



## Answers

1 a  $3\sqrt{5}$

c  $4\sqrt{3}$

e  $10\sqrt{3}$

g  $6\sqrt{2}$

b  $5\sqrt{5}$

d  $5\sqrt{7}$

f  $2\sqrt{7}$

h  $9\sqrt{2}$

2 a  $15\sqrt{2}$

c  $3\sqrt{2}$

e  $6\sqrt{7}$

b  $\sqrt{5}$

d  $\sqrt{3}$

f  $5\sqrt{3}$

3 a  $-1$

c  $10\sqrt{5}-7$

b  $9-\sqrt{3}$

d  $26-4\sqrt{2}$

4 a  $\frac{\sqrt{5}}{5}$

c  $\frac{2\sqrt{7}}{7}$

e  $\sqrt{2}$

g  $\frac{\sqrt{3}}{3}$

b  $\frac{\sqrt{11}}{11}$

d  $\frac{\sqrt{2}}{2}$

f  $\sqrt{5}$

h  $\frac{1}{3}$

5 a  $\frac{3+\sqrt{5}}{4}$

b  $\frac{2(4-\sqrt{3})}{13}$

c  $\frac{6(5+\sqrt{2})}{23}$

6  $x-y$

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

b  $\frac{\sqrt{x}+\sqrt{y}}{x-y}$

## Answers

1 a 1

b 1

c 1

d 1

2 a 7

b 4

c 5

d 2

3 a 125

b 32

c 343

d 8

4 a  $\frac{1}{25}$

b  $\frac{1}{64}$

c  $\frac{1}{32}$

d  $\frac{1}{36}$

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

b  $5x^2$

c  $3x$

d  $\frac{y}{2x^2}$

e  $y^{\frac{1}{2}}$

f  $c^{-3}$

g  $2x^6$

h  $x$

6 a  $\frac{1}{2}$

b  $\frac{1}{9}$

c  $\frac{8}{3}$

d  $\frac{1}{4}$

e  $\frac{4}{3}$

f  $\frac{16}{9}$

7 a  $x^{-1}$

b  $x^{-7}$

c  $x^{\frac{1}{4}}$

d  $x^{\frac{2}{5}}$

e  $x^{\frac{1}{3}}$

f  $x^{\frac{2}{3}}$

8 a  $\frac{1}{x^3}$

b 1

c  $\sqrt[5]{x}$

d  $\sqrt[5]{x^2}$

e  $\frac{1}{\sqrt{x}}$

f  $\frac{1}{\sqrt[4]{x^3}}$

9 a  $5x^{\frac{1}{2}}$

b  $2x^{-3}$

c  $\frac{1}{3}x^{-4}$

d  $2x^{\frac{1}{2}}$

e  $4x^{\frac{-1}{3}}$

f  $3x^0$

10 a  $x^3 + x^{-2}$

b  $x^3 + x$

c  $x^{-2} + x^{-7}$

## 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**  $(x - 8)(x + 3)$   
     **e**  $(x - 9)(x + 2)$                       **f**  $(x + 5)(x - 4)$   
     **g**  $(x - 8)(x + 5)$                       **h**  $(x + 7)(x - 4)$
- 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**  $(3x - 1)(3x - 4)$   
     **e**  $(5x + 3)(2x + 3)$                       **f**  $2(3x - 2)(2x - 5)$
- 5   **a**  $\frac{2(x+2)}{x-1}$                                       **b**  $\frac{x}{x-1}$   
     **c**  $\frac{x+2}{x}$     **d**  $\frac{x}{x+5}$   
     **e**  $\frac{x+3}{x}$     **f**  $\frac{x}{x-5}$
- 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    $(x + 5)$
- 8    $\frac{4(x+2)}{x-2}$

## Answers

1 a  $(x+2)^2 - 1$

b  $(x-5)^2 - 28$

c  $(x-4)^2 - 16$

d  $(x+3)^2 - 9$

e  $(x-1)^2 + 6$

f  $\left(x + \frac{3}{2}\right)^2 - \frac{17}{4}$

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

## 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  $x = 2$   
     **g**  $x = 4$  or  $x = 6$       **h**  $x = -6$  or  $x = 6$   
     **i**  $x = -7$  or  $x = 4$       **j**  $x = 3$   
  
