1 Solve $7x - 27 < 8$

$+27 \quad +27$

$7x < 35$

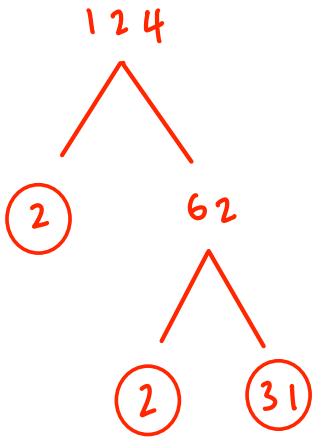
$\div 7 \quad \div 7$

$x < 5$

$x < 5$

(Total for Question 1 is 2 marks)

2 Write 124 as a product of its prime factors.



$2^2 \times 31$

(Total for Question 2 is 2 marks)

3 A delivery company has a total of 160 cars and vans.

the number of cars : the number of vans = 3 : 7 (10 parts)

Each car and each van uses electricity or diesel or petrol.

$\frac{1}{8}$ of the cars use electricity.
25% of the cars use diesel.
The rest of the cars use petrol.

Work out the number of cars that use petrol.
You must show all your working.

160 ÷ 10 = 16 (1 part)

cars : 16 × 3 = 48
vans : 16 × 7 = 112

$\frac{1}{8}$ of 48 = 6 (cars, Electricity)

25% of 48 = 12 (cars, Diesel)

12 + 6 = 18

48 − 18 = 30

30

(Total for Question 3 is 5 marks)

4 (a) Write 1.63×10^{-3} as an ordinary number.

0.00163

(1)

(b) Write 438 000 in standard form.

4.38×10^{5}

(1)

(c) Work out $(4 \times 10^{3}) \times (6 \times 10^{-5})$
Give your answer in standard form.

$= 24 \times 10^{-2}$

$= 2.4 \times 10^{-1}$

2.4×10^{-1}

(2)

(Total for Question 4 is 4 marks)

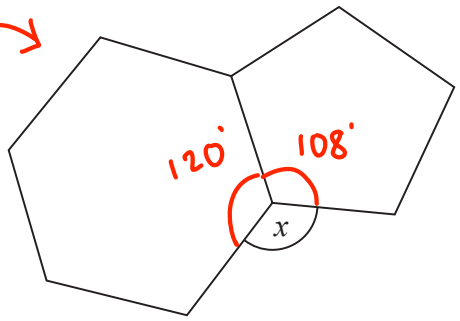
5 Here is a regular hexagon and a regular pentagon.

$(6-2) \times 180$
$= 4 \times 180$
$= 720$

120
$6 \overline{)720}$

$(5-2) \times 180$
$= 3 \times 180$
$= 540$

108
$5 \overline{)540}$



Work out the size of the angle marked x.
You must show all your working.

$120 + 108 = 228$

$360 - 228 = 132$

132 °

(Total for Question 5 is 3 marks)

6 (a) Complete the table of values for $y = x^2 - 3x + 1$

x	−1	0	1	2	3	4
y	5	1	−1	−1	1	5

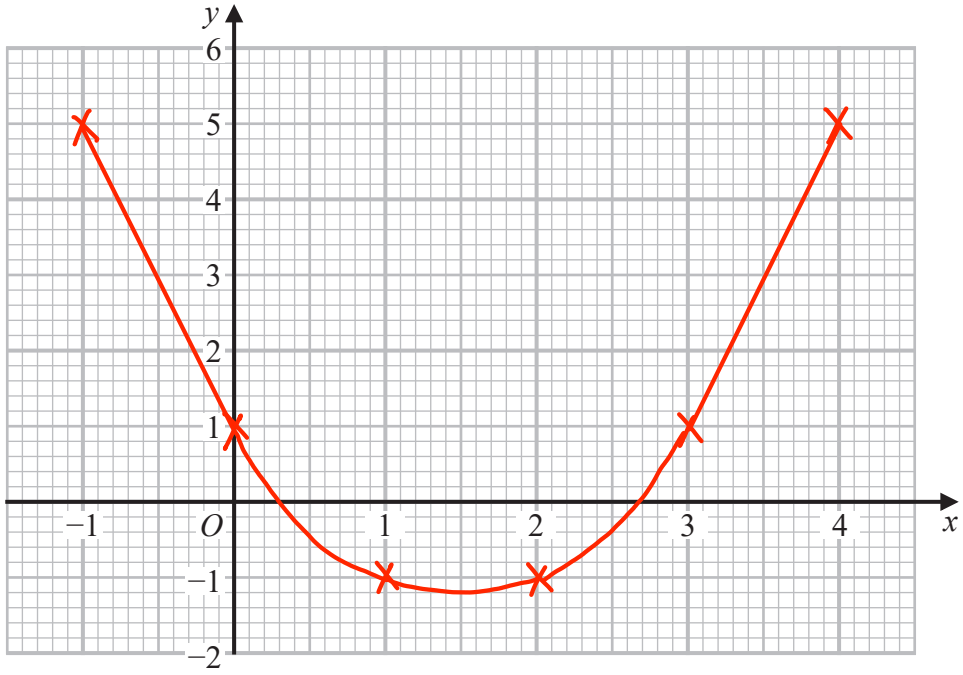
$(-1)^2 - 3(-1) + 1$
$= 1 + 3 + 1$
$= 5$

