Surname	Centre Number	Candidate Number
Other Names		0

GCSE

3310U50-1

S18-3310U50-1

MATHEMATICS – NUMERACY
UNIT 1: NON-CALCULATOR
HIGHER TIER

TUESDAY, 8 MAY 2018 – MORNING

1 hour 45 minutes

ADDITIONAL MATERIALS

The use of a calculator is not permitted in this examination.

A ruler, a protractor and a pair of compasses may be required.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

If you run out of space, use the continuation page at the back of the booklet. Question numbers must be given for the work written on the continuation page.

Take π as 3·14.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part-question.

In question **1***(a)*, the assessment will take into account the quality of your linguistic and mathematical organisation, communication and accuracy in writing.

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**4**	
3.	**6**	
4.	**5**	
5.	**5**	
6.	**6**	
7.	**6**	
8.	**4**	
9.	**6**	
10.	**5**	
11.	**4**	
12.	**3**	
13.	**8**	
14.	**8**	
Total	**80**	

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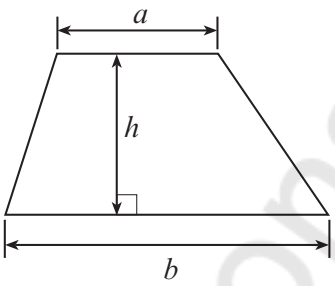
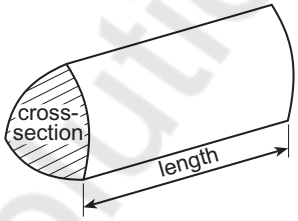
Formula List - Higher Tier

Area of trapezium = $\frac{1}{2}(a + b)h$



Volume of prism = area of cross-section × length

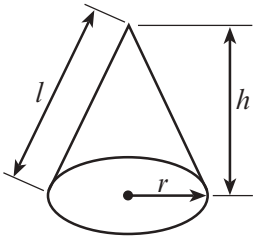


Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$

Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = $\pi r l$

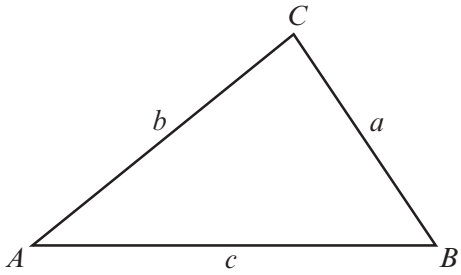


In any triangle ABC

Sine rule $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

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

Area of triangle = $\frac{1}{2}ab\sin C$



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$ are given by $x = \frac{-b \pm \sqrt{(b^2 - 4ac)}}{2a}$

Annual Equivalent Rate (AER)

AER, as a decimal, is calculated using the formula $\left(1+\frac{i}{n}\right)^n - 1$, where i is the nominal interest rate per annum as a decimal and n is the number of compounding periods per annum.

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1. *(a) In this part of the question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

The concrete base of Miss Morgan's new bungalow is shown below.

