1 **A** $= 2^3 \times 3^2 \times 5$ **B** $= 2^2 \times 3^3 \times 5$

Write down the highest common factor (HCF) of A and B

A = 2 x 2 x 2 x 3 x 3 x 5

B = 2 x 2 x 3 x 3 x 3 x 5

They both have :

$2^2 \times 3^2 \times 5$

= 180

180

**(Total for Question 1 is 1 mark)**

---

2 Verity buys 12 bottles of apple juice for a total cost of £15
Verity sells all 12 bottles at £1.75 each bottle.

Work out Verity's percentage profit.

1.75 x 12 = 21

Profit = 21 − 15 = 6

$\%\ \text{Profit} = \frac{\text{Profit}}{\text{original}} \times 100$

$= \frac{6}{15} \times 100$

= 40

40 %

**(Total for Question 2 is 3 marks)**

**3** The table shows the populations of five countries.

| Country | Population |
|---|---|
| India | $1.4 \times 10^9$ |
| Turkey | $8.4 \times 10^7$ |
| Denmark | $5.8 \times 10^6$ |
| Estonia | $1.3 \times 10^6$ |
| Iceland | $3.4 \times 10^5$ |

(a) Work out the difference between the population of India and the population of Turkey.
Give your answer in standard form.

$1.4 \times 10^9 - 8.4 \times 10^7$

$= 1.4 \times 10^9 - 0.084 \times 10^9$

$= (1.4 - 0.084) \times 10^9$

$1.316 \times 10^9$

.....

**(2)**

Given that

$$\text{population of Iceland} = \frac{1}{k} \times \text{population of Denmark}$$

(b) Work out the value of $k$.
Give your answer correct to the nearest whole number.

$$\frac{5.8 \times 10^6}{3.4 \times 10^5} = 17 \text{ (nearest whole numb)}$$

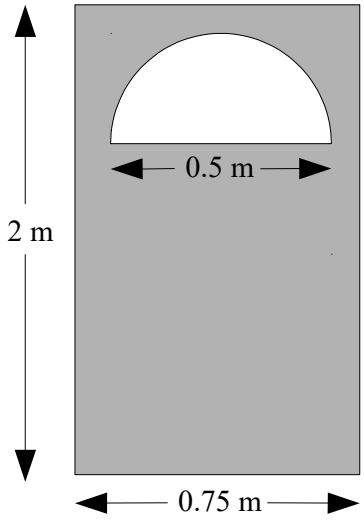
= 17

.....

**(2)**

**(Total for Question 3 is 4 marks)**

**4** The diagram shows the front of a wooden door with a semicircular glass window.




$r = \frac{0.5}{2} = 0.25$

Julie wants to apply 2 coats of wood varnish to the front of the door, shown shaded in the diagram.

250 millilitres of wood varnish covers 4 m² of the wood.

Work out how many millilitres of wood varnish Julie will need.
Give your answer correct to the nearest millilitre.

Shaded Area = $2 \times (0.75) - \frac{\pi (0.25)^2}{2}$

$= 1.40 \text{ m}^2$

2 coats $1.40 \times 2 = 2.80 \text{ m}^2$

250 ml covers $4 \text{ m}^2$ (÷4)