$(2)^2 - 3(2) + 1$
$= 4 - 6 + 1$
$= -1$

$3(3) - 3(3) + 1$
$= 9 - 9 + 1$
$= 1$

(2)

(b) On the grid, draw the graph of $y = x^2 - 3x + 1$ for values of x from −1 to 4



(2)

(c) Using your graph, find estimates for the solutions of the equation $x^2 - 3x + 1 = 0$

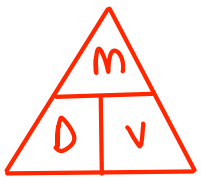
$x = 0.3, 2.7$

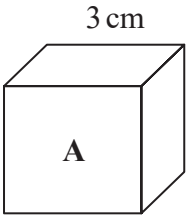
(0.3-0.5 / 2.5-2.7)

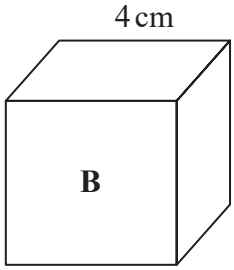
(2)

(Total for Question 6 is 6 marks)

7 Here are two cubes, **A** and **B**.







Cube **A** has a mass of 81 g.

Cube **B** has a mass of 128 g.

Work out

the density of cube **A** : the density of cube **B**

Give your answer in the form $a : b$, where a and b are integers.

Volume A = $3 \times 3 \times 3 = 27\,cm^3$

Volume B = $4 \times 4 \times 4 = 64\,cm^3$

27
54
81

Density A = $\frac{81}{27} = 3$

Density B = $\frac{128}{64} = 2$

3 : 2

(Total for Question 7 is 3 marks)

8 The table shows the amount of snow, in cm, that fell each day for 30 days.

Amount of snow (s cm)	Frequency
$0 \leqslant s < 10$	8
$10 \leqslant s < 20$	10
$20 \leqslant s < 30$	7
$30 \leqslant s < 40$	2
$40 \leqslant s < 50$	3

5 x 8 = 40
15 x 10 = 150
25 x 7 = 175
35 x 2 = 70
45 x 3 = 135
30
570
2 ✓

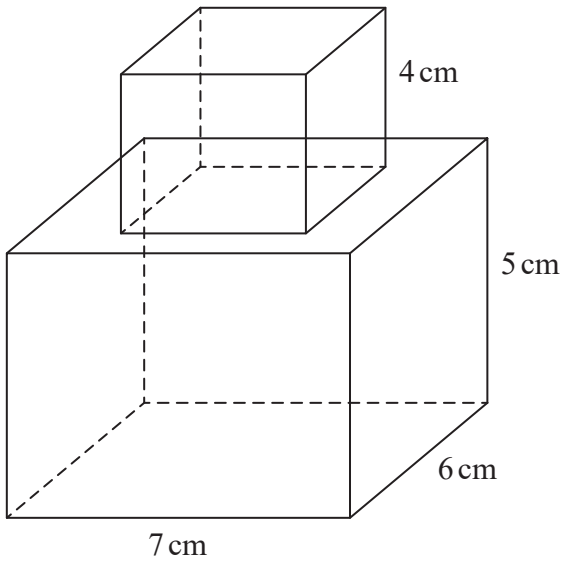
Work out an estimate for the mean amount of snow per day.

$$30 \overline{)\,5^{5}7^{27}0} \quad 0\,1\,9$$

19 cm

(Total for Question 8 is 3 marks)

9 A cube is placed on top of a cuboid, as shown in the diagram, to form a solid.



The cube has edges of length 4 cm.
The cuboid has dimensions 7 cm by 6 cm by 5 cm.