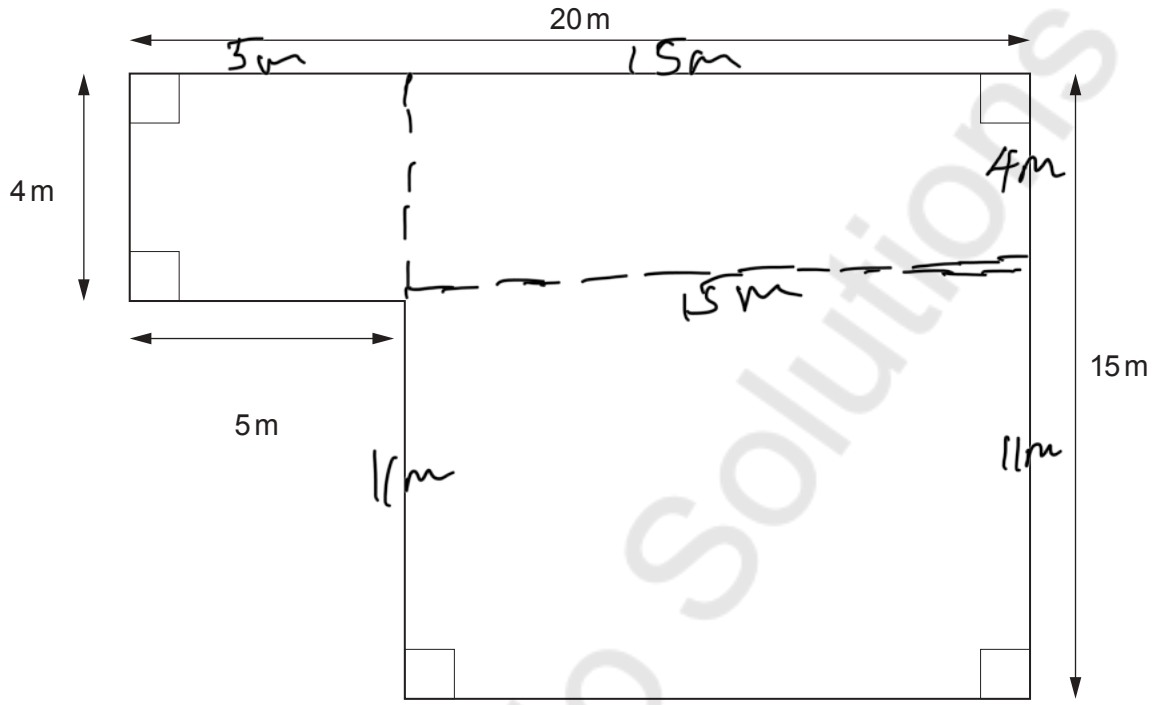

Diagram not drawn to scale

The concrete base of Miss Morgan's bungalow is 0·2 m thick.

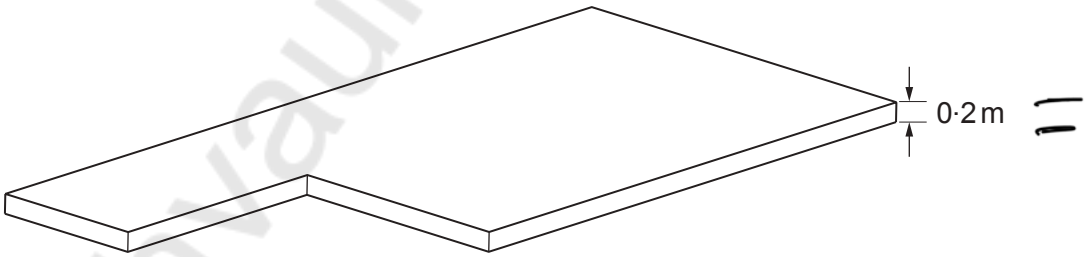

Diagram not drawn to scale

Calculate the volume of the concrete base.
You must show all your working. [4 + 2 OCW]

First partition the base into 3 rectangles

Area of each rectangle added together
= Area of the base

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Total area = $(5 \times 4)m^2 + (15 \times 4)m^2 + (15 \times 11)m^2$

$= 20m^2 + 60m^2 + 165m^2$

$= 245m^2$

Thickness = 0.2 m

Volume of the base = Total area × Thickness

$= 245 \times 0.2$

$= 49 m^3$

15 × 11 = 165

245 × 2 = 490

(b) Mr Graham is building a garage.

A concrete mixer lorry holds a maximum load of 6 m^3 of concrete.
There is a fixed standard delivery charge of £35 per load.
The concrete costs £45 per m^3.

Mr Graham orders $\frac{2}{3}$ of the maximum load of concrete for the base of his garage floor.

What is the total cost of Mr Graham's order? [4]

His concrete = $\frac{2}{3} \times 6 = 4m^3$ of concrete

Cost of his concrete = $45 \times 4 = £180$

245 × 4 = 180

Standard delivery = £35 ⇒ Add to calculate cost

Total Cost = £180 + £35

= £215

180 + 35 = 215

Total cost is £ 215

Examiner only

2.