62.5 ml covers $1 \text{ m}^2$

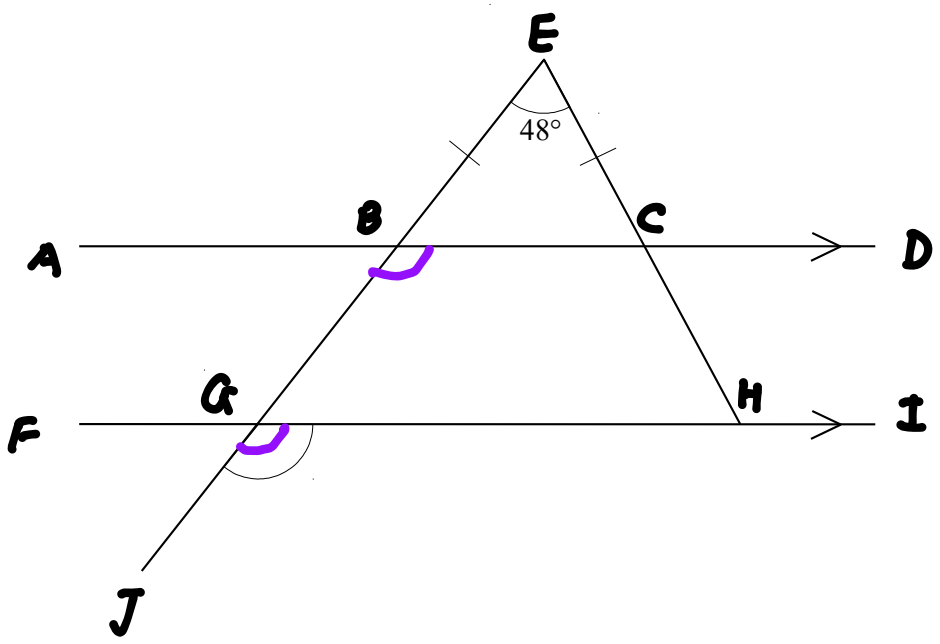
$2.80 \times 62.5 = 175.2$ ml

= 175 (nearest ml)

175 millilitres

**(Total for Question 4 is 5 marks)**

5




ABCD and FGHI are parallel straight lines.
EBGJ and ECH are straight lines.

BE = CE
Angle BEC = 48°

Work out the size of angle JGH.
Give a reason for each stage of your working.

$\angle EBC = \frac{180^\circ - 48^\circ}{2} = 66^\circ$ (∵ isosceles △)

$\angle GBC = 180^\circ - 66^\circ = 114^\circ$ (Angles on a straight line add to 180)

$\angle JGH = 114^\circ$ (∵ corresponding angles)

114 °

**(Total for Question 5 is 5 marks)**

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

**6** Adam drove 56 km from Liverpool to Manchester.
He then drove 61 km from Manchester to Sheffield.

Adam's average speed from Liverpool to Manchester was 80 km/h.
Adam took 85 minutes to drive from Manchester to Sheffield.

(a) Work out Adam's average speed for his total drive from Liverpool to Sheffield.

L → M

D = 56 km

S = 80

$T = \frac{56}{80} = 0.7$ hours

M → S

T = 85 mins

$T = \frac{85}{60} = 1.41\dot{6}$ hours

Avg. speed $= \frac{56 + 61}{0.7 + 1.41\dot{6}} =$

$= 55.3$

55.3 km/h

**(4)**

Bev drove from Reading to Bristol.

Bev's average speed from Reading to Swindon was 80 km/h.
Her average speed from Swindon to Bristol was 60 km/h.

Bev says that the average speed from Reading to Bristol can be found by working out the mean of 80 km/h and 60 km/h.

(b) If Bev is correct, what does this tell you about the two parts of Bev's journey?

The time must be equal.

**(1)**

**(Total for Question 6 is 5 marks)**

**7** A company has to make a large number of boxes.

The company has 6 machines.
All the machines work at the same rate.
When all the machines are working, they can make all the boxes in 9 days.

2 of the machines are not working and cannot be used to make the boxes.

Work out the total number of days taken to make all the boxes.

$6 \times 9 = 54$ days of work

$\frac{54}{4} = 13.5$ days

13.5

**(Total for Question 7 is 3 marks)**

**8** Janet bought a new car three years ago.

At the end of the first year the value of the car had decreased by 17.5%
The value of the car decreased by 10% each year for the next two years.

At the end of the three years, the car was worth £16038

Work out the value of the car when Janet bought it three years ago.

$x \times 0.825 \times 0.9^2 = 16038$

$x = \dfrac{16038}{0.825 \times 0.9^2}$

$= 24000$

£ 24000

**(Total for Question 8 is 3 marks)**

**9** Simplify fully $\left(\frac{16x^4}{9y^{10}}\right)^{-\frac{1}{2}}$

$\left(\frac{4x^2}{3y^5}\right)^{-1}$ (square root)

$\frac{3y^5}{4x^2}$ (flip)

