MATHEMATICS PREPARATION WORKBOOK

ANSWERS

FP16 Mathematics & Statistics
FP17 Economics
FP18 Computer Science

UNIVERSITY OF WARWICK

Contents

Expanding brackets and simplifying expressions

Answers

1 **a** $6x - 3$ **b** $-10pq - 8q^2$

2 **a** $21x + 35 + 12x - 48 = 33x - 13$
b $40p - 16 - 12p - 27 = 28p - 43$

3 **a** $12x^2 + 24x$ **b** $20k^3 - 48k$

4 **a** $-y^2 - 4$ **b** $5x^2 - 11x$

5 **a** $-1 - 2m$ **b** $5p^3 + 12p^2 + 27p$

6 $7x(3x - 5) = 21x^2 - 35x$

7 **a** $x^2 + 9x + 20$ **b** $x^2 + 10x + 21$
c $x^2 + 5x - 14$ **d** $x^2 - 25$
e $10x^2 - 31x + 15$ **f** $12x^2 + 13x - 14$
g $4x^2 - 28x + 49$ **h** $16x^2 - 24xy + 9y^2$

8 **a** $x^2 - 1 - \frac{2}{x^2}$ **b** $x^2 + 2 + \frac{1}{x^2}$

Surds and rationalising the denominator

Answers

1 **a** $3\sqrt{5}$ **b** $5\sqrt{5}$

c $4\sqrt{3}$ **d** $5\sqrt{7}$

2 **a** $15\sqrt{2}$ **b** $\sqrt{5}$

c $3\sqrt{2}$ **d** $\sqrt{3}$

3 **a** -1 **b** $9-\sqrt{3}$

c $10\sqrt{5}-7$ **d** $26-4\sqrt{2}$

4 **a** $\frac{2\sqrt{7}}{7}$ **b** $\frac{\sqrt{2}}{2}$

c $\frac{\sqrt{3}}{3}$ **d** $\frac{1}{3}$

5 **a** $\frac{3+\sqrt{5}}{4}$ **b** $\frac{2(4-\sqrt{3})}{13}$

6 $x-y$

7 **a** $3+2\sqrt{2}$ **b** $\frac{\sqrt{x}+\sqrt{y}}{x-y}$

Rules of indices

Answers

1 **a** 1 **b** 1

2 **a** 7 **b** 4

3 **a** 125 **b** 32

4 **a** $\frac{1}{25}$ **b** $\frac{1}{64}$

5 **a** $\frac{3x^3}{2}$ **b** $5x^2$

c $2x^6$ **d** x

6 **a** $\frac{1}{2}$ **b** $\frac{1}{9}$ **c** $\frac{8}{3}$

7 **a** x^{-1} **b** x^{-7} **c** $x^{\frac{1}{4}}$

8 **a** $\sqrt[5]{x^2}$ **b** $\frac{1}{\sqrt{x}}$ **c** $\frac{1}{\sqrt[4]{x^3}}$

9 **a** $5x^{\frac{1}{2}}$ **b** $2x^{-3}$ **c** $\frac{1}{3}x^{-4}$

10 **a** $x^3 + x^{-2}$ **b** $x^3 + x$ **c** $x^{-2} + x^{-7}$

Factorising expressions

Answers

1 **a** $2x^3y^3(3x - 5y)$ **b** $7a^3b^2(3b^3 + 5a^2)$
c $5x^2y^2(5 - 2x + 3y)$

2 **a** $(x + 3)(x + 4)$ **b** $(x + 7)(x - 2)$
c $(x - 5)(x - 6)$ **d** $(x - 8)(x + 3)$

3 **a** $(6x - 7y)(6x + 7y)$ **b** $(2x - 9y)(2x + 9y)$
c $2(3a - 10bc)(3a + 10bc)$

4 **a** $(x - 1)(2x + 3)$ **b** $(3x + 1)(2x + 5)$
c $(2x + 1)(x + 3)$ **d** $(3x - 1)(3x - 4)$

5 **a** $\frac{2(x+2)}{x-1}$ **b** $\frac{x}{x-1}$
c $\frac{x+2}{x}$ **d** $\frac{x}{x+5}$

6 **a** $\frac{3x+4}{x+7}$ **b** $\frac{2x+3}{3x-2}$
c $\frac{2-5x}{2x-3}$ **d** $\frac{3x+1}{x+4}$

