



2 $f(x) = x - 3$

$g(x) = x^2 + 1$

$h(x) = 10x$

(a) Work out $fg(x)$

Fully simplify your answer.

$$\begin{aligned}
 & f(g(x)) \\
 &= f(x^2 + 1) \\
 &= (x^2 + 1) - 3 \\
 &= x^2 - 2
 \end{aligned}$$

$$fg(x) = \underline{x^2 - 2} \quad (2)$$

(b) Work out $hg(x)$

Fully simplify your answer.

$$\begin{aligned}
 & h(g(x)) \\
 &= h(x^2 + 1) \\
 &= 10(x^2 + 1) \\
 &= 10x^2 + 10
 \end{aligned}$$

$$hg(x) = \underline{10x^2 + 10} \quad (2)$$

(c) Work out $gh(x)$

Fully simplify your answer.

$$\begin{aligned}
 & g(h(x)) \\
 &= g(10x) \\
 &= 10x^2 + 1
 \end{aligned}$$

$g(x) = x^2 + 1$

$$= (10x)^2 + 1$$

$$= 10x \times 10x + 1$$

$$= 100x^2 + 1$$

$$gh(x) = \underline{100x^2 + 1} \quad (2)$$

(Total for Question 2 is 6 marks)

3 $f(x) = \frac{x}{4}$

$g(x) = 4x - 8$

$h(x) = \sqrt{x}$



(a) Work out $fg(x)$

Fully simplify your answer.

$$\begin{aligned} f(g(x)) \\ &= f(4x-8) \\ &= \frac{4x-8}{4} \\ &= x-2 \end{aligned}$$

$fg(x) = \underline{x-2}$
(2)

(b) Work out $gf(x)$

Fully simplify your answer.

$$\begin{aligned} g(f(x)) \\ &= g\left(\frac{x}{4}\right) \\ &= 4\left(\frac{x}{4}\right) - 8 \\ &= \frac{4x}{4} - 8 \\ &= x - 8 \end{aligned}$$

$gf(x) = \underline{x-8}$
(2)

(c) Work out $hf(x)$

Fully simplify your answer.

$$\begin{aligned} h(f(x)) \\ &= h\left(\frac{x}{4}\right) \\ &= \sqrt{\frac{x}{4}} = \frac{\sqrt{x}}{\sqrt{4}} = \frac{\sqrt{x}}{2} \end{aligned}$$

$hf(x) = \underline{\sqrt{\frac{x}{4}}}$
(2)

(Total for Question 3 is 6 marks)

2 $f(x) = \frac{2x+3}{4}$

$g(x) = x^2 - 6$



(a) Find $f^{-1}(x)$

$$\begin{array}{r} x \quad \times 2 \quad + 3 \quad \div 4 \\ \div 2 \quad - 3 \quad \times 4 \quad x \\ \hline 4x - 3 \\ \hline 2 \end{array}$$

$$f^{-1}(x) = \frac{4x-3}{2} \quad (2)$$

(b) Find $g^{-1}(x)$

$$\begin{array}{r} x^2 - 6 \\ \sqrt{\quad} + 6 \quad x \end{array}$$

$$g^{-1}(x) = \sqrt{x+6} \quad (2)$$

(Total for Question 2 is 4 marks)

3 $f(x) = 50 - x^2$

$g(x) = 4x^2 - 1$



(a) Find $f^{-1}(1)$

$$\begin{array}{r} -x^2 + 50 \\ \sqrt{\quad} - 50 \quad x \\ \hline \sqrt{1-50} \end{array}$$

$$\begin{array}{r} x^2 \quad -x^2 \quad 50-x^2 \\ \downarrow \quad \downarrow \quad \downarrow \\ x^2 \quad \times (-1) \quad +50 \\ \sqrt{\quad} \div (-1) \quad -50 \end{array}$$

$$\frac{x-50}{-1} = \frac{x}{-1} - \frac{50}{-1} \quad \sqrt{1-50} \quad (2)$$

(b) Find $g^{-1}(0)$

$$\begin{array}{r} x \quad \times 4 \quad 2 \quad - 1 \\ \div 4 \quad \sqrt{\quad} + 1 \quad x \end{array}$$

$$= -x + 50$$

$$f^{-1}(x) = \sqrt{50-x}$$

$$f^{-1}(1) = \sqrt{50-1} = \sqrt{49} = 7$$

$$\frac{\sqrt{0+1}}{4}$$

$$0.25$$

(2)