$\frac{3y^5}{4x^2}$

**(Total for Question 9 is 3 marks)**

---

**10** Expand and simplify $(2-x)(2x+3)(x+4)$

$(4x + 6 - 2x^2 - 3x)(x+4)$

$(x + 6 - 2x^2)(x+4)$

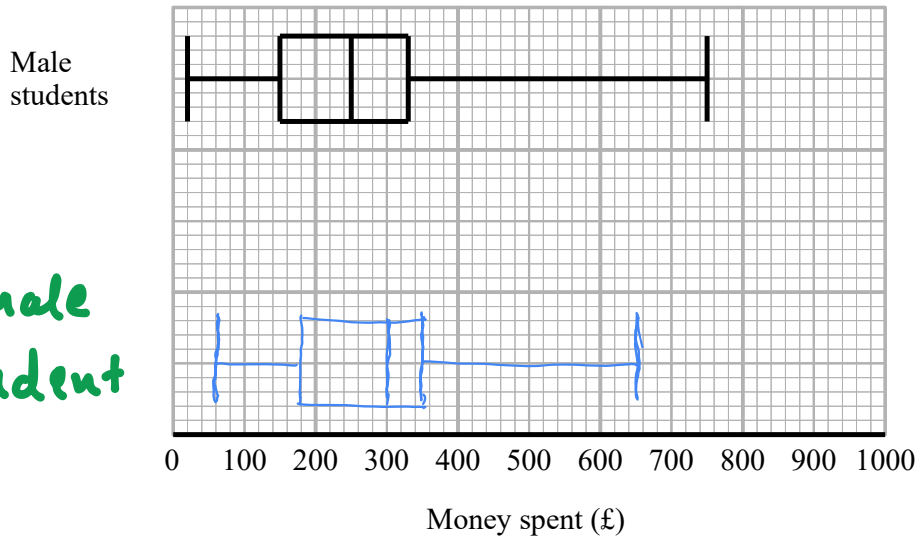
$x^2 + 4x + 6x + 24 - 2x^3 - 8x^2$

$10x - 2x^3 - 7x^2 + 24$

$-2x^3 - 7x^2 + 10x + 24$

**(Total for Question 10 is 3 marks)**

**11** The box plot shows information about the distribution of the amounts of money spent by some male students on their holidays.




(a) Work out the interquartile range for the amounts of money spent by these male students.

330 - 150

£ 180

**(2)**

The table below shows information about the distribution of the amounts of money spent by some female students on their holidays.

| | Smallest | Lower quartile | Median | Upper quartile | Highest |
|---|---|---|---|---|---|
| Money spent (£) | 60 | 180 | 300 | 350 | 650 |

(b) On the grid above, draw a box plot for the information in the table **(2)**

Chris says,

"The box plots show that the female students spent more money than the male students."

(c) Is Chris correct?
Give a reason for your answer.

yes, the median amt. female students spend is greater.

**(1)**

**(Total for Question 11 is 5 marks)**

**12** Using algebra, show that the recurring decimal $0.18\dot{0}\dot{3} = \frac{119}{660}$

$x = 0.18\dot{0}\dot{3}$

$100x = 18.\dot{0}\dot{3}$ —①

$10000x = 1803.\dot{0}\dot{3}$ —②

② − ① gives,

$9990x = 1785$

$x = \frac{1785}{9990} = \frac{119}{660}$ //

**(Total for Question 12 is 2 marks)**

---

**13** Saffron wants to work out an estimate for the total number of fish in a lake.
On Friday, Saffron catches 210 fish from the lake.

She puts a tag on each of these fish and puts them back into the lake.
On Saturday, Saffron catches 240 fish from the same lake.

She finds that 35 of the 240 fish are tagged.
Work out an estimate for the total number of fish in the lake.