Olga took out a high-interest loan for £400.
She paid back £49 per month for 20 months to clear the loan.
Calculate the total interest that Olga paid as a percentage of the original loan. [4]

She paid back a total of £(49×20)
= £980

Interest = £980 − 400
= £580

$$\begin{array}{r} {}^{1}490 \\ \times\ 2 \\ \hline 980 \\ -400 \\ \hline 580 \end{array}$$

Interest as a percentage of the original loan

$$= \frac{{}^{1}580}{400} \times {}^{1}\cancel{100}$$

= 145%

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3. Sara is carrying out a survey of the three villages, Cwm, Allthir and Gwyndir.
The diagram below shows the positions of the three villages.

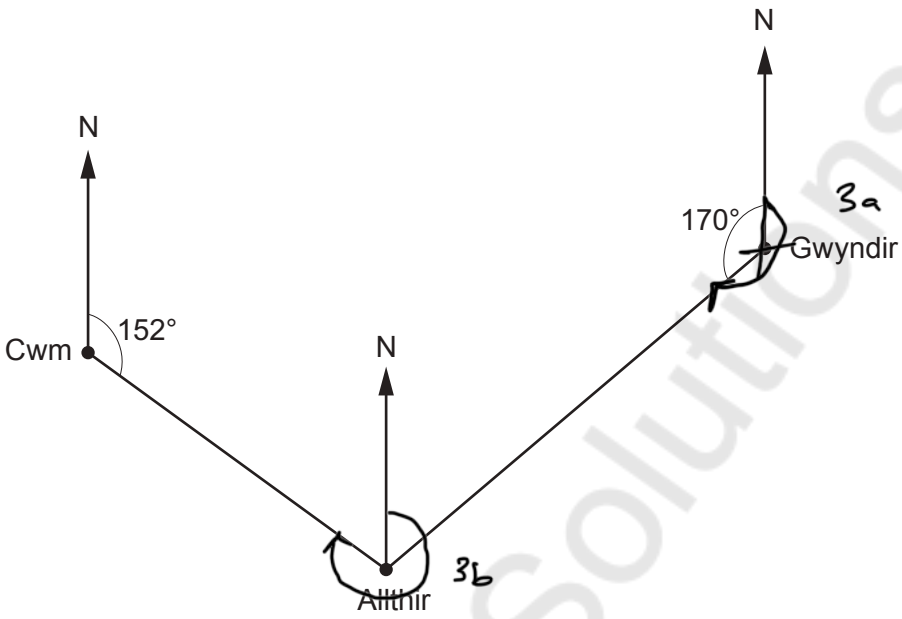

Diagram not drawn to scale

(a) What is the bearing of Allthir from Gwyndir?
Circle your answer. [1]

010° 170° 180° 190° 200°

$360 - 170 = 190$

$$\begin{array}{r} {}^{2}\not{3}60 \\ -\ 170 \\ \hline 190 \end{array}$$

(b) What is the bearing of Cwm from Allthir?
Circle your answer. [1]

028° 152° 242° 332° 352°

$180 + 152 = 180 + 152 = 332$

Examiner only

(c) The area of the land covered by the three villages is 200 km^2.
The total population of the three villages is 8400 people.

(i) What is the population density of the three villages?
Give your answer in population/km^2. [2]

Pop. density = $\frac{\text{Pop.}}{\text{area}} = \frac{8400}{200} = 42$

$= 42$ population/km^2

(ii) The populations of Cwm, Allthir and Gwyndir are in the ratio 3 : 4 : 5.
Calculate the population of Gwyndir. [2]

C : A : G

3 : 4 : 5 Total ratio = 12

$\frac{5}{12} \times 8400$

$= 5 \times 700 = 3500$ people

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4. *(a)* Kingsley invests £3000 in an account that pays 2% compound interest per annum. He does not make any further payments into his account. He does not withdraw any money from his account.

