 for 30√6 or 2√6 or 2√2√3 or 28√2√3 2 for 49 and 1 for − 12√5 or M1 for 3 correct terms from 4 − 6√5 − 6√5 + 45	5
8	20 −160 or ft for −8 × their 20	2 2	0 for just 20 seen in second part; M1 for 6!/(3!3!) or better condone −160x^3; M1 for [–]2^3 × [their] 20 seen or for [their] 20 × (−2x)^3; allow B1 for 160	4
9	(i) 4/27 (ii) 3$a^{10}b^8c^{-2}$ or $\frac{3a^{10}b^8}{c^2}$	2 3	1 for 4 or 27 2 for 3 'elements' correct, 1 for 2 elements correct, −1 for any adding of elements; mark final answer; condone correct but unnecessary brackets	5
10	x^2 + 9x^2 = 25 10x^2 = 25 x= ±(√10)/2 or.±√(5/2) or ±5/√10 oe y = [±] 3√(5/2) o.e. eg y = [±] √22.5	M1 M1 A2 B1	for subst for x or y attempted or x^2 = 2.5 o.e.; condone one error from start [allow 10x^2 − 25 = 0 + correct substn in correct formula] allow ±√2.5; A1 for one value ft 3 × their x value(s) if irrational; condone not written as coords.	5

Section B

11	**i**	grad AB = 8/4 or 2 or $y = 2x - 10$ grad BC = 1/–2 or – ½ or $y = -\frac{1}{2}x + 2.5$ product of grads = –1 [so perp] (allow seen or used)	1 1 1	or M1 for $AB^2 = 4^2 + 8^2$ or 80 and $BC^2 = 2^2 + 1^2$ or 5 and $AC^2 = 6^2 + 7^2$ or 85; M1 for $AC^2 = AB^2 + BC^2$ and 1 for [Pythag.] true so AB perp to BC; if 0, allow G1 for graph of A, B, C	3
	ii	midpt E of AC = (6, 4.5) $AC^2 = (9-3)^2 + (8-1)^2$ or 85 rad = ½ √85 o.e. $(x-6)^2 + (y-4.5)^2 = 85/4$ o.e. $(5-6)^2 + (0-4.5)^2 = 1 + 81/4$ [= 85/4]	1 M1 A1 B2 1	allow seen in (i) only if used in (ii); or $AE^2 = (9 - \text{their } 6)^2 + (8 - \text{their } 4.5)^2$ or rad.^{2} = 85/4 o.e. e.g. in circle eqn M1 for $(x-a)^2 + (y-b)^2 = r^2$ soi or for lhs correct some working shown; or 'angle in semicircle [=90°]'	6
	iii	$\overrightarrow{BE} = \overrightarrow{ED} = \begin{pmatrix} 1 \\ 4.5 \end{pmatrix}$ D has coords (6 + 1, 4.5 + 4.5) ft or (5 + 2, 0 + 9) = (7, 9)	M1 M1 A1	o.e. ft their centre; or for $\overrightarrow{BC} = \begin{pmatrix} -2 \\ 1 \end{pmatrix}$ or (9 − 2, 8 + 1); condone mixtures of vectors and coords. throughout part iii allow B3 for (7,9)	3
12	**i**	f(–2) used –8 + 36 – 40 + 12 = 0	M1 A1	or M1 for division by (x + 2) attempted as far as $x^3 + 2x^2$ then A1 for $x^2 + 7x +$ 6 with no remainder	2
	ii	divn attempted as far as $x^2 + 3x$ $x^2 + 3x + 2$ or $(x + 2)(x + 1)$	M1 A1	or inspection with $b = 3$ or $c = 2$ found; B2 for correct answer	2
	iii	$(x + 2)(x + 6)(x + 1)$	2	allow seen earlier; M1 for $(x + 2)(x + 1)$	2
	iv	sketch of cubic the right way up through 12 marked on y axis intercepts –6, –2, –1 on x axis	G1 G1 G1	with 2 turning pts; no 3rd tp curve must extend to $x > 0$ condone no graph for $x < -6$	3
	v	$[x](x^2 + 9x + 20)$ $[x](x + 4)(x + 5)$ $x = 0, -4, -5$	M1 M1 A1	or other partial factorisation or B1 for each root found e.g. using factor theorem	3
13	**i**	$y = 2x + 3$ drawn on graph x = 0.2 to 0.4 and – 1.7 to –1.9	M1 A2	1 each; condone coords; must have line drawn	3
	ii	$1 = 2x^2 + 3x$ $2x^2 + 3x - 1$ [= 0] attempt at formula or completing square $x = \frac{-3 \pm \sqrt{17}}{4}$	M1 M1 M1 A2	for multiplying by x correctly for correctly rearranging to zero (may be earned first) or suitable step re completing square if they go on ft, but no ft for factorising A1 for one soln	5
	iii	branch through (1,3), branch through (−1,1),approaching y = 2 from below	1 1	and approaching y = 2 from above and extending below x axis	2
	iv	–1 and ½ or ft intersection of their curve and line [tolerance 1 mm]	2	1 each; may be found algebraically; ignore y coords.	2