$\frac{210}{x} = \frac{35}{240}$

$35x = 210 \times 240$

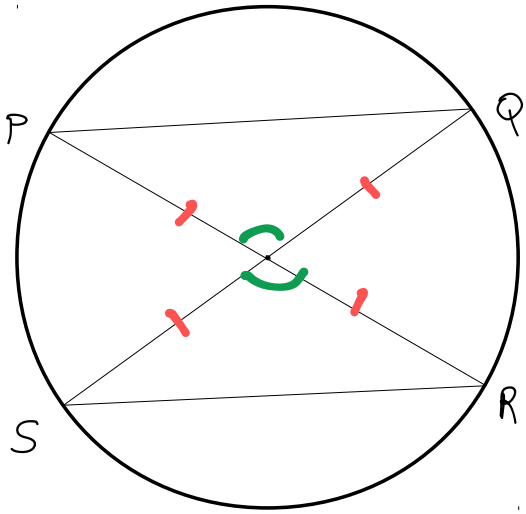
$x = \frac{210 \times 240}{35}$

$x = 1440$

1440

**(Total for Question 13 is 3 marks)**

**14** P, Q, R and S are four points on a circle, centre .




PXR and SXQ are straight lines.

Prove that triangle PQX and triangle SRX are congruent.

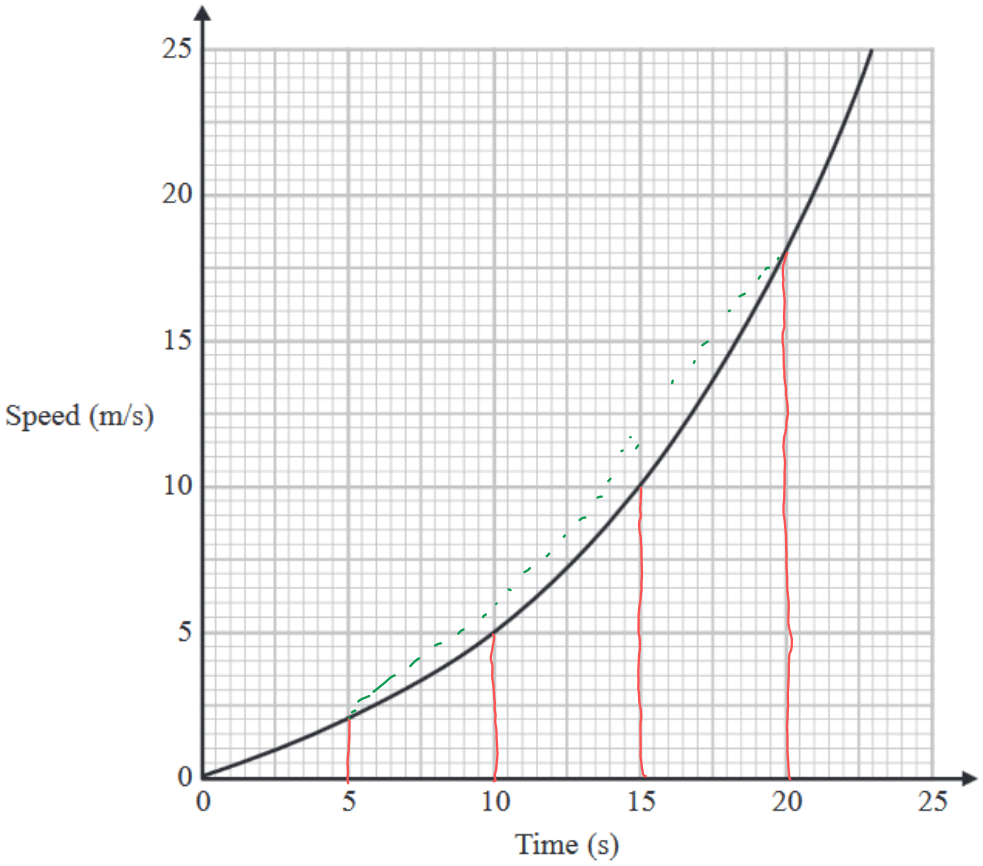
SX = PX = QX = RX (∵ all r radius)

∠PXQ = ∠SXR (∵ opposite angles are equal)

∴ SAS

**(Total for Question 14 is 3 marks)**

**15** Here is a speed-time graph for a train.




(a) Work out an estimate for the distance the train travelled in the first 20 seconds.
Use 4 strips of equal width.

$\frac{1}{2}(5)(2) = 5$

$\frac{1}{2}(2+5)\times 5 = 17.5$

$\frac{1}{2}(5+10)\times 5 = 37.5$

$\frac{1}{2}(10+18)\times 5 = 70$

$5 + 17.5 + 37.5 + 70$

$= 130$

130 ..... m

**(3)**

(b) Is your answer to (a) an underestimate or an overestimate of the actual distance the train travelled?
Give a reason for your answer.

overestimate - the trapezium go over the curve

**(1)**

**(Total for Question 15 is 4 marks)**

**16** Using algebra, prove that, given any 3 consecutive even numbers, the difference between the square of the largest number and the square of the smallest number is always 8 times the middle number.

