Name: _____

GCSE (1 – 9)

Surds

Instructions

- Use **black** ink or ball-point pen.
- Answer all questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- You must **show all your working out.**

Information

- The marks for each question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end

1 Write $\sqrt{48}$ in the form $k\sqrt{3}$, where k is an integer.

$\sqrt{16}\sqrt{3}$

$4\sqrt{3}$

$4\sqrt{3}$

(Total for question 1 is 2 marks)

2 Write $\sqrt{50}$ in the form $k\sqrt{2}$, where k is an integer.

$\sqrt{25}\sqrt{2}$

$5\sqrt{2}$

$5\sqrt{2}$

(Total for question 2 is 2 marks)

3 Write $5\sqrt{27}$ in the form $k\sqrt{3}$, where k is an integer.

$5(\sqrt{9}\sqrt{3})$

$5(3\sqrt{3})$

$15\sqrt{3}$

$15\sqrt{3}$

(Total for question 3 is 2 marks)

4 Write $7\sqrt{20}$ in the form $k\sqrt{5}$, where k is an integer.

$7(\sqrt{4}\sqrt{5})$

$7(2\sqrt{5})$

$14\sqrt{5}$

$14\sqrt{5}$

(Total for question 4 is 2 marks)

5 Expand and Simplify $(2+\sqrt{3})(2-\sqrt{3})$

$4 - 2\sqrt{3} + 2\sqrt{3} - 3$

1

1

(Total for question 5 is 2 marks)

6 Write $(3+\sqrt{5})^2$ in the form $a + b\sqrt{5}$, where a and b are integers.

$(3+\sqrt{5})(3+\sqrt{5})$

$9 + 3\sqrt{5} + 3\sqrt{5} + 5$

$14 + 6\sqrt{5}$

$14 + 6\sqrt{5}$

(Total for question 6 is 2 marks)

7 Expand and Simplify $(2+\sqrt{5})(1-\sqrt{5})$

$2 - 2\sqrt{5} + \sqrt{5} - 5$

$-3 - \sqrt{5}$

$-3 - \sqrt{5}$

(Total for question 7 is 2 marks)

8 Write $(3-\sqrt{2})^2$ in the form $a + b\sqrt{2}$, where a and b are integers.

$(3-\sqrt{2})(3-\sqrt{2})$

$9 - 3\sqrt{2} - 3\sqrt{2} + 2$

$11 - 6\sqrt{2}$

$11 - 6\sqrt{2}$

(Total for question 8 is 2 marks)

9 Expand and Simplify $(2+\sqrt{3})^2-(2-\sqrt{3})^2$

$(2+\sqrt{3})(2+\sqrt{3}) - ((2-\sqrt{3})(2-\sqrt{3}))$

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

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

$7+4\sqrt{3}-7+4\sqrt{3}$

$8\sqrt{3}$

(Total for question 9 is 2 marks)

10 Rationalise the denominator $\frac{6}{\sqrt{3}}$

$\frac{6}{\sqrt{3}} \times \sqrt{3}$

$\frac{6\sqrt{3}}{3}$

$2\sqrt{3}$

$2\sqrt{3}$

(Total for question 10 is 2 marks)

11 Rationalise the denominator $\frac{x}{\sqrt{x}}$

$\frac{x}{\sqrt{x}} \times \sqrt{x}$

$\frac{x\sqrt{x}}{x}$

$\sqrt{x}$

$\sqrt{x}$

(Total for question 11 is 2 marks)

12 Rationalise the denominator $\frac{(1+\sqrt{5})}{\sqrt{2}}$

$\frac{(1+\sqrt{5})}{\sqrt{2}} \times \sqrt{2}$

$\frac{\sqrt{2}+\sqrt{10}}{2}$

$\frac{\sqrt{2}+\sqrt{10}}{2}$

(Total for question 12 is 2 marks)

13 Simplify $\frac{(3+\sqrt{6})}{\sqrt{3}}$

$\times\sqrt{3}$

$\times\sqrt{3}$

$\sqrt{18} = \sqrt{9}\sqrt{2}$

$= 3\sqrt{2}$

$$\frac{3\sqrt{3} + \sqrt{18}}{3}$$

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

~~$\frac{6\sqrt{2}}{3}$~~

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

~~$2\sqrt{2}$~~

(Total for question 13 is 3 marks)

14 Simplify fully $\frac{(4+2\sqrt{3})(4-2\sqrt{3})}{\sqrt{11}}$

You must show all your working.

$$\frac{16 - 8\sqrt{3} + 8\sqrt{3} - 4(3)}{\sqrt{11}}$$

$$\frac{4}{\sqrt{11}} \times\sqrt{11}$$

$\times\sqrt{11}$

$$\frac{4\sqrt{11}}{11}$$

(Total for question 14 is 3 marks)

15 Show that $\frac{5+2\sqrt{3}}{2+\sqrt{3}}$ can be written as $4-\sqrt{3}$

$$\frac{(5+2\sqrt{3})}{(2+\sqrt{3})}\frac{(2-\sqrt{3})}{(2-\sqrt{3})}$$

$$\frac{10-5\sqrt{3}+4\sqrt{3}-2(3)}{4-2\sqrt{3}+2\sqrt{3}-3}$$

$$\frac{4-\sqrt{3}}{1}$$

$$4-\sqrt{3}$$

(Total for question 15 is 3 marks)

16 Show that $\frac{3\sqrt{3}+3}{3+\sqrt{3}}$ can be written as $\sqrt{3}$

$$\frac{(3\sqrt{3}+3)}{(3+\sqrt{3})}\frac{(3-\sqrt{3})}{(3-\sqrt{3})}$$

$$\frac{9\sqrt{3}-3(3)+9-3\sqrt{3}}{9-3\sqrt{3}+3\sqrt{3}-3}$$

$$\frac{6\sqrt{3}}{6}$$

$$\sqrt{3}$$

(Total for question 16 is 3 marks)

17 Show that $\dfrac{1}{\frac{1}{\sqrt{2}}+\sqrt{2}}$ can be written as $\dfrac{\sqrt{2}}{3}$

$1 \div \dfrac{3}{\sqrt{2}}$

$1 \times \dfrac{\sqrt{2}}{3}$

$\dfrac{\sqrt{2}}{3}$

$\dfrac{1}{\sqrt{2}} + \dfrac{\sqrt{2}}{1}$ $\times\sqrt{2}$ $\times\sqrt{2}$

$\dfrac{1}{\sqrt{2}} + \dfrac{2}{\sqrt{2}}$

$\dfrac{3}{\sqrt{2}}$

(Total for question 17 is 3 marks)

18 Show that $\dfrac{2}{\frac{1}{\sqrt{3}}+1}$ can be written as $3-\sqrt{3}$

$2 \div \dfrac{1+\sqrt{3}}{\sqrt{3}}$

$2 \times \dfrac{\sqrt{3}}{1+\sqrt{3}}$

$\dfrac{2\sqrt{3}}{(1+\sqrt{3})(1-\sqrt{3})}$ $(1-\sqrt{3})$

$\dfrac{2\sqrt{3}-2(3)}{1-\sqrt{3}+\sqrt{3}-3}$

$\dfrac{2\sqrt{3}-6}{-2} = -\sqrt{3}+3 = 3-\sqrt{3}$

$\dfrac{1}{\sqrt{3}} + \dfrac{1}{1}$ $\times\sqrt{3}$ $\times\sqrt{3}$

$\dfrac{1}{\sqrt{3}} + \dfrac{\sqrt{3}}{\sqrt{3}}$

$\dfrac{1+\sqrt{3}}{\sqrt{3}}$

(Total for question 18 is 3 marks)

19 Simplify fully $(\sqrt{a}+\sqrt{b})(\sqrt{a}-\sqrt{b})$

$a - \sqrt{ab} + \sqrt{ab} - b$

$a - b$

(Total for question 19 is 2 marks)

20 Simplify fully $(2a+\sqrt{b})^2$

$(2a+\sqrt{b})(2a+\sqrt{b})$

$4a^2 + 2a\sqrt{b} + 2a\sqrt{b} + b$

$4a^2 + 4a\sqrt{b} + b$

(Total for question 20 is 2 marks)