

Question			Answer	Marks	Guidance	Question
1	(i)		$-31 + 6\sqrt{5}$	3  [3]	<b>B2</b> for $-31$ or <b>B1</b> for $9 - 40$ or <b>SC1</b> for $49$ and <b>B1</b> for $6\sqrt{5}$  if 0, allow <b>M1</b> for three terms correct in $9 - 6\sqrt{5} + 12\sqrt{5} - 40$	
1	(ii)		$22\sqrt{2}$	2  [2]	<b>M1</b> for $\sqrt{72} = 6\sqrt{2}$ soi or for $\frac{32}{\sqrt{2}} = 16\sqrt{2}$  soi or for $\frac{12 + 32}{\sqrt{2}}$ oe	

2	(i)		$61 - 28\sqrt{3}$	3  [3]	<b>B2</b> for $61$ or <b>B1</b> for $49 + 12$ found in expansion (may be in a grid)  and <b>B1</b> for $-28\sqrt{3}$  if <b>B0</b> , allow <b>M1</b> for at least three terms correct in $49 - 14\sqrt{3} - 14\sqrt{3} + 12$  the correct answer obtained then spoilt earns <b>SC2</b> only	
2	(ii)		$4\sqrt{3}$	2  [2]	<b>M1</b> for $\sqrt{50} = 5\sqrt{2}$ or $\sqrt{300} = 10\sqrt{3}$ or $20\sqrt{300} = 200\sqrt{3}$ or $\sqrt{48} = 2\sqrt{12}$ seen	

<b>3</b>			$r = \sqrt{\frac{3V}{\pi(a+b)}}$ oe www as final answer	<b>3</b>       <b>[3]</b>	M1 for dealing correctly with 3  and M1 for dealing correctly with $\pi(a+b)$ , ft  and M1 for correctly finding square root, ft <i>their</i> ' $r^2 =$ '; square root symbol must extend below the fraction line	M0 if triple-decker fraction, at the stage where it happens, then ft;  condone missing bracket at rh end  M0 if $\pm \dots$ or $r > \dots$  for M3, final answer must be correct
----------	--	--	---	--	---	--

<b>4</b>	<b>(i)</b>		$5^{3.5}$ oe or $k = 7/2$ oe	<b>2</b>   <b>[2]</b>	M1 for $125 = 5^3$ or $\sqrt{5} = 5^{\frac{1}{2}}$ soi	M0 for just answer of $5^3$ with no reference to 125
----------	------------	--	------------------------------	--------------------------------	--	--

<b>4</b>	<b>(ii)</b>		attempting to multiply numerator and denominator of fraction by $1 + 2\sqrt{5}$   denominator = $-19$ soi   $8 + 3\sqrt{5}$	M1   M1   A1 <b>[3]</b>	must be obtained correctly, but independent of first M1	some cand's are incorporating the $10 + 7\sqrt{5}$ into the fraction. The M1s are available even if this is done wrongly or if $10 + 7\sqrt{5}$ is also multiplied by $1 + 2\sqrt{5}$  eg M1 for denominator of 19 with a minus sign in front of whole expression or with attempt to change signs in numerator
----------	-------------	--	---	--	---	--

5	(i)		$9\sqrt{3}$ www oe as final answer	2  [2]	M1 for $\sqrt{48} = 4\sqrt{3}$ or $\sqrt{75} = 5\sqrt{3}$ soi	
5	(ii)		$\frac{39 + 7\sqrt{5}}{44}$ www as final answer	3  [3]	M1 for attempt to multiply numerator and denominator by $7 - \sqrt{5}$  B1 for each of numerator and denominator correct (must be simplified)	condone $\frac{39}{44} + \frac{7\sqrt{5}}{44}$ for 3 marks  eg M0B1 if denominator correctly rationalised to 44 but numerator not multiplied