$2n,\ 2n+2,\ 2n+4$

$(2n+4)^2 - (2n)^2$

$= 4n^2 + 16n + 16 - 4n^2$

$= 16n + 16$ //

$8(2n+2) = 16n + 16$ //

Both are equal.

**(Total for Question 16 is 3 marks)**

**17** The straight line $L$ passes through the points $(4, -2)$ and $(6, 5)$

The straight line $M$ is perpendicular to $L$ and intersects the $y$-axis at the point $(0, 3)$.

Find the coordinates of the point where $M$ intersects the $x$-axis.

$$m = \frac{dy}{dx} = \frac{5 - -2}{6 - 4} = \frac{7}{2}$$

Perpendicular $m = -\frac{2}{7}$ $\left(\because m_1 = -\frac{1}{m_2}\right)$

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

crosses $x$ when $y = 0$

$$\therefore 0 = -\frac{2}{7}x + 3$$

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

$$-21 = -2x$$

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

$$x = 10.5$$ //

( 10.5 , 0 )

**(Total for Question 17 is 4 marks)**

**18** Show that $\frac{x}{x+3} - \frac{2x-1}{x-3} + 1$ can be written in the form $\frac{ax+b}{x^2-9}$ where $a$ and $b$ are integers.

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

$$= \frac{x^2-3x-(2x^2+6x-x-3)+x^2-9}{x^2-9}$$

$$= \frac{x^2-3x-2x^2-5x+3+x^2-9}{x^2-9}$$

$$= \frac{-8x-6}{x^2-9} \quad //$$

$(a=-8, \; b=-6)$

**(Total for Question 18 is 4 marks)**

**19** (a) Express $9 + 8x - 2x^2$ in the form $a + b(x + c)^2$ where $a$, $b$ and $c$ are integers.

$9 - 2(x^2 - 4x)$

$= 9 - 2[(x-2)^2 - 4]$

$= 9 - 2(x-2)^2 + 8$

$= 17 - 2(x-2)^2$ //

$17 - 2(x-2)^2$

**(3)**

**C** is the curve with equation $y = 9 + 8x - 2x^2$

The point A is the maximum point on **C**

(b) Use your answer to part (a) to write down the coordinates of A.

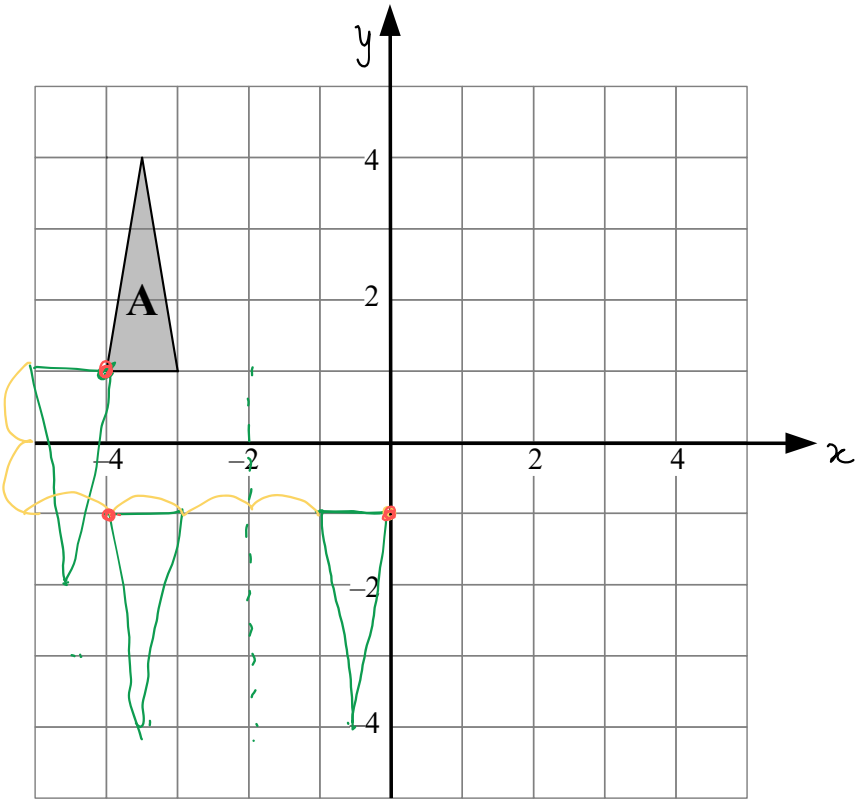
[∵ equation $(x+a)^2 + b$ have max. point $(-a, b)$]