How much will Kingsley have in his account after **two years**? [3]

For the first year = Rate × Principal + Principal

$= (2\% \times 3000) + 3000$

$= \frac{2}{100} \times 3000$

$= 60 + 3000$

$= £3060$ (New principal)

For the 2nd year $= (2\% \times 3060) + 3060$

$= \frac{12}{100} \times 3060 + 3060$

$= 3121.2$

Amount in Kingsley's account after two years is £ 3121.20

Examiner only

(b) Kingsley buys a portable *Bluetooth* speaker.
The speaker has been reduced by 20% in a sale.
He pays £72 for the speaker in the sale.
What was the original price of the speaker? [2]

let the original price be x

$100 - \frac{20}{100} \times x = 72$

$80\% \text{ of } x = 72$

$x = 72 \div 80\%$

$x = 72 \div \frac{80}{100} = 72 \times \frac{5}{4} = £(18 \times 5) = £90$

$18 \times 5 = 90$

Original price of the speaker is £ 90

5. Michelle owns a café.
She stacks coffee mugs as shown in the diagram below.

Michelle measures the height of each coffee mug as 12 cm, **correct to the nearest centimetre.**
Each stacked coffee mug creates 4 cm extra height, **correct to the nearest centimetre**.

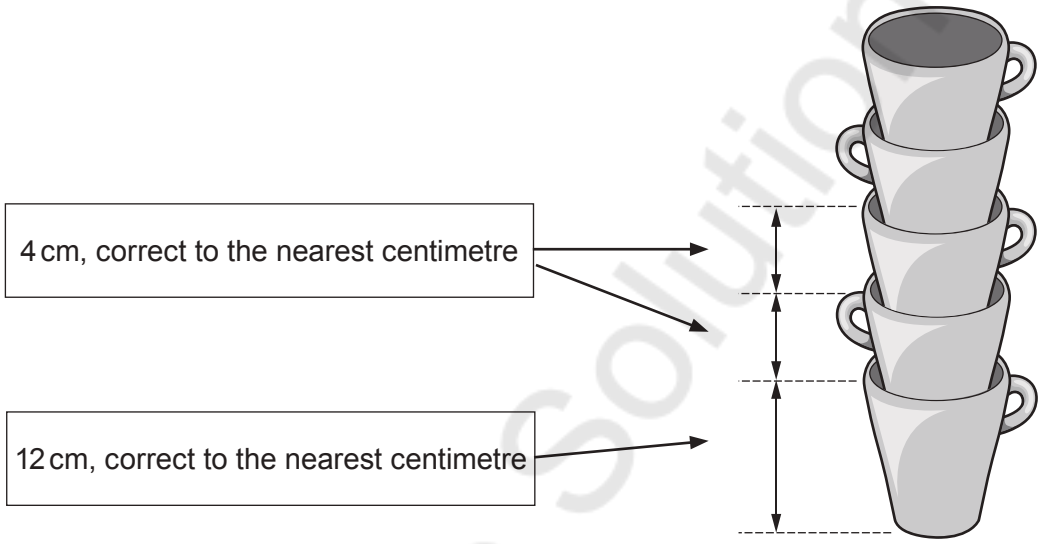


Diagram not drawn to scale

Michelle knows that the vertical height between two shelves is exactly 39 cm, as shown below.

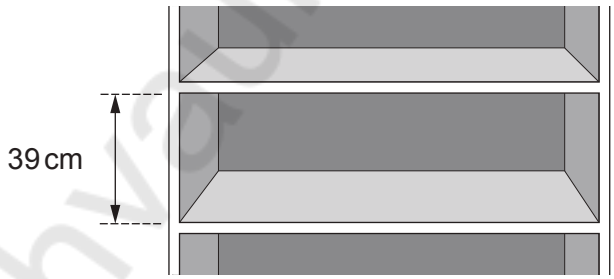


Diagram not drawn to scale

Examiner only

Can Michelle be certain that she will be able to place one stack of 7 coffee mugs between the two shelves?
Give a reason for your answer.
You must show all your working. [5]