     **k**  $x = -\frac{1}{2}$  or  $x = 4$       **l**  $x = -\frac{2}{3}$  or  $x = 5$
- 2   **a**  $x = -2$  or  $x = 5$       **b**  $x = -1$  or  $x = 3$   
     **c**  $x = -8$  or  $x = 3$       **d**  $x = -6$  or  $x = 7$   
     **e**  $x = -5$  or  $x = 5$       **f**  $x = -4$  or  $x = 7$   
  
     **g**  $x = -3$  or  $x = 2\frac{1}{2}$       **h**  $x = -\frac{1}{3}$  or  $x = 2$
- 3   **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  $x = 1 - \sqrt{7}$   
  
     **e**  $x = -2 + \sqrt{6.5}$  or  $x = -2 - \sqrt{6.5}$       **f**  $x = \frac{-3 + \sqrt{89}}{10}$  or  $x = \frac{-3 - \sqrt{89}}{10}$
- 4   **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  $x = \frac{5 - \sqrt{13}}{2}$
- 5   **a**  $x = -1 + \frac{\sqrt{3}}{3}$  or  $x = -1 - \frac{\sqrt{3}}{3}$       **b**  $x = 1 + \frac{3\sqrt{2}}{2}$  or  $x = 1 - \frac{3\sqrt{2}}{2}$
- 6    $x = \frac{7 + \sqrt{41}}{2}$  or  $x = \frac{7 - \sqrt{41}}{2}$

$$7 \quad x = \frac{-3 + \sqrt{89}}{20} \text{ or } x = \frac{-3 - \sqrt{89}}{20}$$

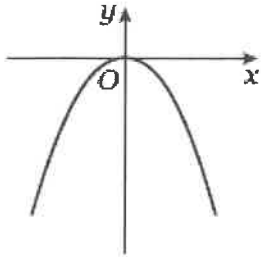
$$8 \quad \mathbf{a} \quad x = \frac{7 + \sqrt{17}}{8} \text{ or } x = \frac{7 - \sqrt{17}}{8}$$

$$\mathbf{b} \quad x = -1 + \sqrt{10} \text{ or } x = -1 - \sqrt{10}$$

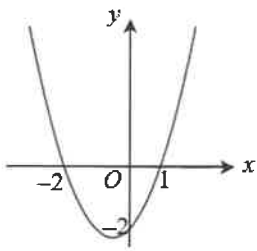
$$\mathbf{c} \quad x = -1\frac{2}{3} \text{ or } x = 2$$

## Answers

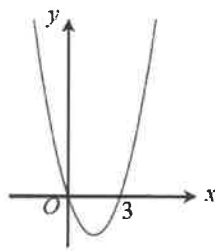
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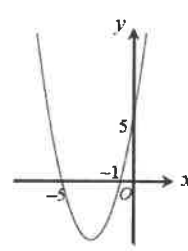
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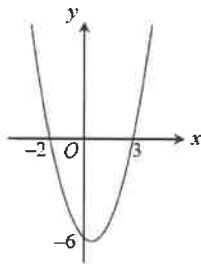
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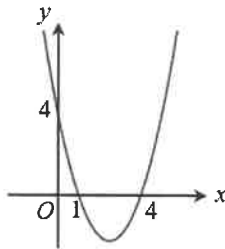
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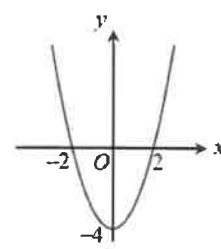
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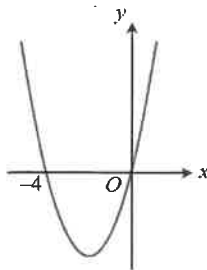
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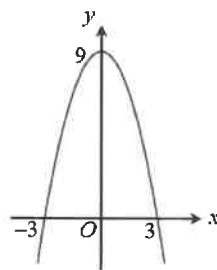
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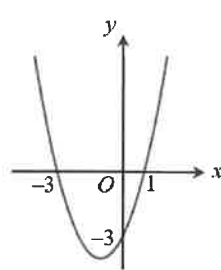
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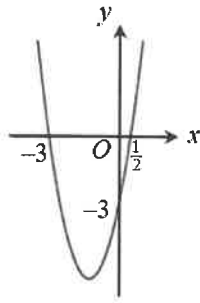
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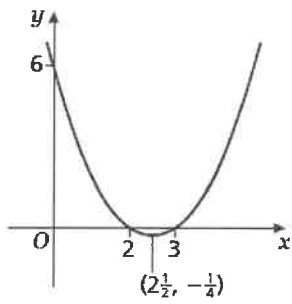
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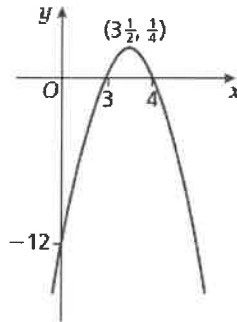
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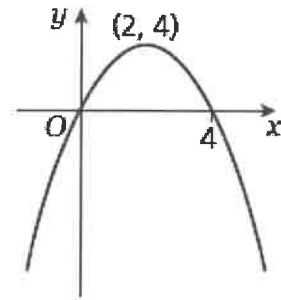
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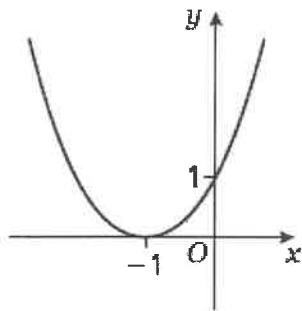
b