7 $\frac{4(x+2)}{x-2}$

Completing the square

Answers

1 **a** $(x + 2)^2 - 1$ **b** $(x - 5)^2 - 28$

c $(x - 4)^2 - 16$ **d** $(x + 3)^2 - 9$

2 **a** $2(x - 2)^2 - 24$ **b** $4(x - 1)^2 - 20$

c $3(x + 2)^2 - 21$ **d** $2\left(x + \frac{3}{2}\right)^2 - \frac{25}{2}$

3 **a** $2\left(x + \frac{3}{4}\right)^2 + \frac{39}{8}$ **b** $3\left(x - \frac{1}{3}\right)^2 - \frac{1}{3}$

c $5\left(x + \frac{3}{10}\right)^2 - \frac{9}{20}$ **d** $3\left(x + \frac{5}{6}\right)^2 + \frac{11}{12}$

4 $(5x + 3)^2 + 3$

Solving quadratic equations by factorisation

Answers

1 **a** $x = 0$ or $x = -\frac{2}{3}$ **b** $x = 0$ or $x = \frac{3}{4}$

c $x = -5$ or $x = -2$ **d** $x = 2$ or $x = 3$

e $x = -1$ or $x = 4$ **f** $x = -5$ or $x = 2$

2 **a** $x = -2$ or $x = 5$ **b** $x = -1$ or $x = 3$

c $x = -3$ or $x = 2\frac{1}{2}$ **d** $x = -\frac{1}{3}$ or $x = 2$

Solving quadratic equations by completing the square

1 **a** $x = 2 + \sqrt{7}$ or $x = 2 - \sqrt{7}$ **b** $x = 5 + \sqrt{21}$ or $x = 5 - \sqrt{21}$

c $x = -4 + \sqrt{21}$ or $x = -4 - \sqrt{21}$ **d** $x = 1 + \sqrt{7}$ or $x = 1 - \sqrt{7}$

2 **a** $x = 1 + \sqrt{14}$ or $x = 1 - \sqrt{14}$ **b** $x = \frac{-3+\sqrt{23}}{2}$ or $x = \frac{-3-\sqrt{23}}{2}$

c $x = \frac{5+\sqrt{13}}{2}$ or $x = \frac{5-\sqrt{13}}{2}$

Solving quadratic equations by using the formula

1 **a** $x = -1 + \frac{\sqrt{3}}{3}$ or $x = -1 - \frac{\sqrt{3}}{3}$ **b** $x = 1 + \frac{3\sqrt{2}}{2}$ or $x = 1 - \frac{3\sqrt{2}}{2}$

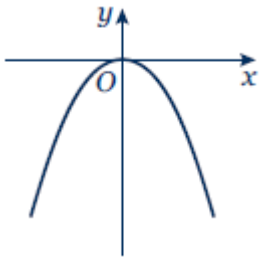
2 $x = \frac{7 + \sqrt{41}}{2}$ or $x = \frac{7 - \sqrt{41}}{2}$

3 $x = \frac{-3 + \sqrt{89}}{20}$ or $x = \frac{-3 - \sqrt{89}}{20}$

Sketching quadratic graphs

Answers

1



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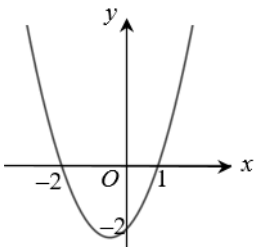

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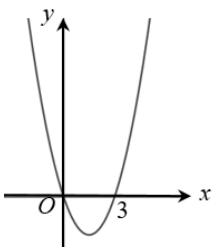

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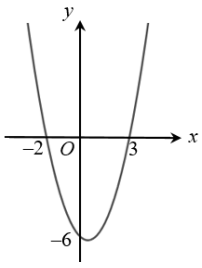

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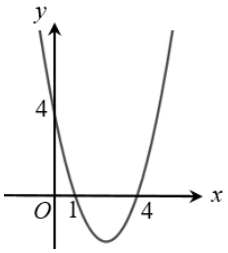

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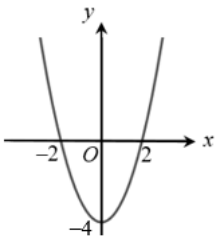

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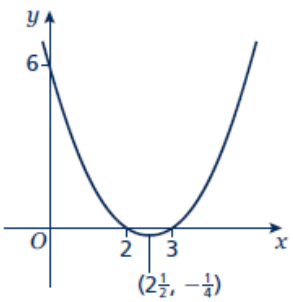

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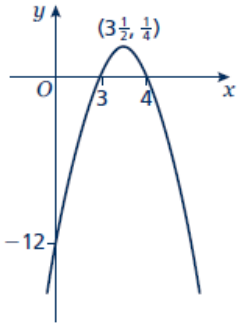

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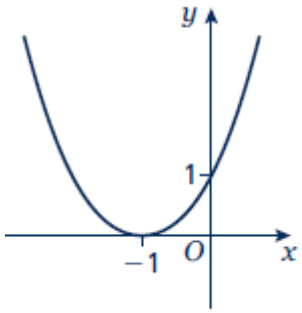


Line of symmetry at $x = -1$.