(Total for Question 3 is 4 marks)

4 $f(x) = \frac{2x^3}{5}$

$g(x) = \frac{x}{4} - 3$



(a) Find $f^{-1}(x)$

$$\begin{array}{cccc} x & \times 2 & 3 & \div 5 \\ \div 2 & - 3 & \times 5 & x \end{array}$$

$$\begin{array}{cccc} x & ^3 & \times 2 & \div 5 \\ \sqrt[3]{} & \div 2 & \times 5 & \end{array}$$

$$f^{-1}(x) = \sqrt[3]{\frac{5x}{2}}$$

$$f^{-1}(x) = \frac{5x-3}{2} \quad (2)$$

(b) Find $g^{-1}(x)$

$$\begin{array}{ccc} x & \div 4 & - 3 \\ \times 4 & + 3 & x \end{array}$$

$$4(x+3)$$

$$g(x) = \frac{x}{4} - 3$$

$$g^{-1}(x) = x+12 \quad (2)$$

(Total for Question 4 is 4 marks)

5 $f(x) = \sqrt[3]{100-x}$

$g(x) = 2(x+14)$



(a) Find $f^{-1}(4)$

$$\begin{array}{ccc} x & - 100 & \sqrt[3]{} \\ + 100 & 3 & x \\ 4^3 + 100 & & \\ = 164 & & \end{array}$$

$$\begin{array}{cccc} x & \times (-1) & + 100 & \sqrt[3]{} \\ \div (-1) & - 100 & ^3 & \leftarrow x \end{array}$$

$$\frac{x^3 - 100}{-1} = \frac{-x^3 + 100}{-1}$$

$$164 \quad (2)$$

(b) Find $g^{-1}(26)$

$$\begin{array}{ccc} x & + 14 & \times 2 \\ - 14 & \div 2 & x \\ 26 \div 2 & - 14 & \\ = -1 & & \end{array}$$

$$f^{-1}(x) = 100 - x^3$$

$$-1 \quad (2)$$

(Total for Question 5 is 4 marks)

6 $f(x) = \frac{5}{x+10}$

$g(x) = \sqrt{2x^3 - 3}$



(a) Find $f^{-1}(x)$

$$\begin{array}{rcl} x+10 & \div 5 & \\ -10 & \times 5 & x \end{array}$$

$$\begin{array}{rcl} & \frac{1}{x+10} & \\ & \downarrow & \\ x+10 & -1 & \\ -10 & -1 & \div 5 \quad x \end{array}$$

$$\frac{x}{5} = \frac{5}{x} - 10$$

$$f^{-1}(x) = \frac{x-50}{5}$$

(2)

(b) Find $g^{-1}(x)$

$$\begin{array}{rcl} x & \times 2 & -3 \\ \sqrt[3]{} & \div 2 & +3 \quad x \end{array}$$

$$f^{-1}(x) = \frac{5}{x} - 10$$

$$g^{-1}(x) = \sqrt[3]{\frac{x+3}{2}}$$

(2)

(Total for Question 6 is 4 marks)