c



6



Line of symmetry at  $x = -1$ .

## Answers

1  $x = 1, y = 4$

2  $x = 3, y = -2$

3  $x = 2, y = -5$

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

5  $x = 6, y = -1$

6  $x = -2, y = 5$

7  $x = 9, y = 5$

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

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

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

11  $x = -4, y = 5$

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

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

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

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

## Answers

1  $x = 1, y = 3$

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

2  $x = 2, y = 4$

$$x = 4, y = 2$$

3  $x = 1, y = -2$

$$x = 2, y = -1$$

4  $x = 4, y = 1$

$$x = \frac{16}{5}, y = \frac{13}{5}$$

5  $x = 3, y = 4$

$$x = 2, y = 1$$

6  $x = 7, y = 2$

$$x = -1, y = -6$$

7  $x = 0, y = 5$

$$x = -5, y = 0$$

8  $x = -\frac{8}{3}, y = -\frac{19}{3}$

$$x = 3, y = 5$$

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

$$x = 2, y = 4$$

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

$$x = 3, y = 5$$

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

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

**12**  $x = \frac{-1+\sqrt{7}}{2}, y = \frac{3+\sqrt{7}}{2}$

$$x = \frac{-1-\sqrt{7}}{2}, y = \frac{3-\sqrt{7}}{2}$$



## Answers

1 a  $x > 4$

b  $x \leq 2$

c  $x \leq -1$

d  $x > -\frac{7}{2}$

e  $x \geq 10$

f  $x < -15$

2 a  $x < -20$

b  $x \leq 3.5$

c  $x < 4$

3 a  $x \leq -4$

b  $-1 \leq x < 5$

c  $x \leq 1$

d  $x < -3$

e  $x > 2$

f  $x \leq -6$

4 a  $t < \frac{5}{2}$

b  $n \geq \frac{7}{5}$