Work out the total surface area of the solid.

Cube : $4 \times 4 = 16$
$16 \times 5 = 80$

Tip: We multiply by 5 as we do not want to include the base of the cube in the surface area

Cuboid : $7 \times 5 = 35 \times 2 = 70$ (front + back)
$6 \times 5 = 30 \times 2 = 60$ (sides)
$7 \times 6 = 42$ (Bottom)
$7 \times 6 = 42 - 16 = 26$ (Top)

198

Tip: To find the surface area of the top of the rectangle, we need to make sure we subtract the area of the base of the cube

$$\begin{array}{r} 198 \\ +\ 80 \\ \hline 278 \end{array}$$

278 ..... cm^2

(Total for Question 9 is 3 marks)

10 The table shows some information about the profit made each day at a cricket club on 100 days.

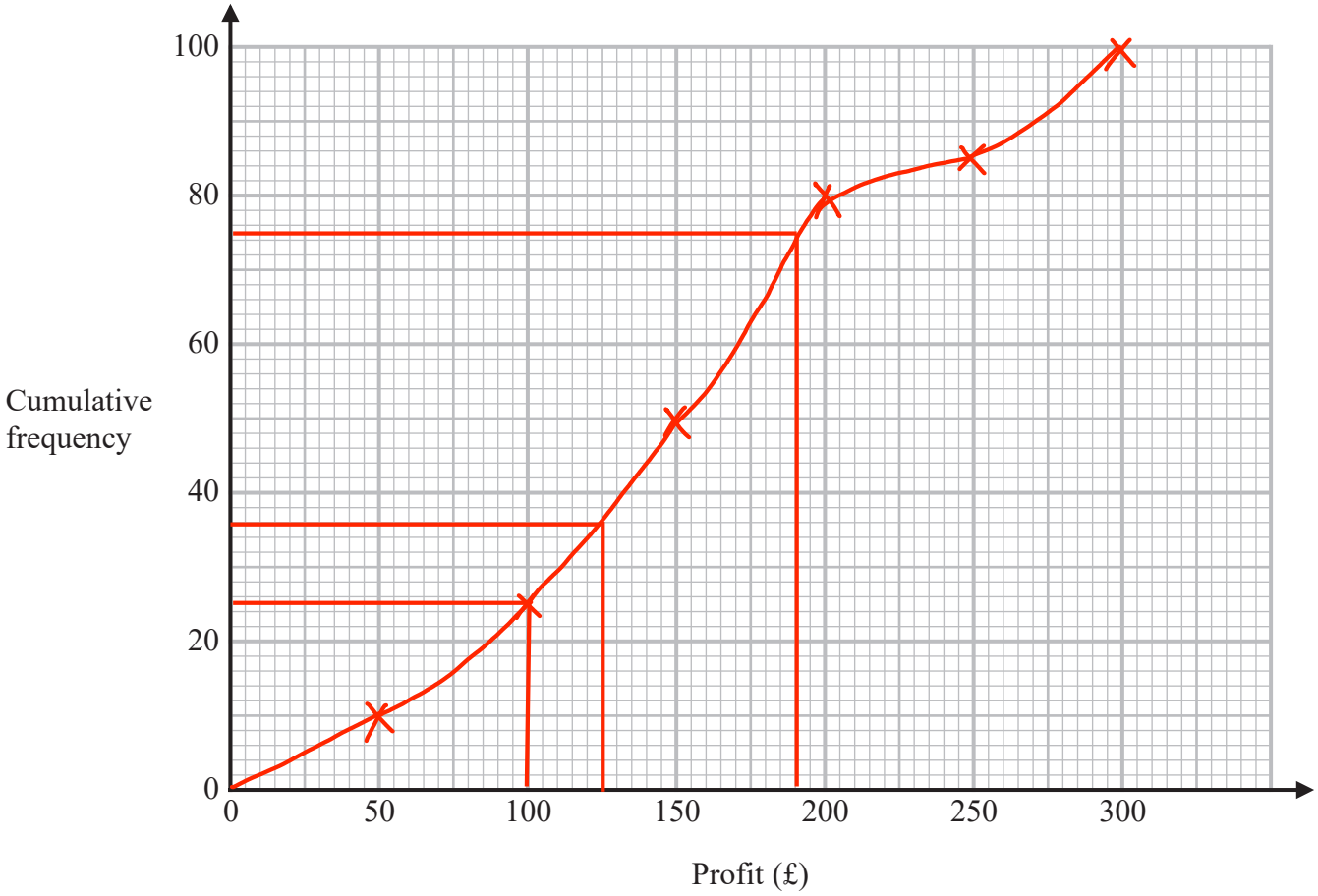
Profit (£x)	Frequency
$0 \leqslant x < 50$	10
$50 \leqslant x < 100$	15
$100 \leqslant x < 150$	25
$150 \leqslant x < 200$	30
$200 \leqslant x < 250$	5
$250 \leqslant x < 300$	15