Maximum cup height = 12.5cm
AND Maximum gap = 4.5cm

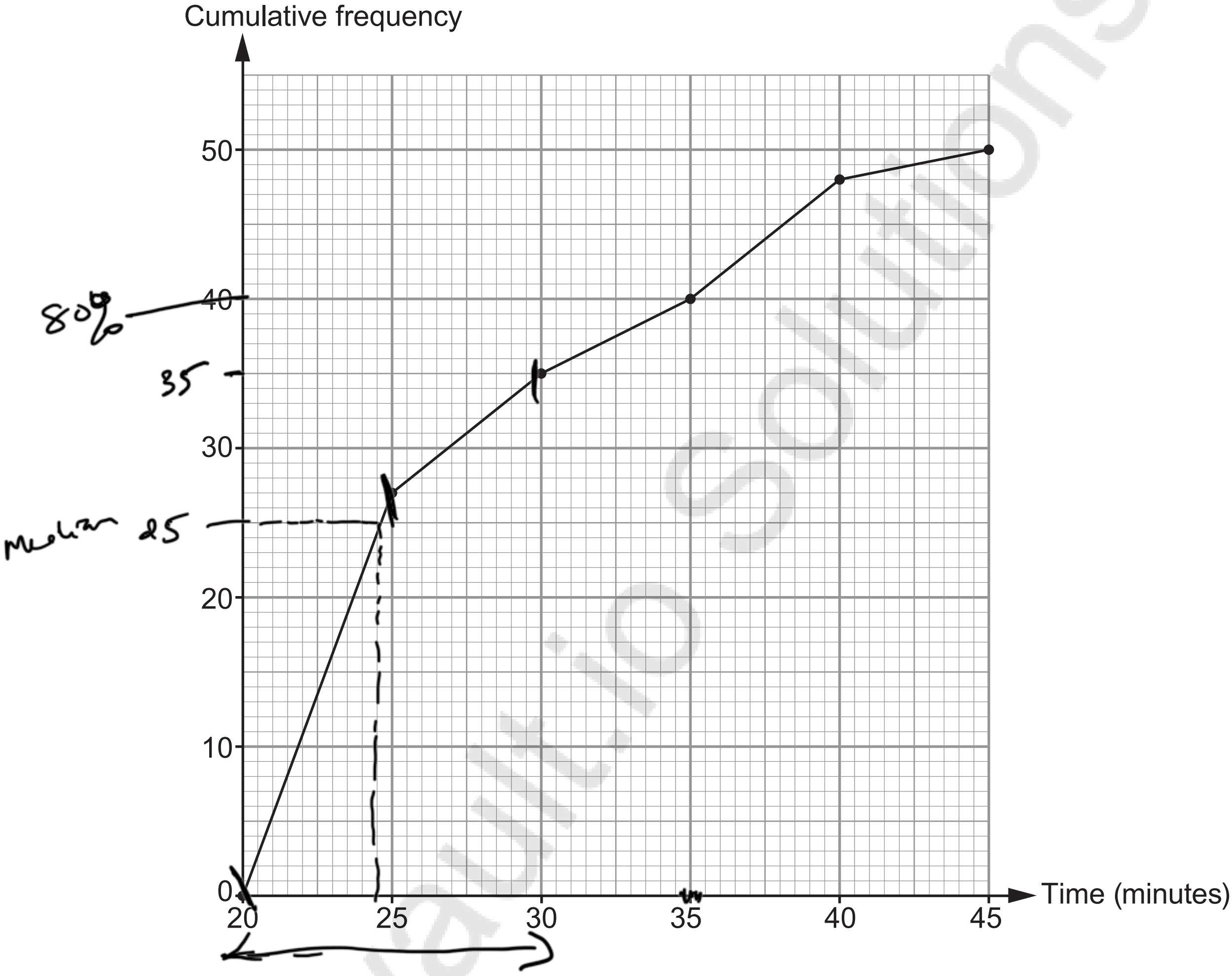
Maximum height of 7 coffee mugs
= 12.5 + 6 × 4.5
= 39.5 cm

CONCLUSION – Michelle cannot be certain that the coffee mugs will fit because
39.5cm > 39cm

Examiner only

6. This year, 50 runners took part in a 5 km race in the Brecon Beacons.
All 50 runners finished the race.

The cumulative frequency diagram below shows the times taken by the runners to finish the race.