5 a  $x < -6$

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

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

## Answers

1  $-7 \leq x \leq 4$

2  $x \leq -2$  or  $x \geq 6$

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

4  $x < -\frac{3}{2}$  or  $x > \frac{1}{2}$

5  $-3 \leq x \leq 4$

6  $-3 \leq x \leq 2$

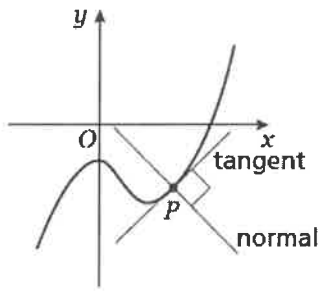
7  $2 < x < 2\frac{1}{2}$

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

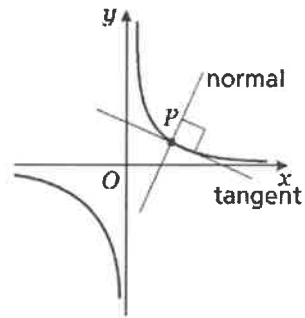
**Answers**

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

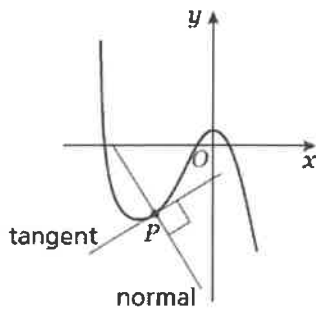
b ii



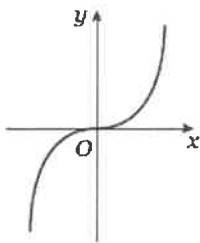
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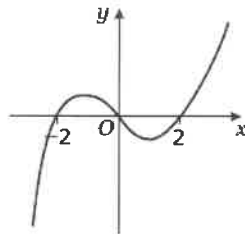
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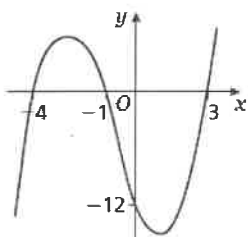
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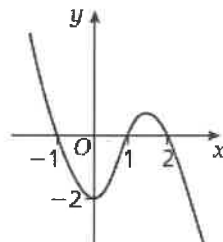
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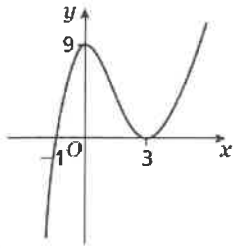
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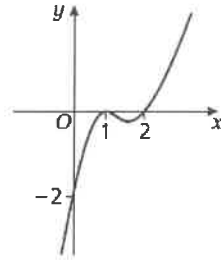
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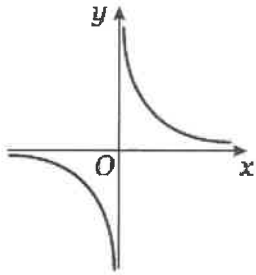
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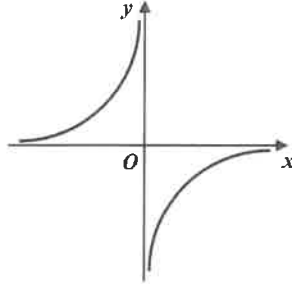
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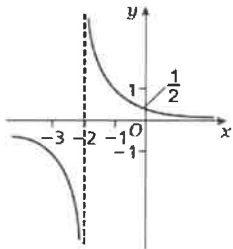
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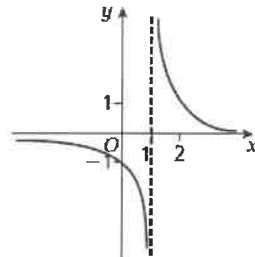
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10

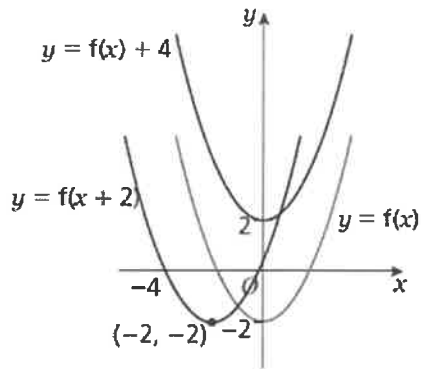


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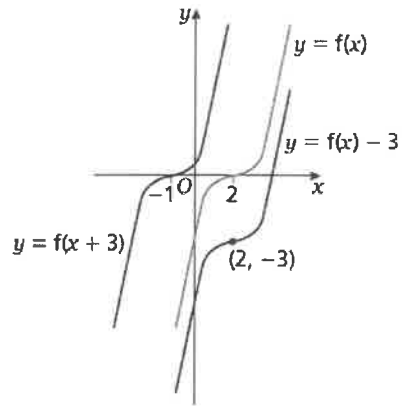