(a) Complete the cumulative frequency table.

Profit (£x)	Cumulative frequency
$0 \leqslant x < 50$	10
$0 \leqslant x < 100$	25
$0 \leqslant x < 150$	50
$0 \leqslant x < 200$	80
$0 \leqslant x < 250$	85
$0 \leqslant x < 300$	100

(1)

(b) On the grid, draw a cumulative frequency graph for this information.



(2)

(c) Use your graph to find an estimate for the number of days on which the profit was less than £125

36 days
(35 to 39) (1)

(d) Use your graph to find an estimate for the interquartile range.

190 - 100

£ 90
(85 to 93) (2)

(Total for Question 10 is 6 marks)

11 Cormac has some sweets in a bag.
The sweets are lime flavoured or strawberry flavoured or orange flavoured.

In the bag

number of lime flavoured sweets : number of strawberry flavoured sweets : number of orange flavoured sweets $= 9 : 4 : x$

Cormac is going to take at random a sweet from the bag.

The probability that he takes a lime flavoured sweet is $\frac{3}{7} = \frac{9}{21}$

Work out the value of x.

$9 + 4 = 13$

$21 - 13 = 8$

$x =$ 8

(Total for Question 11 is 3 marks)

12 Express $0.1\dot{1}\dot{7}$ as a fraction.
You must show all your working.

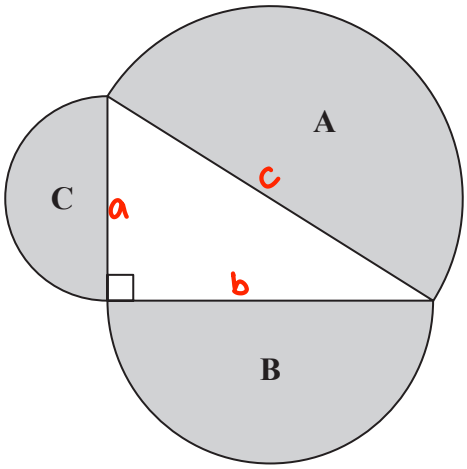
$100x = 11.7777777...$
$-\quad x = 0.1777777...$

$99x = 11.6$
$\div 99 \quad \div 99$
$x = \frac{11.6}{99} = \frac{116}{990}$

$\frac{116}{990}$

(Total for Question 12 is 3 marks)

13 A right-angled triangle is formed by the diameters of three semicircular regions, **A**, **B** and **C** as shown in the diagram.



Show that

area of region **A** = area of region **B** + area of region **C**

using pythagoras : $a^2 + b^2 = c^2$

Area A = $\frac{1}{2} \times \pi \times \left(\frac{c}{2}\right)^2 = \frac{1}{2} \times \pi \times \frac{c^2}{4} = \frac{c^2}{8}\pi$

Area B = $\frac{1}{2} \times \pi \times \left(\frac{b}{2}\right)^2 = \frac{b^2}{8}\pi$

Area C = $\frac{1}{2} \times \pi \times \left(\frac{a}{2}\right)^2 = \frac{a^2}{8}\pi$