(a) Which is the modal group?
Circle your answer. [1]

20 to 25 minutes   25 to 30 minutes   30 to 35 minutes

35 to 40 minutes   40 to 45 minutes

modal group = group with highest NO of finishers

 (3310U50-1)

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(b) Is it certain that the last runner's finish time was 45 minutes?
You must give a reason for your answer. [1]

Yes ☐ No ☑

Reason – The graph only shows data for groups not individuals

(c) The organisers hoped that 80% of the runners would finish the race within 30 minutes.

Complete the following two statements. [2]

'70 % of runners finished the race within 30 minutes.'

'80% of runners finished the race within 35 minutes.'

35 runners finished within 30 minutes ≈ 70%

40 runners is synonymous to 80% and they finished in 35 minutes

(d) Last year, the median finish time was 26 minutes.
By how many minutes was the median time better this year?
You must show all your working. [2]

Median time is around 24.8 minutes

Difference b/w both years = 26 − 24.8
= 1.2 minutes

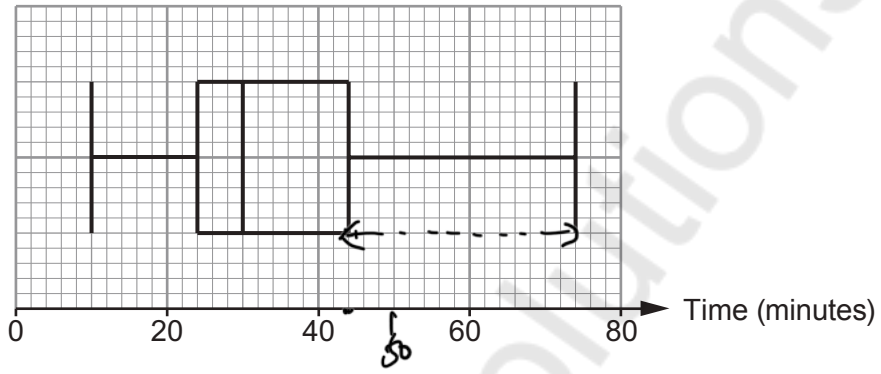
or 1 minute 12 secs

26.0
−24.8
1.2

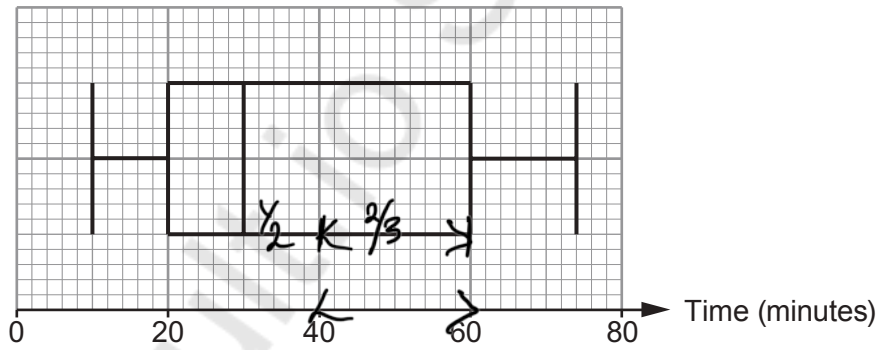
Examiner only

7. There are two entrances to a stadium, North Entrance and South Entrance.
At each entrance, 3000 people queued to pass through security.
The length of time each of these people spent in the queue was recorded.
The box-and-whisker diagrams show the results.