Answers

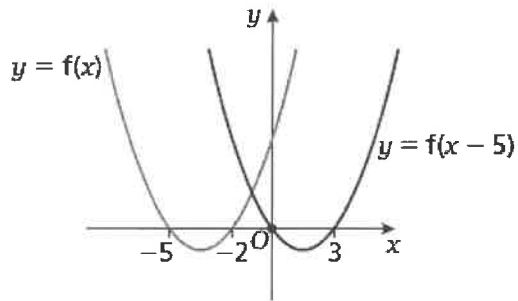
1



2



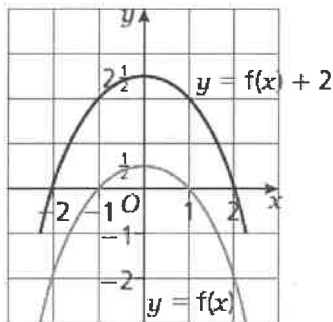
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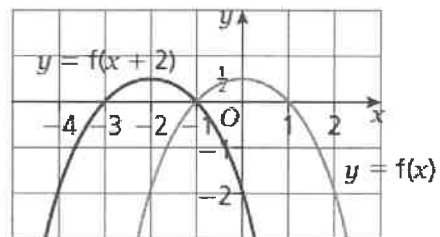
- 4  $C_1: y = f(x - 90^\circ)$   
 $C_2: y = f(x) - 2$

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

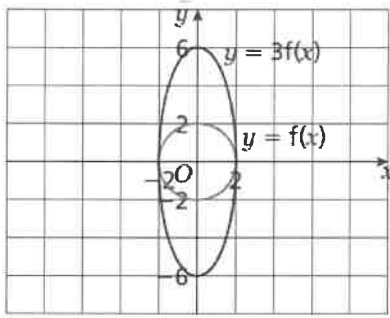
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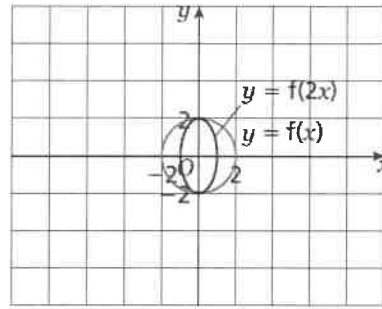
b



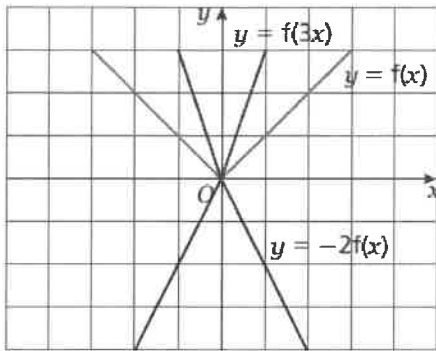
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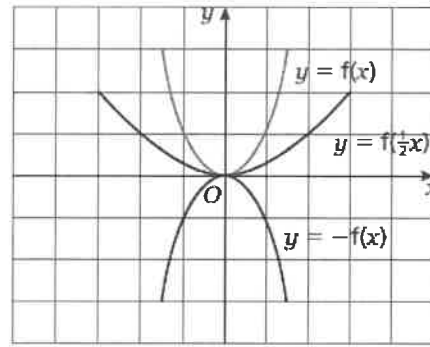
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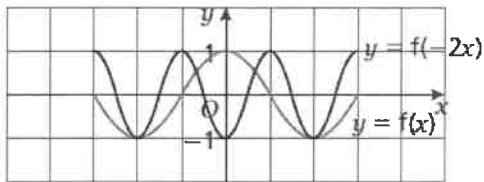
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9



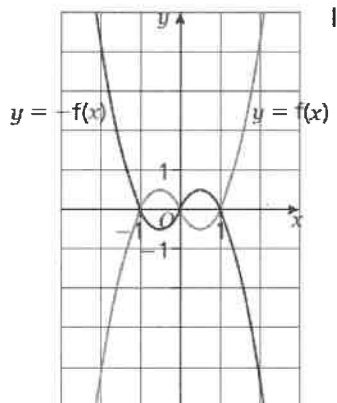
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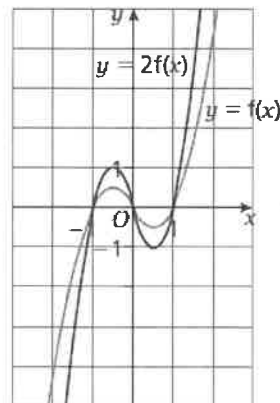
11  $y = f(2x)$

12  $y = -2f(2x)$  or  $y = 2f(-2x)$

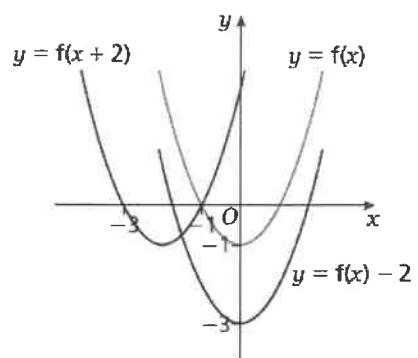
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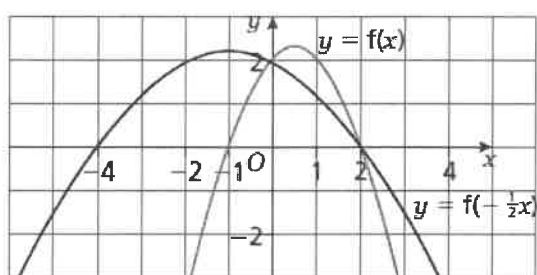
b



14



15



## Answers

- 1 **a**  $m = 3, c = 5$                       **b**  $m = -\frac{1}{2}, c = -7$
- c**  $m = 2, c = -\frac{3}{2}$                       **d**  $m = -1, c = 5$
- e**  $m = \frac{2}{3}, c = -\frac{7}{3}$  or  $-2\frac{1}{3}$                       **f**  $m = -5, c = 4$

2

Gradient	y-intercept	Equation of the line
5	0	$y = 5x$
-3	2	$y = -3x + 2$
4	-7	$y = 4x - 7$

- 3 **a**  $x + 2y + 14 = 0$                       **b**  $2x - y = 0$
- c**  $2x - 3y + 12 = 0$                       **d**  $6x + 5y + 10 = 0$

4  $y = 4x - 3$

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

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

**c**  $y = 5x - 2$                       **d**  $y = -3x + 19$

7  $y = -\frac{3}{2}x + 3$ , the gradient is  $-\frac{3}{2}$  and the y-intercept is 3.

The line intercepts the axes at (0, 3) and (2, 0).

Students may sketch the line or give coordinates that lie on the line such as  $\left(1, \frac{3}{2}\right)$  or (4, -3).

## Answers

1 a  $y = 3x - 7$

b  $y = -2x + 5$

c  $y = -\frac{1}{2}x$

d  $y = \frac{3}{2}x + 8$

2  $y = -2x - 7$

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

b  $y = 3x + 7$

c  $y = -4x + 35$

d  $y = \frac{5}{2}x - 8$

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

b  $y = 2x$

5 a Parallel

b Neither

c Perpendicular

d Perpendicular

e Neither

f Parallel

6 a  $x + 2y - 4 = 0$

b  $x + 2y + 2 = 0$

c  $y = 2x$

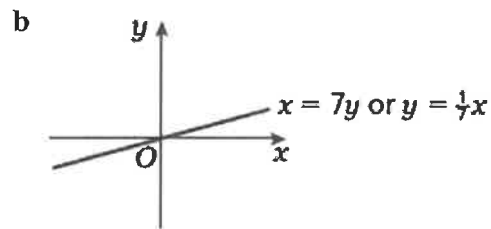
## Answers

- 1   **a**   10.3 cm                      **b**   7.07 cm  
     **c**   58.6 mm                      **d**   8.94 cm
- 2   **a**    $4\sqrt{3}$  cm                      **b**    $2\sqrt{21}$  cm  
     **c**    $8\sqrt{17}$  mm                    **d**    $18\sqrt{5}$  mm
- 3   **a**    $18\sqrt{13}$  mm                   **b**    $2\sqrt{145}$  mm  
     **c**    $42\sqrt{2}$  mm                    **d**    $6\sqrt{89}$  mm
- 4   95.3 mm
- 5   64.0 km
- 6    $3\sqrt{5}$  units
- 7    $4\sqrt{3}$  cm

## Answers

1 £77

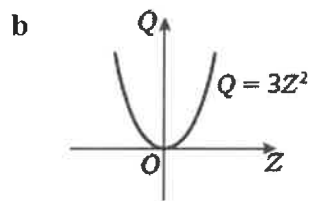
2 a  $x = 7y$



c 91

d 9

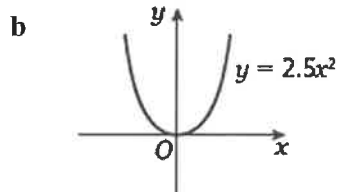
3 a  $Q = 3Z^2$



c 75

d  $\pm 10$

4 a  $y = 2.5x^2$



c  $\pm 6$

5 a 16

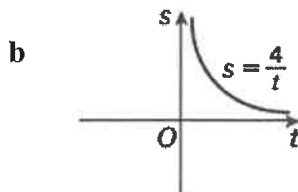
b 100

6 300

7 11.1

8 5

9 a  $s = \frac{4}{t}$



c 4

10 a 2

b 10

11 a  $v = \frac{80}{w}$

c 40

12 6

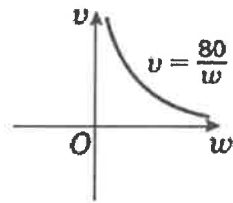
13 a 24

14 1

15 1

16 a 0.1

b



b 4

b 0.1

## Answers

- 1   **a**    $a = 112^\circ$ , angle OAP = angle OBP =  $90^\circ$  and angles in a quadrilateral total  $360^\circ$ .  
   **b**    $b = 66^\circ$ , triangle OAB is isosceles, Angle OAP =  $90^\circ$  as AP is tangent to the circle.  
   **c**    $c = 126^\circ$ , triangle OAB is isosceles.  
      $d = 63^\circ$ , Angle OBP =  $90^\circ$  as BP is tangent to the circle.  
   **d**    $e = 44^\circ$ , the triangle is isosceles, so angles  $e$  and angle OBA are equal. The angle OBP =  $90^\circ$  as BP is tangent to the circle.  
      $f = 92^\circ$ , the triangle is isosceles.  
   **e**    $g = 62^\circ$ , triangle ABP is isosceles as AP and BP are both tangents to the circle.  
      $h = 28^\circ$ , the angle OBP =  $90^\circ$ .
- 2   **a**    $a = 130^\circ$ , angles in a full turn total  $360^\circ$ .  
      $b = 65^\circ$ , the angle at the centre of a circle is twice the angle at the circumference.  
      $c = 115^\circ$ , opposite angles in a cyclic quadrilateral total  $180^\circ$ .  
   **b**    $d = 36^\circ$ , isosceles triangle.  
      $e = 108^\circ$ , angles in a triangle total  $180^\circ$ .  
      $f = 54^\circ$ , angle in a semicircle is  $90^\circ$ .  
   **c**    $g = 127^\circ$ , angles at a full turn total  $360^\circ$ , the angle at the centre of a circle is twice the angle at the circumference.  
   **d**    $h = 36^\circ$ , the angle at the centre of a circle is twice the angle at the circumference.
- 3   **a**    $a = 25^\circ$ , angles in the same segment are equal.  
      $b = 45^\circ$ , angles in the same segment are equal.  
   **b**    $c = 44^\circ$ , angles in the same segment are equal.  
      $d = 46^\circ$ , the angle in a semicircle is  $90^\circ$  and the angles in a triangle total  $180^\circ$ .  
   **c**    $e = 48^\circ$ , the angle at the centre of a circle is twice the angle at the circumference.  
      $f = 48^\circ$ , angles in the same segment are equal.  
   **d**    $g = 100^\circ$ , angles at a full turn total  $360^\circ$ , the angle at the centre of a circle is twice the angle at the circumference.  
      $h = 100^\circ$ , angles in the same segment are equal.
- 4   **a**    $a = 75^\circ$ , opposite angles in a cyclic quadrilateral total  $180^\circ$ .  
      $b = 105^\circ$ , angles on a straight line total  $180^\circ$ .  
      $c = 94^\circ$ , opposite angles in a cyclic quadrilateral total  $180^\circ$ .  
   **b**    $d = 92^\circ$ , opposite angles in a cyclic quadrilateral total  $180^\circ$ .  
      $e = 88^\circ$ , angles on a straight line total  $180^\circ$ .  
      $f = 92^\circ$ , angles in the same segment are equal.  
   **c**    $h = 80^\circ$ , alternate segment theorem.  
   **d**    $g = 35^\circ$ , alternate segment theorem and the angle in a semicircle is  $90^\circ$ .