Solving linear simultaneous equations using the elimination method

Answers

1 $x = 1, y = 4$

2 $x = 3, y = -2$

3 $x = 2, y = -5$

4 $x = 3, y = -\frac{1}{2}$

Solving linear simultaneous equations using the substitution method

1 $x = 9, y = 5$

2 $x = -2, y = -7$

3 $x = \frac{1}{2}, y = 3\frac{1}{2}$

4 $x = \frac{1}{2}, y = 3$

5 $x = -2\frac{1}{2}, y = 5\frac{1}{2}$

Solving linear and quadratic simultaneous equations

Answers

1 $x = 1, y = 3$

$x = -\frac{9}{5}, y = -\frac{13}{5}$

2 $x = 2, y = 4$

$x = 4, y = 2$

3 $x = 3, y = 4$

$x = 2, y = 1$

4 $x = 7, y = 2$

$x = -1, y = -6$

5 $x = -2, y = -4$

$x = 2, y = 4$

6 $x = \frac{5}{2}, y = 6$

$x = 3, y = 5$

Solving simultaneous equations graphically

Answers

1 **a** $x = 2, y = 5$

b $x = 2, y = -3$

2 **a** $x = -2, y = 2$

b $x = 0.5, y = 0.5$

3 **a** $x = 1, y = 0$ and $x = 4, y = 3$

b $x = -2, y = 7$ and $x = 2, y = -5$

4 $x = -3, y = 4$ and $x = 4, y = -3$

Linear inequalities

Answers

1 **a** $x > 4$ **b** $x \leq 2$ **c** $x \leq -1$

2 **a** $x < -20$ **b** $x \leq 3.5$ **c** $x < 4$

3 **a** $x \leq -4$ **b** $-1 \leq x < 5$ **c** $x \leq 1$

4 **a** $t < \frac{5}{2}$ **b** $n \geq \frac{7}{5}$

5 $x > 5$ (which also satisfies $x > 3$)

Quadratic inequalities

Answers

1 $-7 \leq x \leq 4$

2 $\frac{1}{2} < x < 3$

3 $-3 \leq x \leq 4$

4 $2 < x < 2\frac{1}{2}$

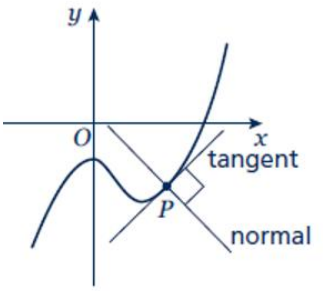
5 $x \leq -\frac{3}{2}$ or $x \geq \frac{5}{3}$

Sketching cubic and reciprocal graphs

Answers

1 **a** i – C
ii – E
iii – B
iv – A
v – F
vi – D

b **ii**



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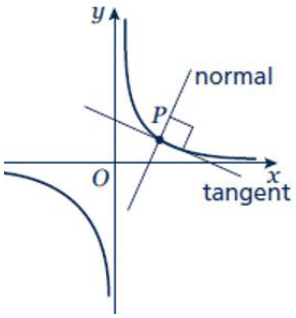

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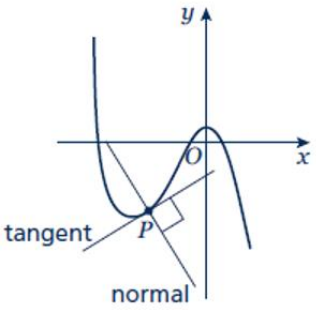

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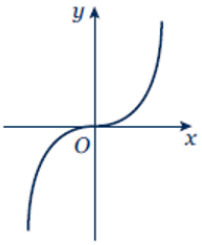

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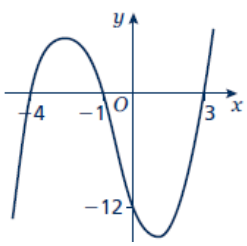

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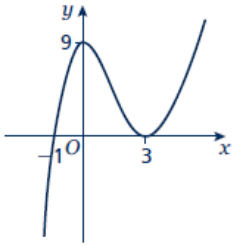

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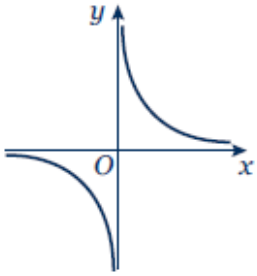