6			$[b =] \pm \sqrt{\frac{3a}{2c}}$ oe www	3  [3]	M2 for $[b^2 =] \frac{3a}{2c}$ soi  or M1 for other $[b^2 =] \frac{ka}{c}$ or $[b^2 =] \frac{a}{kc}$ oe  and M1 for correctly taking the square root of their $b^2$ , including the $\pm$ sign;	eg M2 for $[b =] \sqrt{\frac{3a}{2c}}$  allow M1 for a triple-decker or quadruple-decker fraction or decimals eg $\frac{1.5a}{c}$ , if no recovery later  square root must extend below the fraction line
---	--	--	---	--------------	---	--

Question		er	Marks	Guidance		
7	(i)		23 + $\sqrt{2}$ as final answer	3	B2 for 23 and B1 for $\sqrt{2}$ or $1\sqrt{2}$ or M2 for 3 or more terms correct of $35 - 14\sqrt{2} + 15\sqrt{2} - 12$ or M1 for 2 terms correct	mark one scheme or other, but not a mixture, to advantage of candidate  eg M2 for $35 + \sqrt{2} + 24$
				[3]		
7	(ii)		$5\sqrt{6}$ isw	2	condone $\frac{30}{\sqrt{6}}$ for 2 marks  M1 for $[\sqrt{54} = ]3\sqrt{6}$ or $[\frac{12}{\sqrt{6}} = ]2\sqrt{6}$	eg 2 isw for $5\sqrt{6} = \sqrt{150}$
				[2]		

8	$\frac{3V}{\pi r^2} = \sqrt{l^2 - r^2}$ $\left(\frac{3V}{\pi r^2}\right)^2 = l^2 - r^2$ $l^2 = \left(\frac{3V}{\pi r^2}\right)^2 + r^2$ $[l = ]\sqrt{\left(\frac{3V}{\pi r^2}\right)^2 + r^2}$	<b>M1</b>  <b>M1</b>  <b>M1</b>  <b>M1</b>	for correctly getting non- ' $l^2 - r^2$ ' terms on other side [M0 for 'triple decker' fraction]  oe or ft; for squaring correctly  oe or ft; for getting $l$ term as subject  oe. or ft; mark final answer; for finding square root ( and dealing correctly with coefficient of $l$ term if needed at this stage); condone $\pm\sqrt{\text{etc}}$	may be done in several steps, if so, condone omission of brackets in eg $9V^2 = \pi^2 r^4 l^2 - r^2$ if they recover – if not, do not give 1 <sup>st</sup> <b>M1</b> [but can earn the 2 <sup>nd</sup> <b>M1</b> ]  for combined steps, allow credit for correct process where possible;  eg $\pi^2 r^4 l^2$ as the term on one side  For <b>M4</b> , the final expression must be totally correct, [condoning omission of $l$ and insertion of $\pm$ ]  eg <b>M4</b> for $\frac{\sqrt{9V^2 + \pi^2 r^6}}{\pi r^2}$
---	--	--	--	---

<b>9</b>	<b>(i)</b>	$7\sqrt{3}$	<b>2</b>	<b>M1</b> for $\sqrt{48} = 4\sqrt{3}$ or $\sqrt{27} = 3\sqrt{3}$
<b>9</b>	<b>(ii)</b>	$\frac{10+15\sqrt{2}}{7}$ www isw	<b>3</b>	<b>B1</b> for 7 [B0 for 7 wrongly obtained]  and <b>B2</b> for $10+15\sqrt{2}$ or <b>B1</b> for one term of numerator correct;  if <b>B0</b> , then <b>M1</b> for attempt to multiply num and denom by $3+\sqrt{2}$

<b>10</b>	(i)	2 www	2	M1 for $4/6$ or for $\sqrt{48} = 2\sqrt{12}$ or $4\sqrt{3}$ or $\sqrt{27} = 3\sqrt{3}$ or $\sqrt{108} = 3\sqrt{12}$ or for $\sqrt{\frac{4}{9}}$	5
	(ii)	$43 - 30\sqrt{2}$ www as final answer	3	M2 for 3 terms correct of $25 - 15\sqrt{2} - 15\sqrt{2} + 18$ soi, M1 for 2 terms correct	