5 Angle  $BAT = x$ .

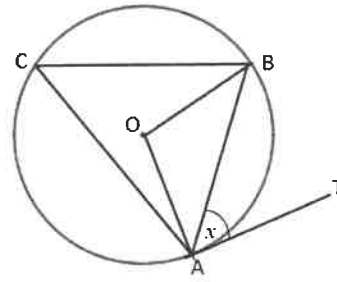
Angle  $OAB = 90^\circ - x$  because the angle between the tangent and the radius is  $90^\circ$ .

$OA = OB$  because radii are equal.

Angle  $OAB =$  angle  $OBA$  because the base of isosceles triangles are equal.

Angle  $AOB = 180^\circ - (90^\circ - x) - (90^\circ - x) = 2x$  because angles in a triangle total  $180^\circ$ .

Angle  $ACB = 2x \div 2 = x$  because the angle at the centre is twice the angle at the circumference.



## Answers

- 1   **a** 6.49 cm                      **b** 6.93 cm                      **c** 2.80 cm  
     **d** 74.3 mm                      **e** 7.39 cm                      **f** 6.07 cm
- 2   **a** 36.9°                      **b** 57.1°                      **c** 47.0°                      **d** 38.7°
- 3   5.71 cm
- 4   20.4°
- 5   **a** 45°                      **b** 1 cm                      **c** 30°                      **d**  $\sqrt{3}$  cm
- 6   **a** 6.46 cm                      **b** 9.26 cm                      **c** 70.8 mm                      **d** 9.70 cm
- 7   **a** 22.2°                      **b** 52.9°                      **c** 122.9°                      **d** 93.6°
- 8   **a** 13.7 cm                      **b** 76.0°
- 9   **a** 4.33 cm                      **b** 15.0 cm                      **c** 45.2 mm                      **d** 6.39 cm
- 10 **a** 42.8°                      **b** 52.8°                      **c** 53.6°                      **d** 28.2°
- 11 **a** 8.13 cm                      **b** 32.3°
- 12 **a** 18.1 cm<sup>2</sup>                      **b** 18.7 cm<sup>2</sup>                      **c** 693 mm<sup>2</sup>
- 13 5.10 cm
- 14 **a** 6.29 cm                      **b** 84.3°                      **c** 5.73 cm                      **d** 58.8°
- 15 15.3 cm

## Answers

$$1 \quad d = \frac{C}{\pi}$$

$$2 \quad w = \frac{P-2l}{2}$$

$$3 \quad T = \frac{S}{D}$$

$$4 \quad t = \frac{q-r}{p}$$

$$5 \quad t = \frac{2u}{2a-1}$$

$$6 \quad x = \frac{V}{a+4}$$

$$7 \quad y = 2 + 3x$$

$$8 \quad a = \frac{3x+1}{x+2}$$

$$9 \quad d = \frac{b-c}{x}$$

$$10 \quad g = \frac{2h+9}{7-h}$$

$$11 \quad e = \frac{1}{x+7}$$

$$12 \quad x = \frac{4y-3}{2+y}$$

$$13 \quad \text{a} \quad r = \sqrt{\frac{A}{\pi}}$$

$$\text{b} \quad r = \sqrt[3]{\frac{3V}{4\pi}}$$

$$\text{c} \quad r = \frac{P}{\pi+2}$$

$$\text{d} \quad r = \sqrt{\frac{3V}{2\pi h}}$$

$$14 \quad \text{a} \quad x = \frac{abz}{cdy}$$

$$\text{b} \quad x = \frac{3dz}{4\pi cpy^2}$$

$$15 \quad \sin B = \frac{b \sin A}{a}$$

$$16 \quad \cos B = \frac{a^2 + c^2 - b^2}{2ac}$$

17 a  $x = \frac{q + pt}{q - ps}$

b  $x = \frac{3py + 2pgy}{3p - apq} = \frac{y(3 + 2q)}{3 - aq}$



## Answers

1 34 units<sup>2</sup>

2 149 units<sup>2</sup>

3 14 units<sup>2</sup>

4  $25\frac{1}{4}$  units<sup>2</sup>

5 35 units<sup>2</sup>

6 42 units<sup>2</sup>

7  $26\frac{7}{8}$  units<sup>2</sup>

8 56 units<sup>2</sup>

9 35 units<sup>2</sup>

10  $6\frac{1}{4}$  units<sup>2</sup>