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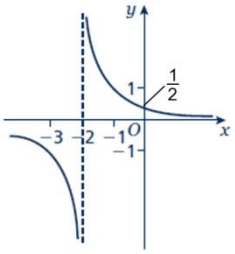
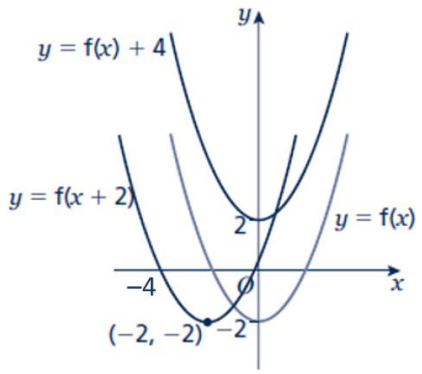


Translating graphs

Answers

1



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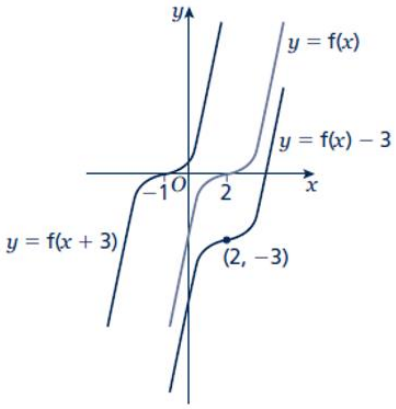
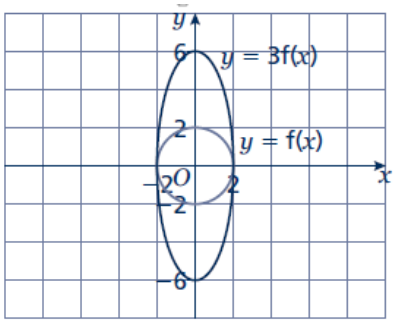


3 C_1: $y = f(x - 5)$
C_2: $y = f(x) - 3$

Stretching graphs

1 **a**



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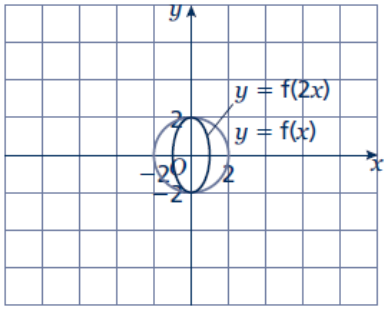

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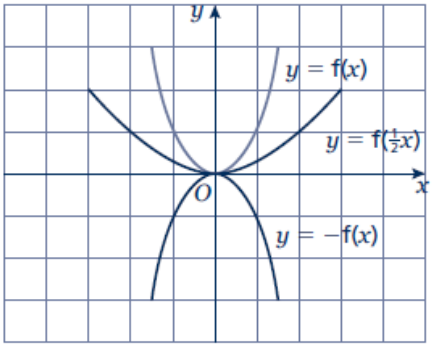

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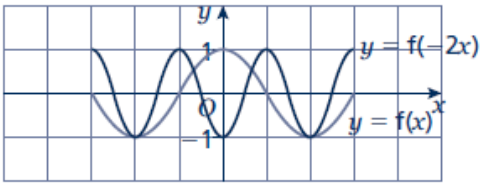
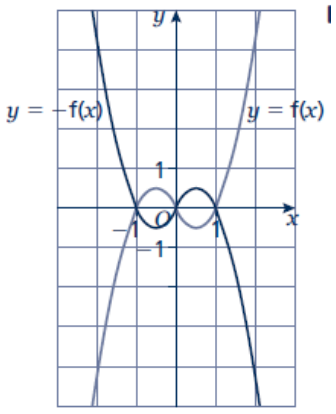


4 **a**



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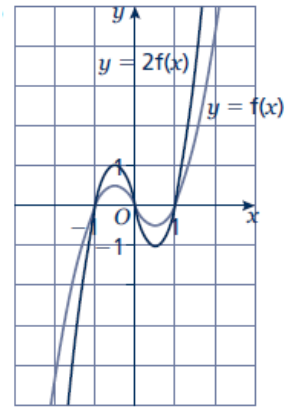

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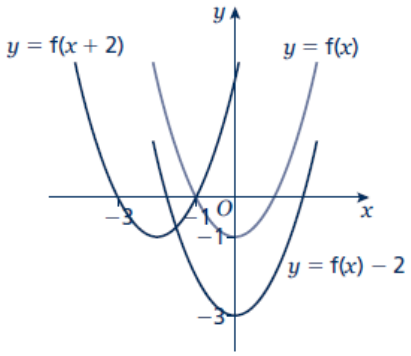


