1. Write $(1 + \sqrt{3})^2$ in the form $a + b\sqrt{3}$.

_____ [3]

2. Find $\sqrt{32} + \sqrt{50}$, giving your answer in the form $k\sqrt{2}$.

_____ [2]

3(a). B0, B1, B2, ... , B10 are labels given to different sized sheets of paper.
The lengths of the sheets are related as follows:

$$\boxed{\text{Length of B10}} \times \sqrt{2} = \boxed{\text{Length of B9}}$$

$$\boxed{\text{Length of B9}} \times \sqrt{2} = \boxed{\text{Length of B8}}$$

and so on from B10, the smallest size, up to B0 the largest size.

The length of B7 paper is 125 mm.

(i) What is the **exact** length of B6 paper?

(i) _____ mm **[1]**

(ii) What is the length of B5 paper?
Give your answer in its simplest form.

(ii) _____ mm **[2]**

(b). The length of B1 paper is 1000 mm.

Find the length of B2 paper.

Give your answer in the form $k\sqrt{2}$, where k is an integer.

_____ mm **[3]**

4. Simplify the following, giving your answer in the form $k\sqrt{2}$, where k is an integer.

$$8\sqrt{50}+\frac{30}{\sqrt{2}}$$

_____ [4]

5. Multiply out and simplify.

$$(4 + \sqrt{3})(1 - \sqrt{3})$$

Give your answer in the form $a + b\sqrt{3}$ where *a* and *b* are integers.
Show all your working.

_____ [3]

6. Multiply out and simplify fully.

$$(3 + \sqrt{7})(4 + \sqrt{7})$$

You must show your working.

_____ [2]

7(a). Expand and simplify.

$$(1 + \sqrt{3})(4 + 2\sqrt{3})$$

_____ [2]

(b). Rationalise the denominator in this expression.

$$\frac{3 + \sqrt{2}}{\sqrt{2}}$$

_____ [2]

8.

Simplify fully.

(i) $\sqrt{50}+\sqrt{2}$

(i) _____ [2]

(ii) $\frac{10}{\sqrt{6}}$

(ii) _____ [2]

9.

Write $\sqrt{12}+\sqrt{75}$ in the form $k\sqrt{3}$

_____ [3]

10.

Show that $\frac{(4+2\sqrt{5})}{\sqrt{5}-1}$ can be simplified to $\frac{3\sqrt{5}+7}{2}$. **[4]**

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Part marks and guidance	
1			$4+2\sqrt{3}$	3	M1 for expanding $(1+\sqrt{3})^2 = 1+\sqrt{3}+\sqrt{3}+\sqrt{3}\times\sqrt{3}$ **B1** for $\sqrt{3}\times\sqrt{3}=3$ **soi**	
			Total	3		
2			$9\sqrt{2}$	2	**M1** for $\left[\sqrt{32}\right]=4\sqrt{2}$ or $\left[\sqrt{50}\right]=5\sqrt{2}$	nfww but $4+\sqrt{2}$ etc loses 1 mark eg $4+\sqrt{2}+5+\sqrt{2}=9\sqrt{2}$ scores 1, $4+\sqrt{2}=4\sqrt{2}$ does not score Examiner's Comments More able candidates dealt with both terms and successfully collected them. The $5\sqrt{2}$ was found more often than the $4\sqrt{2}$. Less able candidates combined the 32 and 50 before attempting to square root. This often resulted in an incorrect answer of $41\sqrt{2}$ from $\sqrt{82}$ but those giving the correct answer of $9\sqrt{2}$ from this method did not score.
			Total	2		
3	a	i	$125\sqrt{2}$ final answer	1		

Question			Answer/Indicative content	Marks	Part marks and guidance	
		ii	250	2	M1 for *their* (i) × $\sqrt{2}$ Examiner's Comments The word 'exact' in the question was significant only to the strongest candidates who had little difficulty in achieving 3 correct answers. However many candidates gave answers to multiple decimal places. In part (i), many candidates spoiled a correct answer by trying to 'evaluate' 125√2. Common errors involved attempts at √125 and common wrong answers were √250, 250 or 62.5. Many managed to get a follow through mark in part (ii) for their answer to (i) × √2.	
	b		$500\sqrt{2}$	3	M2 for $\frac{1000}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$ or better Or M1 for $\frac{1000}{\sqrt{2}}$ oe Examiner's Comments Many candidates gained 1 mark for $\frac{1000}{\sqrt{2}}$, although many did 1000×√2 by mistake. The better candidates knew that numerator and denominator needed multiplying by √2 and generally went on to give the correct answer.	
			Total	6		

Question			Answer/Indicative content	Marks	Part marks and guidance	
4			$55\sqrt{2}$	4	Or **B1** for $5\sqrt{2}$ or $40\sqrt{2}$ And **M1A1** for $\frac{30\sqrt{2}}{\sqrt{2}\sqrt{2}} = 15\sqrt{2}$ **Examiner's Comments** This question differentiated well with some stronger candidates successfully arriving at the correct answer. Many gained a mark for knowing to multiply $\frac{30}{\sqrt{2}}$ by $\frac{\sqrt{2}}{\sqrt{2}}$ but many of these did not get the second mark for cancelling $\frac{30\sqrt{2}}{2} = 15\sqrt{2}$. While others gained a mark for knowing $\sqrt{50} = 5\sqrt{2}$ many spoilt this by adding the 8 and writing $13\sqrt{2}$ instead of $8\times5\sqrt{2}$. Answer: $55\sqrt{2}$	
			Total	4		