$\frac{c^2}{8}\pi = \frac{b^2}{8}\pi + \frac{a^2}{8}\pi$

$\times 8 \quad \times 8$

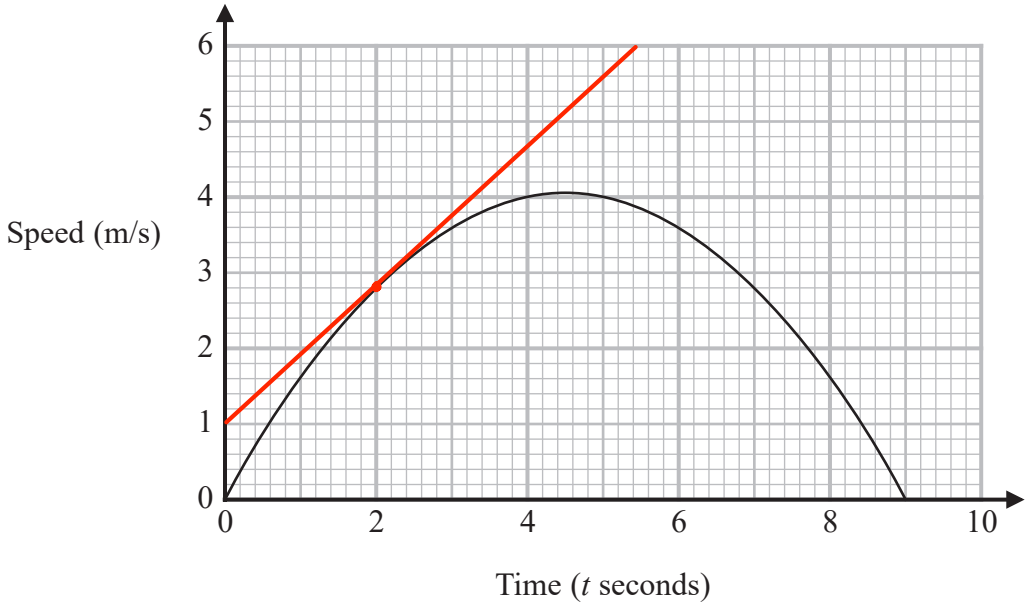
$c^2\pi = b^2\pi + a^2\pi$

$\div \pi \quad \div \pi$

$c^2 = b^2 + a^2$ ⟶ pythagoras !

(Total for Question 13 is 3 marks)

14 Here is a speed-time graph.



(a) Work out an estimate of the gradient of the graph at $t = 2$

Gradient = rise / run = 5 / 5.4 = 50 / 54

50/54

(3)

(0.7 to 1.1)

(b) What does the area under the graph represent?

The distance travelled

(1)

(Total for Question 14 is 4 marks)

15 A, B and C are three points such that

$\overrightarrow{AB} = 3\mathbf{a} + 4\mathbf{b}$

$\overrightarrow{AC} = 15\mathbf{a} + 20\mathbf{b}$ ↘ x5

(a) Prove that A, B and C lie on a straight line.

$\overrightarrow{AC} = 5 \times \overrightarrow{AB}$

on a straight line as $\overrightarrow{AC}$ is a multiple of $\overrightarrow{AB}$

(2)

D, E and F are three points on a straight line such that

$\overrightarrow{DE} = 3\mathbf{e} + 6\mathbf{f}$

$\overrightarrow{EF} = -10.5\mathbf{e} - 21\mathbf{f}$

(b) Find the ratio

length of DF : length of DE

$\overrightarrow{DF} = 3e + 6f - 10.5e - 21f$

$= -7.5e - 15f$

$\overrightarrow{DE} = 3e + 6f$ ↖ x -2.5

$6 \overline{)15.30}$ = 02.5

$\overrightarrow{DF} : \overrightarrow{DE}$

$-2.5 : 1$

$-5 : 2$

Tip: In our final answer we have to change -5 to +5 as a lenth cannot be negative