Straight line graphs

Answers

1 **a** $m = 3, c = 5$ **b** $m = -\frac{1}{2}, c = -7$

c $m = 2, c = -\frac{3}{2}$ **d** $m = -1, c = 5$

2 **a** $x + 2y + 14 = 0$ **b** $2x - y = 0$

3 $y = -\frac{2}{3}x + 7$

4 **a** $y = 2x - 3$ **b** $y = -\frac{1}{2}x + 6$

Parallel and perpendicular lines

Answers

1 **a** $y = 3x - 7$ **b** $y = -2x + 5$

2 $y = -2x - 7$

3 **a** $y = -\frac{1}{2}x + 2$ **b** $y = 3x + 7$

4 **a** $y = -\frac{1}{2}x$ **b** $y = 2x$

5 **a** Parallel **b** Neither **c** Perpendicular

6 **a** $x + 2y - 4 = 0$ **b** $x + 2y + 2 = 0$ **c** $y = 2x$

Pythagoras’ theorem

Answers

1 **a** 10.3 cm **b** 7.07 cm

2 **a** $4\sqrt{3}$ cm **b** $2\sqrt{21}$ cm

3 **a** $18\sqrt{13}$ mm **b** $2\sqrt{145}$ mm

4 95.3 mm

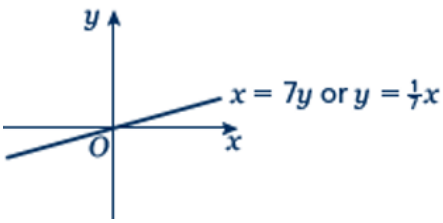
5 64.0 km

Proportion

Answers

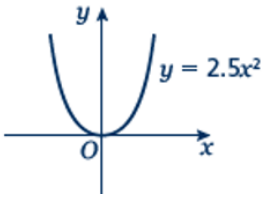
1 £77

2 **a** $x = 7y$ **b**



c 91 **d** 9

3 **a** $y = 2.5x^2$ **b**

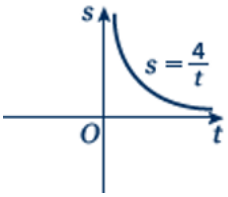


c ±6

4 **a** 16 **b** 100

5 5

6 **a** $s = \frac{4}{t}$ **b**



c 4

7 1

8 1

Trigonometry

Answers

1 **a** 6.49 cm **b** 6.93 cm **c** 2.80 cm
d 74.3 mm

2 **a** 36.9° **b** 57.1°

3 5.71 cm

4 20.4°

5 **a** 45° **b** 1 cm

The cosine rule

1	**a**	6.46 cm	**b**	9.26 cm
2	**a**	22.2°	**b**	52.9°
3	**a**	13.7 cm	**b**	76.0°

The sine rule

1	**a**	4.33 cm	**b**	15.0 cm
2	**a**	42.8°	**b**	52.8°
3	**a**	8.13 cm	**b**	32.3°

Areas of triangles

1 **a** 18.1 cm^2 **b** 18.7 cm^2

2 5.10 cm

3 **a** 6.29 cm **b** 84.3°

4 15.3 cm

Rearranging equations

Answers

1 $d = \frac{C}{\pi}$ **2** $w = \frac{P - 2l}{2}$ **3** $T = \frac{S}{D}$

4 $y = 2 + 3x$ **5** $a = \frac{3x + 1}{x + 2}$ **6** $d = \frac{b - c}{x}$

7 **a** $r = \sqrt{\frac{A}{\pi}}$ **b** $r = \sqrt[3]{\frac{3V}{4\pi}}$

8 **a** $x = \frac{abz}{cdy}$ **b** $x = \frac{3dz}{4\pi cpy^2}$

9 $\sin B = \frac{b \sin A}{a}$

10 **a** $x = \frac{q + pt}{q - ps}$ **b** $x = \frac{3py + 2pqy}{3p - apq} = \frac{y(3 + 2q)}{3 - aq}$

Volume and surface area of 3D shapes

Answers

1 **a** $V = 396\text{ cm}^3$

b $V = 402.5\text{ cm}^3$

c $V = 1008\pi\text{ cm}^3$

d $V = 121.5\pi\text{ cm}^3$

e $V = 48\pi\text{ cm}^3$

2 17 cm

3 17 cm

4 21.4 cm

5 $r = \sqrt[3]{36x}$

Area under a graph

Answers

1 34 units^2

2 149 units^2

3 42 units^2

4 $26\frac{7}{8}$ units^2

5 35 units^2