7 $f(x) = 3 - \frac{2}{x}$

$g(x) = (x-5)^3$



(a) Find $f^{-1}(2.5)$

$$\begin{array}{rcl} x & \div 2 & -3 \\ \times 2 & +3 & x \\ 2.5+3 & \times 2 & \\ = & 8.5 & \end{array}$$

$$\begin{array}{rcl} & \frac{1}{x} & \\ & \downarrow & \\ x & -1 & \times 2 \\ -1 & \div 2 & \times (-1) \\ & & \downarrow \\ & & +3 \end{array}$$

$$\frac{x-3}{-1} = -x+3$$

$$g(x) = (x-5)^3 = \frac{3-x}{2} = \frac{2}{3-x}$$

(b) Find $g^{-1}(-27)$

$$\begin{array}{rcl} x-5 & \sqrt[3]{} & \\ +5 & \sqrt[3]{} & x \\ \sqrt[3]{-27+5} & & \\ = \sqrt[3]{-22} & & \\ = -2.8 & & \end{array}$$

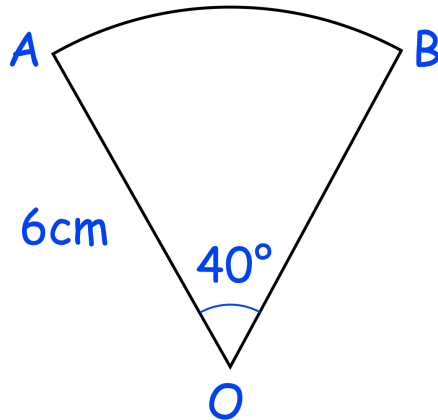
$$f^{-1}(x) = \frac{2}{3-x}$$

$$-2.8$$

(2)

(Total for Question 7 is 4 marks)

3. OAB is a sector of a circle.

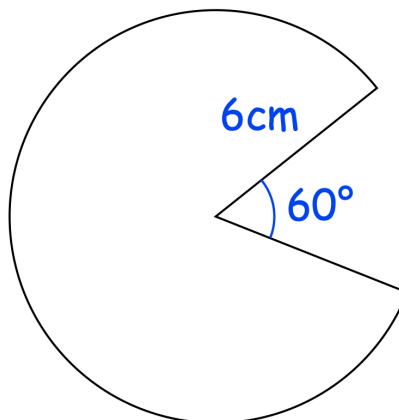


Find the area of the sector.
Give your answer in terms of π

$$\begin{aligned}\frac{\theta}{360} \times \pi r^2 \\ \frac{40}{360} \times \pi \times 6^2 \\ = 4\pi\end{aligned}$$

..... 4π cm²
(3)

4. Shown is a major sector of a circle.

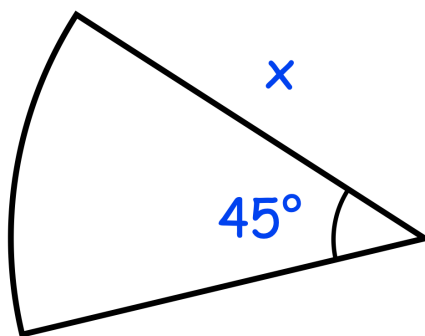


Find the area of the major sector.
Give your answer in terms of π

$$\begin{aligned}360 - 60 &= 300^\circ \\ \frac{300}{360} \times \pi \times 6^2 \\ &= 30\pi\end{aligned}$$

..... 30π cm²
(3)

5. Shown below is a sector of a circle, with radius x cm.



The area of the sector is 18π cm²

Find the length of x .

$$\frac{45}{360} \times \pi r^2 = 18\pi$$

$$45 \times \pi r^2 = 18\pi \times 360$$

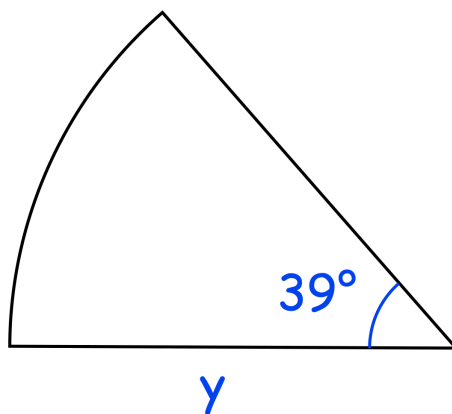
$$45 r^2 = 6480\pi \div \pi$$

$$r = \sqrt{6480 / 45}$$

$$r = 12$$

.....12.....cm
(3)

6. The area of the sector below is 2.48cm²



Find the length of y .