$5 : 2$

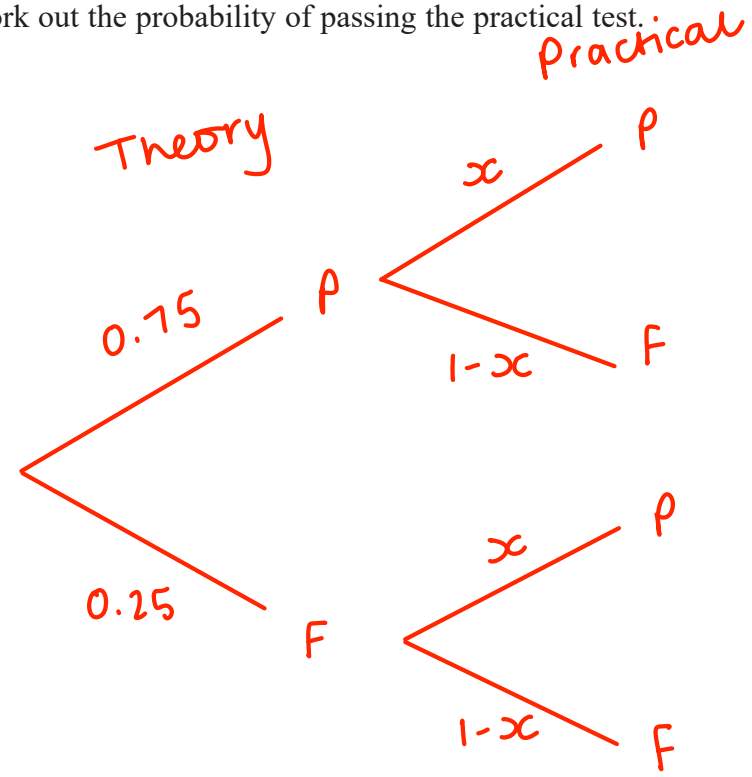
(3)

(Total for Question 15 is 5 marks)

16 A first aid test has two parts, a theory test and a practical test.
The probability of passing the theory test is 0.75
The probability of passing only one of the two parts is 0.36

The two events are independent.

Work out the probability of passing the practical test.



$P(P,F) = 0.75(1-x) = 0.75 - 0.75x$

$P(F,P) = 0.25x$

$0.75 - 0.75x + 0.25x = 0.36$

$0.75 - 0.5x = 0.36$

$+0.5x \quad +0.5x$

$0.75 = 0.5x + 0.36$

$-0.36 \quad -0.36$

$0.39 = 0.5x$

$\times 2 \quad \times 2$

$0.18 = x$

0.18

(Total for Question 16 is 4 marks)

17 y is directly proportional to the square root of t.
$y = 15$ when $t = 9$

t is inversely proportional to the cube of x.
$t = 8$ when $x = 2$

Find a formula for y in terms of x.
Give your answer in its simplest form.

$y \propto \sqrt{t}$

$y = k\sqrt{t}$

$15 = k \times \sqrt{9}$

$15 = k \times 3$

$\div 3 \quad \div 3$

$5 = k$

$y = 5\sqrt{t}$

$t \propto \frac{1}{x^3}$

$t = \frac{k}{x^3}$

$8 = \frac{k}{(2)^3}$

$8 = \frac{k}{8}$

$\times 8 \quad \times 8$

$64 = k$

$t = \frac{64}{x^3}$

$y = 5\sqrt{\frac{64}{x^3}}$

$= \frac{5}{1} \times \frac{8}{\sqrt{x^3}}$

$\frac{40}{\sqrt{x^3}}$

(Total for Question 17 is 4 marks)

18 Work out the value of $\dfrac{\left(5\frac{4}{9}\right)^{-\frac{1}{2}} \times \left(4\frac{2}{3}\right)}{2^{-3}}$

You must show all your working.

$\left(\frac{49}{9}\right)^{-\frac{1}{2}} \times \left(\frac{14}{3}\right) = \left(\frac{9}{49}\right)^{\frac{1}{2}} \times \left(\frac{14}{3}\right)$

$= \frac{3}{7} \times \frac{14}{3}$

$= \frac{42}{21} = 2$

$2^1 \div 2^{-3} = 2^4$

$= 16$

16

(Total for Question 18 is 4 marks)

19 Solve $\frac{1}{2x-1}+\frac{3}{x-1}=1$

Give your answer in the form $\frac{p\pm\sqrt{q}}{2}$ where p and q are integers.