North Entrance



South Entrance



(a) At the **North Entrance**, how many people had to queue for more than 44 minutes?
You must show all your working. [2]

> 44 minutes = 25% of the population
= 25% × 3000 = $\frac{25}{100} \times 3000$
= 750 people

Number of people is 750

Examiner only

(b) For the **South Entrance**, calculate an estimate of the number of people who had to queue there for between 40 and 60 minutes.
You must show all your working. [3]

$\frac{2}{3} \times 25\%$ of 3000

$\frac{2}{3} \times \overset{250}{\cancel{2800}} = 2 \times 250$

$= 500$ people

Number of people is 500

(c) At which entrance did the security team seem to be more effective at getting people into the stadium quickly?
You must give a reason for your answer. [1]

North Entrance ✓ South Entrance ☐

Upper quartile of the North Entrance is less than that of the South Entrance

It could also be the South Entrance with reason; – 25% people in 20 minutes compared with 24 minutes at the North Entrance

Examiner only

8. Eirlys works for an accountancy firm.
She receives an annual salary, which is paid in equal instalments.

Eirlys has calculated that, so far this financial year, she has been paid $0{\cdot}41\dot{6}$ of her annual salary.

(a) Express $0{\cdot}41\dot{6}$ as a fraction in its lowest terms. [3]

let the fraction be x

$100x = 41.666$

$x = \frac{41.666}{100}$

$x = \frac{4166}{10000}$ Correct this to nearest Tens

$= \frac{4160}{10000} = \frac{5}{12}$

(b) Use your answer from part *(a)* to find the number of months' pay Eirlys has received. [1]

$\frac{5}{12} = \frac{5 \text{ months}}{12 \text{ months}}$

$= 5$ months for the year

Examiner only

9. Matas knows the following information about the amount of fuel his car uses.

Speed	Miles per gallon
30 mph	54
50 mph	60
70 mph	50

During one journey, Matas drove at 50 mph for part of the time and at 70 mph for the rest of the time.

He drove for 3 hours at a speed of 50 mph.
For the whole journey, Matas used 4·6 gallons of fuel.

For how long did Matas travel at 70 mph?
You must show all your working. [6]

Fuel at 50mph = $\frac{50 \times 3 \text{ hours}}{\text{a}60}$ = 2.5 gallons

Fuel at 70mph = 4.6 gallons − 2.5 gallons
= 2.1 gallons

Distance at 70mph = 2.1 gallons × 50 miles/gallon
= 105 miles

Time for 70mph = $\frac{\text{Distance}}{\text{Speed}} = \frac{105}{70}$

= 1.5 hours

Examiner only

10. Astronomers use astronomical units (AU) to describe distances in our solar system.
The distance between the Sun and the Earth is 1 AU.
1 AU is $1{\cdot}496 \times 10^8$ km, correct to 4 significant figures.

(a) The distance of Pluto from the Sun is $5{\cdot}913 \times 10^9$ km, correct to 4 significant figures.

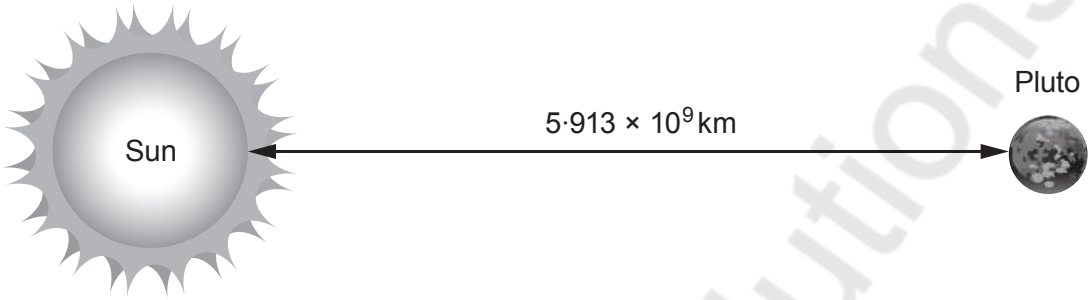


Diagram not drawn to scale

Siôn says that the distance of Pluto from the Sun is less than 50 AU.