Question			Answer/Indicative content	Marks	Part marks and guidance	
5			$4, -4\sqrt{3}$, [+][1] $\sqrt{3}$, $-\sqrt{3}\sqrt{3}$ all seen $1 - 3\sqrt{3}$	M2 B1	M1 for two of $4, -4\sqrt{3}$, [+][1] $\sqrt{3}$, $-\sqrt{3}\sqrt{3}$ seen **Examiner's Comments** There were many correct answers here, though often these were obtained using a calculator. Most knew how to multiply out two brackets but many could not do this correctly. Frequently, negative signs were omitted and problems also occurred when collecting terms.	Allow –3 or $-\sqrt{9}$ or $-\sqrt{3^2}$ for $-\sqrt{3}\sqrt{3}$
			Total	3		
6			Three of 3 × 4; 3 × √7; 4 × √7; √7 × √7 oe 19 + 7√7 final answer	M1 B1	**Examiner's Comments** This question was answered well. Most obtained the correct answer and those who decided to give their answer as a decimal usually did so after correctly multiplying out the brackets. Surprisingly, some left their answer as 12 + 7√7 + 7and others had difficulty in finding 3√7 + 4√7.	
			Total	2		

Question			Answer/Indicative content	Marks	Part marks and guidance	
7	a		$10 + 6\sqrt{3}$	2	M1 for three correct terms from 4 [+] $2\sqrt{3}$ [+] $4\sqrt{3}$ [+] $2\sqrt{3}$ $\sqrt{3}$ oe or better Examiner's Comments Many were able to expand the brackets and produce four terms, although they did struggle to simplify $2\sqrt{3} \times \sqrt{3}$ and $2\sqrt{6}$ was a common response. It was also surprising that having reached $4 + 6\sqrt{3} + 6$ many did not simplify this expression.	eg $2\sqrt{9}$ is acceptable for $2\sqrt{3}\ \sqrt{3}$
	b		$\frac{2+3\sqrt{2}}{2}$ oe	2	M1 for $\frac{(3+\sqrt{2})\times\sqrt{2}}{\sqrt{2}\times\sqrt{2}}$ oe Examiner's Comments Many knew they had to multiply the numerator and denominator by $\sqrt{2}$ but they only multiplied the 3 by $\sqrt{2}$ and not the $\sqrt{2}$ as well. Some just cancelled the two $\sqrt{2}$ s and gave the answer as 3.	ie for intention to multiply top and bottom by $\sqrt{2}$
			Total	4		

Question			Answer/Indicative content	Marks	Part marks and guidance	
8		i	$6\sqrt{2}$ final answer	2	M1 for $\sqrt{25\times 2}$ or better seen **Examiner's Comments** Many were well prepared for part (a). In part (i) many scored a method mark for $\sqrt{2}\times\sqrt{25}$, but those who converted this to $5\sqrt{2}$ did not always simplify to $6\sqrt{2}$ as the answer. The common errors were answers of $\sqrt{52}$, $\sqrt{100}$ and $\sqrt{50}=2\sqrt{5}$ in the working.	
		ii	$\frac{5\sqrt{6}}{3}$ final answer	2	M1 for $\frac{10}{\sqrt{6}}\times\frac{\sqrt{6}}{\sqrt{6}}$ oe For 2 marks accept $1\frac{2}{3}\sqrt{6}$ **Examiner's Comments** In part (ii), most candidates rationalised the denominator correctly, but few cancelled $\frac{10\sqrt{6}}{6}$ to its simplest form.	
			Total	4		

Question			Answer/Indicative content	Marks	Part marks and guidance	
9			$7\sqrt{3}$	3	M2 for $2\sqrt{3}$ and $\sqrt{4\times3}$ or M1 for $5\sqrt{3}$ or better or $\sqrt{25\times3}$ or better Examiner's Comments In part (a), the work on surds was generally weak and candidates need to learn the conventions for simplifying surd expressions.	
			Total	3		

Question			Answer/Indicative content	Marks	Part marks and guidance		
10			$\frac{(4+2\sqrt{5})(\sqrt{5}+1)}{(\sqrt{5}-1)(\sqrt{5}+1)}$	4			
				M1			
			$(4\sqrt{5} + 4 + 10 + 2\sqrt{5})$ oe or better	M1	condone one error	bracket expansion could be in a table	
			$(5 - \sqrt{5} + \sqrt{5} - 1)$ oe or better	M1	soi by 5 -1 or 4		
			$\frac{6\sqrt{5}+14}{4} = \frac{3\sqrt{5}+7}{2}$	A1	condone one error	i.e. dividing by 2	
					Examiner's Comments Most candidates who multiplied top and bottom by √5 + 1, obtained the correct solution. A few candidates were unable to simplify their expression. Most did not know how to start this question.		
			Total	4			