Give your answer to 1 decimal place.

$$\frac{39}{360} \times \pi y^2 = 2.48$$

$$39 \times \pi y^2 = 2.48 \times 360$$

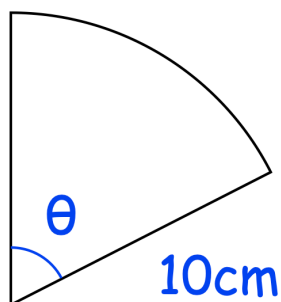
$$39 y^2 = 892.8 \div \pi$$

$$y = \sqrt{228.2 \div 39}$$

$$y = 2.7$$

.....2.7.....cm
(3)

7. Below is a sector of a circle with area $5\pi \text{ cm}^2$



Find the size of angle θ

$$\frac{\theta}{360} \times \pi \times 10^2 = 5\pi$$

$$\theta \times \pi \times 10^2 = 5\pi \times 360$$

$$\theta \times 10^2 = 1800\pi \div \pi \rightarrow$$

$$\theta \times 10 = \sqrt{1800}$$

$$\theta = 42.4 \div 10$$

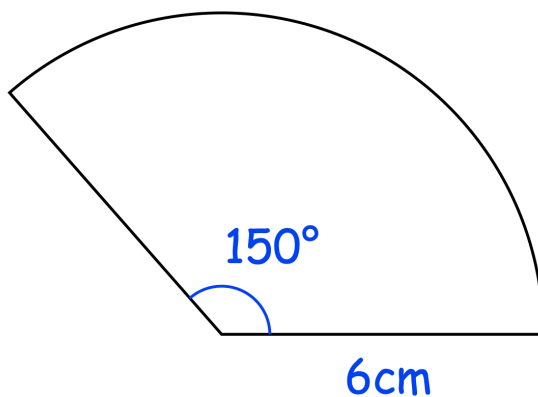
$$\theta = 4.2$$

$$\frac{\theta \times 10^2}{10^2} = \frac{1800}{100}$$

$$\theta = 18^\circ$$

4.2^o
(3)

8. Shown is a sector of a circle.



Find the area of the sector.

Give your answer in terms of π

$$\frac{150}{360} \times \pi \times 6^2$$

$$= 15\pi$$

15\pi cm^2
(3)

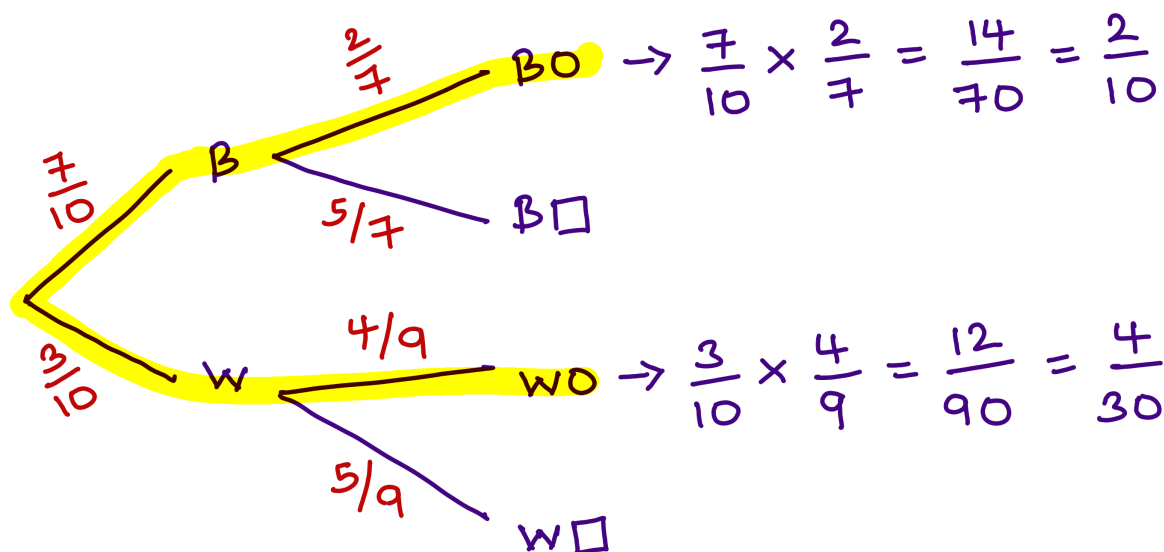
- 14 White shapes and black shapes are used in a game.
Some of the shapes are circles.
All the other shapes are squares.

The ratio of the number of white shapes to the number of black shapes is 3:7

The ratio of the number of white circles to the number of white squares is 4:5

The ratio of the number of black circles to the number of black squares is 2:5

Work out what fraction of all the shapes are circles.



$$\frac{3}{3} \times \frac{2}{10} + \frac{4}{30}$$

$$\frac{6}{30} + \frac{4}{30} = \frac{10}{30} = \frac{1}{3}$$

(Total for Question 14 is 4 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



- 2 On Saturday, some adults and some children were in a theatre.
The ratio of the number of adults to the number of children was 5 : 2

Each person had a seat in the Circle or had a seat in the Stalls.

$\frac{3}{4}$ of the children had seats in the Stalls. $\rightarrow \frac{1}{4}$ in circle

117 children had seats in the Circle.

There are exactly 2600 seats in the theatre.

On this Saturday, were there people on more than 60% of the seats?
You must show how you get your answer.

$$\frac{1}{4} \text{ of children} = 117$$

(x)

$$\cancel{4} \times \frac{1}{\cancel{4}} \times x = 117 \times 4$$

$$x = 468$$

A	:	C	total
5	:	2	7
↓		↓	
1170		468	

$$\frac{2}{2} \text{ parts} = \frac{468}{2}$$

$$1 \text{ part} = 234$$

$$\begin{aligned} \text{Seats occupied} &= 1170 + 468 \\ &= 1638 \end{aligned}$$

$$\frac{1638}{2600} \times \cancel{100} = 63\%$$

(Total for Question 2 is 5 marks)



- 11 Jeff is choosing a shrub and a rose tree for his garden.
At the garden centre there are 17 different types of shrubs and some rose trees.

Jeff says,

“There are 215 different ways to choose one shrub and one rose tree.”

Could Jeff be correct?

You must show how you get your answer.

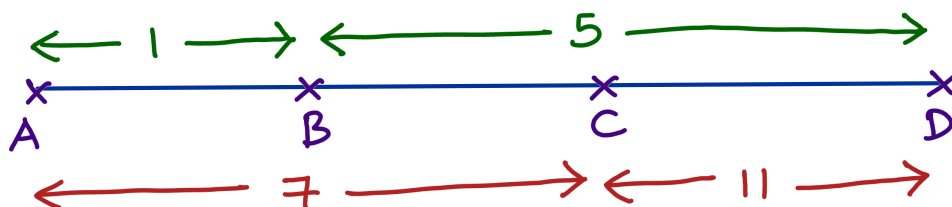
(Total for Question 11 is 2 marks)

- 12 The points A , B , C and D lie in order on a straight line.

$$AB:BD = 1:5$$

$$AC:CD = 7:11$$

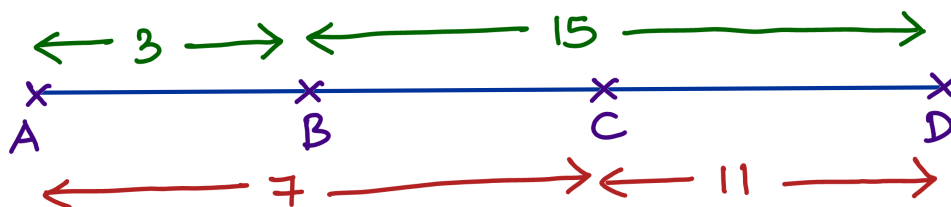
Work out $AB:BC:CD$



Total

6 $\rightarrow$ $\times 3$

18



$$BC = 7 - 3 = 4$$

$$AB:BC:CD = 3:4:11$$

(Total for Question 12 is 3 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



17 p and q are two numbers such that $p > q$

When you subtract 5 from p and subtract 5 from q the answers are in the ratio 5 : 1

When you add 20 to p and add 20 to q the answers are in the ratio 5 : 2

Find the ratio $p : q$

Give your answer in its simplest form.

$$\frac{p-5}{q-5} = \frac{5}{1}$$

$$p-5 = 5(q-5)$$

$$p-5 = 5q-25$$

$$p-5q = -20$$

$$\begin{array}{r} p - 5q = -20 \\ 2p - 5q = 60 \\ \hline (-) \quad (+) \quad (-) \end{array}$$

$$\begin{array}{r} \cancel{p} = \cancel{80} \\ \cancel{1} \quad \cancel{1} \end{array}$$

$$p = 80$$

$$\frac{p+20}{q+20} = \frac{5}{2}$$

$$2(p+20) = 5(q+20)$$

$$2p+40 = 5q+100$$

$$2p-5q = 60$$

$$\begin{array}{r} \cancel{80} - 5q = -20 \\ -\cancel{80} \quad -80 \end{array}$$

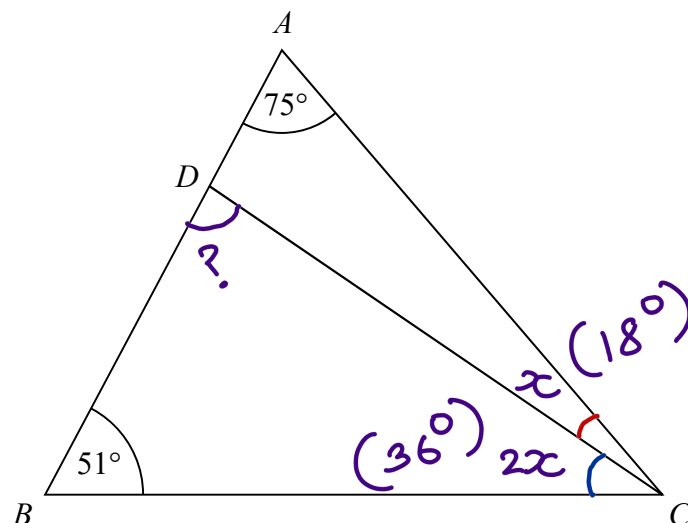
$$\begin{array}{r} \cancel{-5q} = \cancel{-100} \\ \cancel{-5} \quad \cancel{15} \end{array}$$

$$q = 20$$

(Total for Question 17 is 5 marks)



- 5 The diagram shows triangle ABC .



ADB is a straight line.

the size of angle DCB : the size of angle $ACD = 2 : 1$

Work out the size of angle BDC .

$$\frac{2}{1} = \frac{10}{5} = \frac{20}{10} = \frac{40}{20} = \dots$$

$\nearrow \times x$
 $\searrow \times x$

Actual angles = $2x$ and x

$$51 + 75 + 2x + x = 180$$

$$126 + 3x = 180$$

$$3x = 180 - 126$$

$$x = \frac{54}{3}$$

$$x = 18$$

(Total for Question 5 is 4 marks)