<b>11</b>	(i)	$9\sqrt{3}$	2	M1 for $5\sqrt{3}$ or $4\sqrt{3}$ seen	5
	(ii)	6 $\sqrt{2}$ www	3	M1 for attempt to multiply num. and denom. by $3 + \sqrt{2}$ and M1 for denom. 7 or $9 - 2$ soi from denom. mult by $3 + \sqrt{2}$	

12	(i) $\frac{5-\sqrt{3}}{22}$ or $\frac{5+(-1)\sqrt{3}}{22}$ or $\frac{5-1\sqrt{3}}{22}$	2	or $a = 5, b = -1, c = 22$ ; M1 for attempt to multiply numerator and denominator by $5-\sqrt{3}$	5
	(ii) $-12\sqrt{7}$ isw www	3	2 for 37 and 1 for $-12\sqrt{7}$ or M1 for 3 correct terms from $9 - 6\sqrt{7} - 6\sqrt{7} + 28$ or $9 - 3\sqrt{28} - 3\sqrt{28} + 28$ or $9 - \sqrt{252} - \sqrt{252} + 28$ o.e. eg using $2\sqrt{63}$ or M2 for $9 - 12\sqrt{7} + 28$ or $9 - 6\sqrt{28} + 28$ or $9 - 2\sqrt{252} + 28$ or $9 - \sqrt{1008} + 28$ o.e.; 3 for $37 - \sqrt{1008}$ but not other equivs	

13	$[v =][\pm]\sqrt{\frac{2E}{m}}$ www	3	M2 for $v^2 = \frac{2E}{m}$ or for $[v =][\pm]\sqrt{\frac{E}{\frac{1}{2}m}}$ or M1 for a correct constructive first step and M1 for $v = [\pm]\sqrt{k}$ ft their $v^2 = k$ ; if M0 then SC1 for $\sqrt{E/\frac{1}{2}m}$ or $\sqrt{2E/m}$ etc	3
----	-------------------------------------	---	---	---

14	$t = [\pm]\sqrt{\frac{2s}{a}}$ o.	3	B2 for $t$ omitted or $t = \sqrt{\frac{s}{\frac{1}{2}a}}$ o. M1 for correct constructive first step in rearrangement and M1 (indep) for finding sq rt of their $t^2$	3
----	-----------------------------------	---	---	---

<b>15</b>	(i) $\sqrt{2}$ or $\sqrt{8}$	2	M1 for $7\sqrt{2}$ or $5\sqrt{2}$ seen	5
	(ii) $-12\sqrt{5}$	3	M1 for attempt to multiply num. and denom. by $2 - \sqrt{5}$ and M1 (dep) for denom $-1$ or $4 - 5$ soi or for numerator $12\sqrt{5} - 30$	

<b>16</b>	$[r] = [\pm] \sqrt{\frac{3V}{\pi h}}$ o.e. 'double-decke	3	2 for $r^2 = \frac{3V}{\pi h}$ or $r = \sqrt{\frac{V}{\frac{1}{3}\pi h}}$ o.e. or for correct constructive first step or for $r = \sqrt{k}$ ft their $r^2 = k$	3
-----------	--	---	--	---

<b>17</b>	(i) $\sqrt{2}$	2	M1 for $\sqrt{8}=2\sqrt{2}$ or $\sqrt{50} = 5\sqrt{2}$ soi	5
	(ii) $\frac{1}{11} + \frac{2}{11}\sqrt{3}$ or $\frac{3}{33} + \frac{6}{33}\sqrt{3}$ or mixture of these	3	B1 for $6\sqrt{50}$ or other correct $a\sqrt{b}$ M1 for mult num and denom by $6+\sqrt{3}$ and M1 for denom = 11 or 33	