

# Surds

# Mark Scheme

1. 3.5

3

$$\frac{6+9\sqrt{2}-2\sqrt{2}-6}{\sqrt{8}}$$

$$\frac{7\sqrt{2}}{\sqrt{8}} = \frac{7\sqrt{2} \times \sqrt{8}}{\sqrt{8} \times \sqrt{8}}$$

B1 for  $\frac{6+9\sqrt{2}-2\sqrt{2}-6}{\sqrt{8}}$

M1 multiplying numerator and denominator by  $\sqrt{8}$  oe  
(oe eg reduces  $\sqrt{2} \div \sqrt{8}$  to  $\frac{1}{2}$ )  
A1 for 3.5

[3]

2.  $\sqrt{22}$

3

$$(5+\sqrt{3})(5-\sqrt{3}) = 5 \times 5 - 5\sqrt{3} + 5\sqrt{3} - \sqrt{3}\sqrt{3} = 5 \times 5 - 3$$

$$\frac{22}{\sqrt{22}} = \frac{22\sqrt{22}}{22}$$

B1 for correct expansion  $25 - 5\sqrt{3} + 5\sqrt{3} - \sqrt{3}\sqrt{3}$  with 1<sup>st</sup>  
three terms reducing to 25 **without** any errors seen

B1 (indep) for  $\sqrt{3}\sqrt{3} = 3$

B1 for  $\sqrt{22}$  coming from  $\frac{22}{\sqrt{22}}$

(S.C  $\frac{(5+\sqrt{3})(5-\sqrt{3})\sqrt{22}}{22}$  gets B1)

[3]

3. (a)  $3\sqrt{2}$

2

$$\frac{6}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{6\sqrt{2}}{2} =$$

M1 for sight of multiplying top and bottom by  $\sqrt{2}$  or  $\sqrt{\frac{36}{2}}$

A1 for  $3\sqrt{2}$  oe

(b) 9

2

$$\frac{1}{2} \times \frac{6}{\sqrt{2}} \times \frac{6}{\sqrt{2}} = \frac{36}{4} =$$

M1 for  $\frac{1}{2} \times \frac{6}{\sqrt{2}} \times \frac{6}{\sqrt{2}}$  oe ft where  $\frac{6}{\sqrt{2}}$  is in form  $a\sqrt{b}$  where

$\sqrt{b}$  is irrational

A1 for 9 cao

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4. (a) 2 1  
*BI cao*

(b) 1.5 1  
*BI 1.5 oe*

(c)  $8 \times \sqrt{4} \times \sqrt{2}$   
 $16\sqrt{2}$  2  
*M1*  $(\sqrt{8} \Rightarrow) \sqrt{4 \times 2}$  or  $\sqrt{2} \times \sqrt{2} \times \sqrt{2}$  or  $(2^3)^{\frac{3}{2}}$   
*A1 for*  $16\sqrt{2}$  (accept  $m=16$ )

(d)  $\frac{1}{8\sqrt{8}} \times \frac{\sqrt{8}}{\sqrt{8}}$   
 $= \frac{\sqrt{8}}{64} = \frac{\sqrt{2}}{32}$   
 $\frac{\sqrt{2}}{32}$  2

*M1*  $\frac{1}{8\sqrt{8}} \times \frac{\sqrt{8}}{\sqrt{8}}$  or  $\frac{1}{8\sqrt{8}} \times \frac{8\sqrt{8}}{8\sqrt{8}}$  or  $\frac{1}{"16\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$  oe  
or  $\frac{1}{8\sqrt{8}} \times \frac{\sqrt{2}}{\sqrt{2}}$   
*A1 for*  $\frac{\sqrt{2}}{32}$  (accept  $p = 32$ )

[6]

5. (a)  $\frac{1}{\sqrt{7}} \times \frac{\sqrt{7}}{\sqrt{7}}$  2

$$M1 \frac{1}{\sqrt{7}} \times \frac{\sqrt{7}}{\sqrt{7}}$$

*AI cao*

(b) (i)  $3 + 15 + 2\sqrt{3 \times 15}$  5

$$18 + 2\sqrt{45}$$

$$18 + 6\sqrt{5}$$

$$18 + 6\sqrt{5}$$

$$M1 \text{ for } (\sqrt{3})^2 + (\sqrt{15})^2 + \sqrt{3} \times \sqrt{15} + \sqrt{15} \times \sqrt{3}$$

$$A1 \ 18 + 2\sqrt{45}$$

$$B1 \text{ for } 18 + 6\sqrt{5}$$

(ii)  $(3 + \sqrt{5})^2 = 9 + 5 + 6\sqrt{5}$   
 $= 14 + 6\sqrt{5}$   
 $(\sqrt{3} + \sqrt{15})^2 - (3 + \sqrt{5})^2$   
 $= 18 + 6\sqrt{5} - (14 + 6\sqrt{5}) = 4$   
 2

$$M1 \text{ for correct expansion of } (3 + \sqrt{5})^2 \text{ to } 3^2 + (\sqrt{5})^2 + 3\sqrt{5} +$$

$$3\sqrt{5}$$

*AI cao*

[7]

6.  $3 + 5\sqrt{2}$  2

$$\frac{\sqrt{18} + 10}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{36} + 10\sqrt{2}}{2}$$

$$M1 \text{ for multiplying by } \frac{\sqrt{2}}{\sqrt{2}} \text{ or } \frac{\sqrt{2 \times 9} + \sqrt{2 \times 50}}{\sqrt{2}}$$

$$A1 \text{ for } p = 3 \text{ and } q = 5 \text{ or } 3 + 5\sqrt{2}$$

$$(SC: B1 \text{ for } p = 3 \text{ or } q = 5)$$

[2]