( 2 , 17 )

**(1)**

**(Total for Question 19 is 4 marks)**

**20**




Triangle **A** is transformed by the combined transformation of a reflection in the $x$-axis, followed by a reflection in the line $x = -2$, followed by a translation with vector $\begin{pmatrix} -4 \\ 2 \end{pmatrix}$

One point on triangle **A** is invariant under the combined transformation.
Find the coordinates of this point.

You must show your working.

( -4 , 1 )

**(Total for Question 20 is 2 marks)**

**21** Prove algebraically that the straight line with equation $2x + y + 5 = 0$ is a tangent to the circle with equation $x^2 + y^2 = 5$

$y = -2x - 5$

$x^2 + (-2x - 5)^2 = 5$

$x^2 + 4x^2 + 10x + 10x + 25 = 5$

$5x^2 + 20x + 20 = 5$

$x^2 + 4x + 4 = 0$

$(x + 2)^2 = 0$

$x = -2$

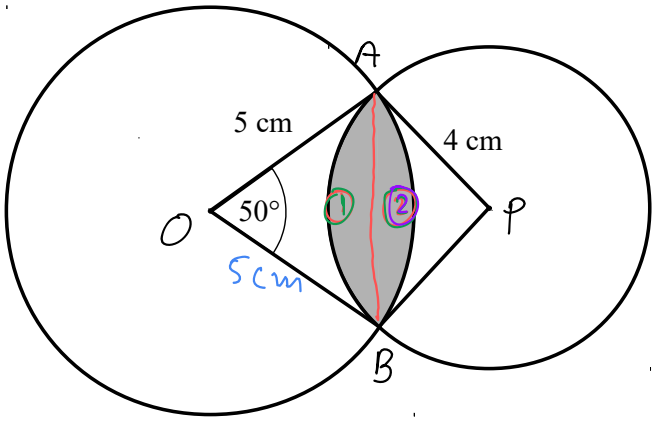
$y = -2(-2) - 5 = -1$

The line only touches the circle at one point $(-2, -1)$

$\therefore$ it is a tangent.

**(Total for Question 21 is 5 marks)**

**22** The diagram shows two circles such that the region **R**, shown shaded in the diagram, is the region common to both circles.




One of the circles has centre O and radius 5 cm.
The other circle has centre P and radius 4 cm.
Angle AOB = 50°

Calculate the area of region **R**.
Give your answer correct to 3 significant figures.

$a^2 = b^2 + c^2 - 2bc\cos A$

$a^2 = 5^2 + 5^2 - 2(5)(5)\cos(50)$

$a^2 = 17.86$

$a = 4.226$ cm

$\cos A = \dfrac{b^2 + c^2 - a^2}{2bc}$

$= \dfrac{4^2 + 4^2 - 4.226^2}{2(4)(4)}$

$= 0.442$

$A = \cos^{-1}(0.442)$

$\angle A = 63.8°$

Segment Area
= Area of Sector − Area of Triangle.

① $\dfrac{63.8}{360} \times \pi(4)^2 - \dfrac{1}{2}(4)(4)\sin(63.8)$

$= 1.725$ cm²

② $\dfrac{50}{360} \times \pi(5)^2 - \dfrac{1}{2}(5)(5)\sin 50$

$= 1.333$ cm²

Total R = 1.728 + 1.333
= 3.06 cm²

3.06 cm²

**(Total for Question 22 is 6 marks)**

**TOTAL FOR PAPER IS 80 MARKS**