$x-1$ $\qquad$ $6x-3$

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

$$=\frac{7x-4}{(2x-1)(x-1)}$$

$$7x-4$$

$$7x-4$$

$$7x-4$$

$$0$$

$$=1$$

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

$$=2x^2-2x-x+1$$

$$=2x^2-3x+1$$

$$=2x^2-10x+5$$

$$\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

$$\frac{-(-10)\pm\sqrt{(-10)^2-4(2)(5)}}{2(2)}$$

$a=2$

$b=-10$

$c=5$

$$=\frac{10\pm\sqrt{100-40}}{4}$$

$$=\frac{10\pm\sqrt{60}}{4}$$

$$\sqrt{60}=\sqrt{4}\times\sqrt{15}$$
$$=2\sqrt{15}$$

$$=\frac{10\pm2\sqrt{15}}{4}$$

$5\pm\sqrt{1}$

.....

(Total for Question 19 is 4 marks)

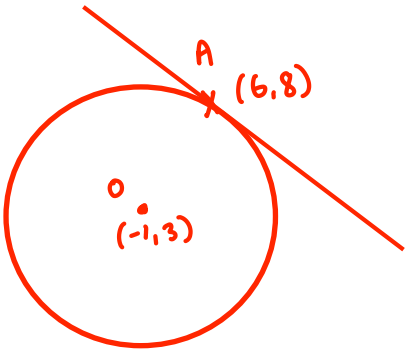
20 The centre of a circle is the point with coordinates (−1, 3)

The point A with coordinates (6, 8) lies on the circle.

Find an equation of the tangent to the circle at A.
Give your answer in the form $ax + by + c = 0$ where a, b and c are integers.

Gradient OA $= \frac{8-3}{6--1} = \frac{5}{7}$

Gradient Tangent $= -\frac{7}{5}$



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

$8 = -\frac{7}{5}(6) + c$

$8 = -\frac{42}{5} + c$

$\frac{40}{5} = -\frac{42}{5} + c$

$+\frac{42}{5} \quad +\frac{42}{5}$

$\frac{82}{5} = c$

Tip: 8 can be written as 8/1 which is equivalent to 40/5

$y = -\frac{7}{5}x + \frac{82}{5}$ ×5

$5y = -7x + 82$

$7x + 5y - 82 = 0$

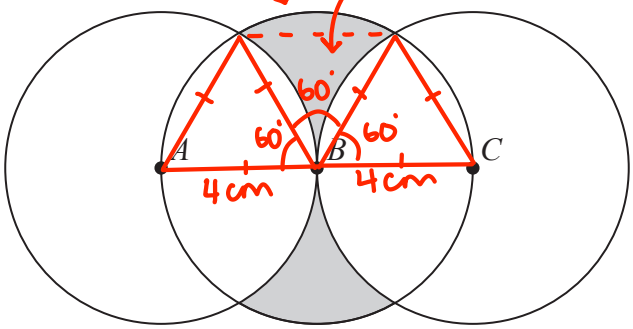
(Total for Question 20 is 4 marks)

21 The diagram shows three circles, each of radius 4 cm.

The centres of the circles are A, B and C such that ABC is a straight line and $AB = BC = 4$ cm.

Segment

Sector



$\sin(60) = \frac{\sqrt{3}}{2}$

Work out the total area of the two shaded regions.
Give your answer in terms of π

Area of Sector $= \frac{60}{360} \times \pi \times 4^2 = \frac{1}{6} \times \pi \times 16 = \frac{8}{3}\pi$

Area of triangle $= \frac{1}{2}(4)(4)\sin(60)$ $= \frac{1}{2} \times 16 \times \frac{\sqrt{3}}{2}$

$= \frac{16\sqrt{3}}{4} = 4\sqrt{3}$

$(\frac{1}{2}ab\sin C)$

Area of segment $= \frac{8}{3}\pi - 4\sqrt{3}$

(sector - triangle)

Shaded region = 2 sectors - 4 segments

$= 2\left(\frac{8}{3}\pi\right) - 4\left(\frac{8}{3}\pi - 4\sqrt{3}\right)$

$= \frac{16}{3}\pi - \frac{32}{3}\pi + 16\sqrt{3}$

$= -\frac{16}{3}\pi + 16\sqrt{3}$

$16\sqrt{3} - \frac{16}{3}\pi$ cm^2

(Total for Question 21 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS