



Mathematics

Instructions

1. Working time - 70 minutes
2. All questions should be attempted.
3. Show all working.
4. **Start each question on a new page.**
5. Marks will be deducted for careless work or poorly presented solutions.
6. On the cover sheet of the answer booklet clearly show:

- a) your name
- b) your mathematics class and teacher

Question 1: (8 Marks) - Start A New Page

Marks

- a) If $m = -2$ find the value of $m^2 - 3m$ 1
- b) Subtract $4x^2y - x^2 + y^3$ from $2x^2 - x^2y - y^3$ 1
- c) What is the reciprocal of 2.6 expressed as a simplified fraction? 1
- d) Calculate $\sqrt{\frac{15.7 \times 13.6}{15.7 - 13.6}}$ correct to 1 decimal place. 1
- e) Express $0.2\bar{7}$ as a simplified fraction. 2
- f) Given that $x = 3.2 \times 10^8$ and $y = 2.9 \times 10^7$ evaluate $\frac{5x^2}{2y}$. 2

Give your answer in scientific notation correct to 2 significant figures.

Question 2: (8 Marks) - Start A New Page

Marks

- a) Expand and simplify $(y - 4)(y + 3) - (y + 4)(y - 3)$ 2
- b) Simplify
 - (i) $\frac{6x^3y}{10t} \div \frac{9xy^2}{25t^2}$ 2
 - (ii) $\frac{5x^2 + 10x}{x^2 - 4}$ 2
- c) Expand and simplify $(2\sqrt{3} + \sqrt{6})^2$ 2

Question 3: (8 Marks) – Start A New Page

Marks

a) At a sale all prices were reduced by 15%. What was the original price of a coat that sold for \$106.25.

1

b) Simplify $\sqrt{90} - 2\sqrt{80} - 2\sqrt{40} + \sqrt{500}$

2

c) Find the value of x if $\sqrt{x} = \sqrt{50} - \sqrt{18}$

2

d) Express as a simplified fraction with rational denominator

(i) $\frac{6}{5\sqrt{2}}$

1

(ii) $\frac{2}{\sqrt{7}-2} + \frac{5}{\sqrt{7}+2}$

2

Question 4: (8 Marks) – Start A New Page

Marks

a) Factorise

(i) $m^3 + 64$

1

(ii) $x^6 - x^3$

2

b) Write as a single simplified fraction

(i) $\frac{2x-1}{3} - \frac{x-3}{2}$

2

(ii) $\frac{2}{x^2-x} + \frac{1}{x^2-1}$

3

Question 5: (8 Marks) – Start A New Page

Marks

Solve the following equations

a) $4x + 9 = 13 - 2x$

2

b) $\frac{3x}{2} + \frac{1-2x}{3} = \frac{x+1}{6}$

2

c) $x^2 = 5x$

2

d) $x^2 + 20x - 44 = 0$

2

Question 6: (8 Marks) – Start A New Page

Marks

Factorise:

a) $5k^2 - 80$

2

b) $a^2 - 7a - 18$

2

c) $6x^2 + 11x - 10$

2

d) $y^3 + 3y^2 + 6y + 18$

2

Question 7: (8 Marks) – Start A New Page

Marks

- a) Solve by “completing the square”

3

$$x^2 + 6x - 2 = 0$$

Leave your answer in surd form.

- b) Solve the simultaneous equations

3

$$3x + y = 5$$

$$2x - 4y = 1$$

- c) Simplify

2

$$\frac{4 - 2x}{x^2 - 4}$$

Question 8: (8 Marks) – Start A New Page

Marks

- a) Factorise $x^2 + 6x + 9 - y^2$

2

- b) $\frac{\sqrt{10}+4}{\sqrt{5}+\sqrt{2}} = a\sqrt{5} + b\sqrt{2}$ find a and b

3

- c) The length of a rectangle is 3 cm less than twice its width. The perimeter is 100 cm. Write an equation and solve it to find the dimensions of the rectangle.

3

SOLUTIONS

$$1. a) (-2)^2 - 3(-2)$$

$$= 4 - (-6)$$

$$= 10 \quad \checkmark$$

$$b) 2x^2 - x^2y - y^3 - (4x^2y - x^2 + y^3)$$

$$= 2x^2 - x^2y - y^3 - 4x^2y + x^2 - y^3$$

$$= 3x^2 - 5x^2y - 2y^3 \quad \checkmark$$

$$c) 2.6 = \frac{13}{5}$$

$$\text{reciprocal} = \frac{5}{13} \quad \checkmark$$

$$d) 10.08346123$$

$$= 10.1 \quad (\text{to 1 dp}) \quad \checkmark$$

$$e) 0.2\dot{7}$$

$$\text{Let } 0.2\dot{7} = x$$

$$\therefore 10x = 2.7$$

$$\therefore 100x = 27.7$$

$$100x - 10x = 90x$$

$$90x = 25$$

$$x = \frac{25}{90}$$

$$= \frac{5}{18} \quad //$$

$$f) \frac{5(3.2 \times 10^8)^2}{2(2.9 \times 10^7)}$$

$$= 8827586207 \quad //$$

$$= 8.8 \times 10^9 \quad (\text{to 2 sig fig})$$

$$2. a) (y-4)(y+3) - (y+4)(y-3)$$

$$= y^2 + 3y - 4y - 12 - (y^2 - 3y + 4y - 12)$$

$$= y^2 + 3y - 4y - 12 - y^2 + 3y - 4y + 12$$

$$= 6y - 8y$$

$$= -2y \quad \checkmark$$

$$b) i. \frac{6x^3y}{10t} \div \frac{9xy^2}{25t^2}$$

$$= \frac{2x^2}{10t} \times \frac{5t}{9xy^2}$$

$$= \frac{10x^2t}{6y} \quad \checkmark$$

$$= \frac{5x^2t}{3y} \quad \checkmark$$

$$ii. \frac{5x^2 + 10x}{x^2 - 4}$$

$$= \frac{5x(x+2)}{(x-2)(x+2)}$$

$$= \frac{5x}{x-2} \quad \checkmark$$

$$c) (2\sqrt{3} + \sqrt{6})^2$$

$$= 4 \times 3 + 4\sqrt{18} + 6$$

$$= 12 + 12\sqrt{3} + 6$$

$$= 18 + 12\sqrt{3}$$

$$3. a) 100 \cdot 25 = 85\%$$

$$1 \cdot 25 = 1\%$$

$$\therefore 100\% = 1 \cdot 25 \times 100 \\ = \$125$$

\therefore original price was \$125 ✓

$$b) \sqrt{90} - 2\sqrt{80} - 2\sqrt{40} + \sqrt{500}$$

$$= 3\sqrt{10} - 8\sqrt{5} - 4\sqrt{10} + 10\sqrt{5} \quad * 3\sqrt{10} - 2 \times 4\sqrt{5} - 2 \times 2\sqrt{10} + 10\sqrt{5}$$

$$= 2\sqrt{5} - \sqrt{10} \quad \checkmark \checkmark$$

$$c) \sqrt{x} = \sqrt{50} - \sqrt{18}$$

$$\sqrt{x} = 5\sqrt{2} - 3\sqrt{2}$$

$$\sqrt{x} = 2\sqrt{2}$$

$$\sqrt{x} = \sqrt{8}$$

$$\therefore x = 8 \quad \checkmark \checkmark$$

$$d) i. \frac{6}{5\sqrt{2}} \times \frac{5\sqrt{2}}{5\sqrt{2}} \quad ii. \frac{2}{\sqrt{7}-2} + \frac{5}{\sqrt{7}+2}$$

$$= \frac{30\sqrt{2}}{25 \times 2}$$

$$= \frac{2 \times \sqrt{7}+2}{\sqrt{7}-2 \sqrt{7}+2} + \frac{5 \times \sqrt{7}-2}{\sqrt{7}+2 \sqrt{7}-2}$$

$$= \frac{30\sqrt{2}}{50}$$

$$= \frac{2\sqrt{7}+4}{7-4} + \frac{5\sqrt{7}-10}{7-4}$$

$$= \frac{3\sqrt{2}}{5} \quad \checkmark$$

$$= \frac{7\sqrt{7}-6}{3} \quad \checkmark \checkmark$$

$$4. a) i. m^3 + 64$$

$$= (m+4)(m^2-4m+16) \quad \checkmark$$

$$ii. x^6 - x^3$$

$$x^3(x^3-1)$$

$$x^3(x-1)(x^2+x+1) \quad \checkmark \checkmark$$

$$b) i. \frac{2x-1}{3} - \frac{x-3}{2}$$

$$= \frac{2(2x-1) - 3(x-3)}{6}$$

$$= \frac{4x-2-3x+9}{6} \quad \checkmark$$

$$= \frac{x+7}{6} \quad \checkmark$$

$$ii. \frac{2}{x^2-x} + \frac{1}{x^2-1}$$

$$= \frac{2}{x(x-1)} + \frac{1}{(x-1)(x+1)} = \frac{2(x+1)}{x(x-1)(x+1)} + \frac{1(x)}{x(x-1)(x+1)}$$

$$= \frac{2(x+1) + x}{x(x-1)(x+1)} \quad \checkmark$$

$$= \frac{2x+2+x}{x(x-1)(x+1)} \quad \checkmark$$

$$= \frac{3x+2}{x(x-1)(x+1)} \quad \checkmark$$

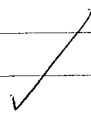
8

$$5. a) 4x + 9 = 13 - 2x$$

$$6x + 9 = 13$$

$$6x = 4$$

$$x = \frac{4}{6} = \frac{2}{3}$$



$$b) \frac{3x}{2} + \frac{1-2x}{3} = \frac{x+1}{6}$$

$$9x + 2(1-2x) = x+1$$

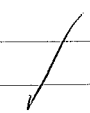
$$9x + 2 - 4x = x + 1$$

$$5x + 2 = x + 1$$

$$4x + 2 = 1$$

$$4x = -1$$

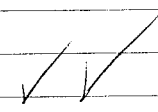
$$x = -\frac{1}{4}$$



$$c) x^2 = 5x$$

$$x^2 - 5x = 0$$

$$x(x-5) = 0$$

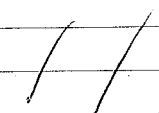


$$\therefore x = 0 \text{ or } 5$$

$$d) x^2 + 20x - 44 = 0$$

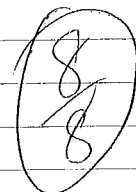
$$\begin{array}{l} x \\ x \end{array} \begin{array}{l} +22 \\ -2 \end{array}$$

$$(x-2)(x+22) = 0$$



$$\therefore x = 2 \text{ or } -22$$

$$6. a) 5k^2 - 80$$



$$= 5(k^2 - 16)$$

$$5(k-4)(k+4) \quad \checkmark 2$$

$$b) a^2 - 7a - 18$$

$$\begin{array}{l} a \\ a \end{array} \begin{array}{l} -9 \\ +2 \end{array}$$

$$(a-9)(a+2) \quad \checkmark 2$$

$$c) 6x^2 + 11x - 10$$

$$\begin{array}{l} 3x \\ 2x \end{array} \begin{array}{l} -2 \\ +5 \end{array}$$

$$(3x-2)(2x+5) \quad \checkmark 2$$

e)

$$d) y^3 + 3y^2 + 6y + 18$$

$$y^2(y+3) + 6(y+3)$$

$$(y^2+6)(y+3) \quad \checkmark 2$$

$$7. a) x^2 + 6x - 2 = 0$$

$$x^2 + 6x = 2$$

$$x^2 + 6x + (3)^2 = 2 + 3^2$$

$$x^2 + 6x + 3^2 = 11$$

$$(x+3)^2 = 11$$

$$x+3 = \pm\sqrt{11}$$

$$x = \pm\sqrt{11} - 3$$

$$x = -3 \pm \sqrt{11}$$

$$b) (3x+y=5) \times 4$$

$$2x-4y=1$$

$$\therefore \text{of } 12x+4y=20$$

$$12x+4y=20$$

$$+ 2x-4y=1$$

↓

$$14x = 21$$

$$x = \frac{21}{14}$$

$$x = \frac{3}{2}$$

sub x in

$$3\left(\frac{3}{2}\right) + y = 5 - \frac{63}{10}$$

$$y = 5 - 6 \cdot 3$$

$$y = -13 \text{ or } -\frac{13}{10}$$

Q. 7 ctd.

$$c) \frac{4-2x}{x^2-4}$$

$$\frac{2(2-x)}{(x-2)(x+2)}$$

$$\frac{-2(\cancel{x-2})}{(\cancel{x-2})(x+2)}$$

$$\frac{-2}{x+2}$$

$$\frac{7}{8}$$

$$(x+3)^2 - y^2$$

$$8^{(1)} \quad x^2 + 6x + 9 - y^2 = (x+3-y)(x+3+y)$$

$$x(x+6) + (3-y)(3+y)$$

$$b) \frac{\sqrt{10} + 4}{\sqrt{5} + \sqrt{2}} = a\sqrt{5} + b\sqrt{2}$$

$$\frac{\sqrt{10} + 4}{\sqrt{5} + \sqrt{2}} \times \frac{\sqrt{5} - \sqrt{2}}{\sqrt{5} - \sqrt{2}} = a\sqrt{5} + b\sqrt{2}$$

$$\frac{\sqrt{50} - \sqrt{10} + 4\sqrt{5} - 4\sqrt{2}}{3} = a\sqrt{5} + b\sqrt{2}$$

$$\frac{5\sqrt{2} - 2\sqrt{5} + 4\sqrt{5} - 4\sqrt{2}}{3} = a\sqrt{5} + b\sqrt{2}$$

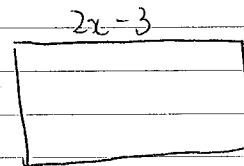
$$\frac{\sqrt{2} + 2\sqrt{5}}{3} = a\sqrt{5} + b\sqrt{2}$$

$$\therefore a = \frac{1}{3} \quad \text{and} \quad b = \frac{1}{3} \quad \checkmark \quad \{$$

$$\frac{1}{3}\sqrt{2} + \frac{2}{3}\sqrt{5} = a\sqrt{5} + b\sqrt{2}$$

end.

c)



$$P = 100$$

$$100 = 2(2x-3) + 2x$$

$$100 = 4x - 6 + 2x$$

$$100 = 6x - 6$$

$$106 = 6x$$

$$6x = 106$$

$$x = \frac{106}{6} = \frac{53}{3}$$

$$\therefore \text{width of rectangle} = \frac{53}{3} \text{ cm}$$

$$\text{length of rectangle} = 2\left(\frac{53}{3}\right) - 3$$

$$= \frac{97}{3} \text{ cm} \quad \checkmark \quad \{$$