Using **suitable** approximations, estimate the distance of Pluto from the Sun, in AU, to show that Siôn is correct.
You must show all your working. [2]

Using suitable approximations;

$\frac{\text{Distance in km}}{\text{Conversion rate}} = \frac{6 \times 10^9}{1.5 \times 10^8} = 4 \times 10^1$

or 40 AU

So, Siôn is right

(b) A light year is the distance light travels in one year.

1 light year is approximately 63 000 AU.

Estimate the length of a light year in km.
Give your answer in standard form. [3]

$1 \text{ AU} = 1.5 \times 10^8 \text{ km}$

$63000 \text{ AU} = 63000 \times (1.5 \times 10^8)$

$= 63000 \times 150000000$

Examiner only

$= 9.45 \times 10^{12}$

so

9×10^{12} km

$$\begin{array}{r} 163 \\ \times 15 \\ \hline 815 \\ 63 \\ \hline 945 \end{array}$$

Examiner only

11. During a chemistry experiment, it was found that a particle **lost** $\frac{3}{4}$ of its mass every second.

The initial mass of the particle was 160 mg.

(a) Calculate the mass of the particle after 4 seconds.
Circle your answer. [1]

2·5 mg 0·15625 mg 40 mg 0·625 mg 0·875 mg

Remaining fraction is $1 - \frac{3}{4} = \frac{1}{4}$

$160 \times (\text{Remaining fraction})^{\text{time}}$

$= (60 \times (\frac{1}{4})^4 = 160 \times \frac{1}{256}$

$= \frac{160}{256} = \frac{5}{8} \simeq 0.625$

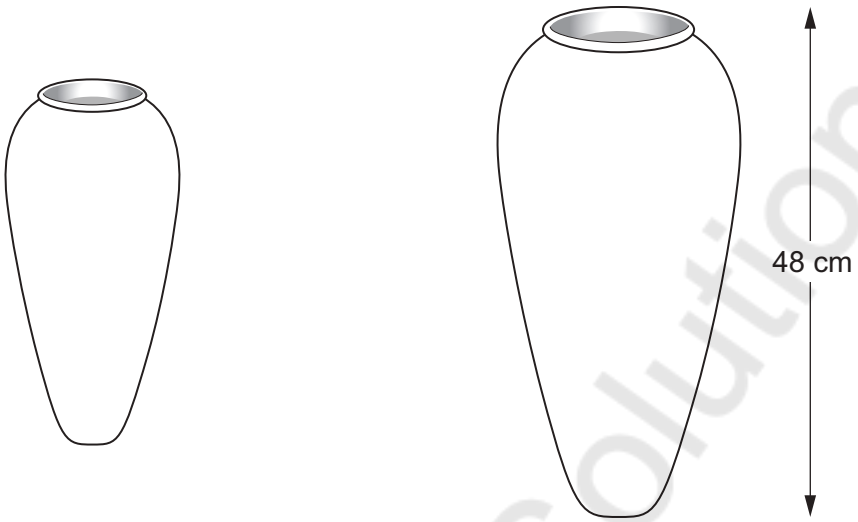
$= 0.625 mg$

(b) Write down a formula for the mass m, in milligrams, of the particle after t seconds. [3]

$M = 160 \times (\frac{1}{4})^t$ or $\frac{160}{4^t}$

Examiner only

12. *Ffiol-Aur* is a company that makes vases.
They make one of their vases in two mathematically similar sizes.



Diagrams not drawn to scale

A decorative glaze covers the surfaces of each vase.
The glaze covers an area of:

- 400 cm^2 on the smaller vase,
- 3600 cm^2 on the larger vase.

The height of the larger vase is 48 cm.
Calculate the height of the smaller vase. [3]

Scale factor

$\sqrt{\frac{400}{3600}} = \frac{x}{48}$

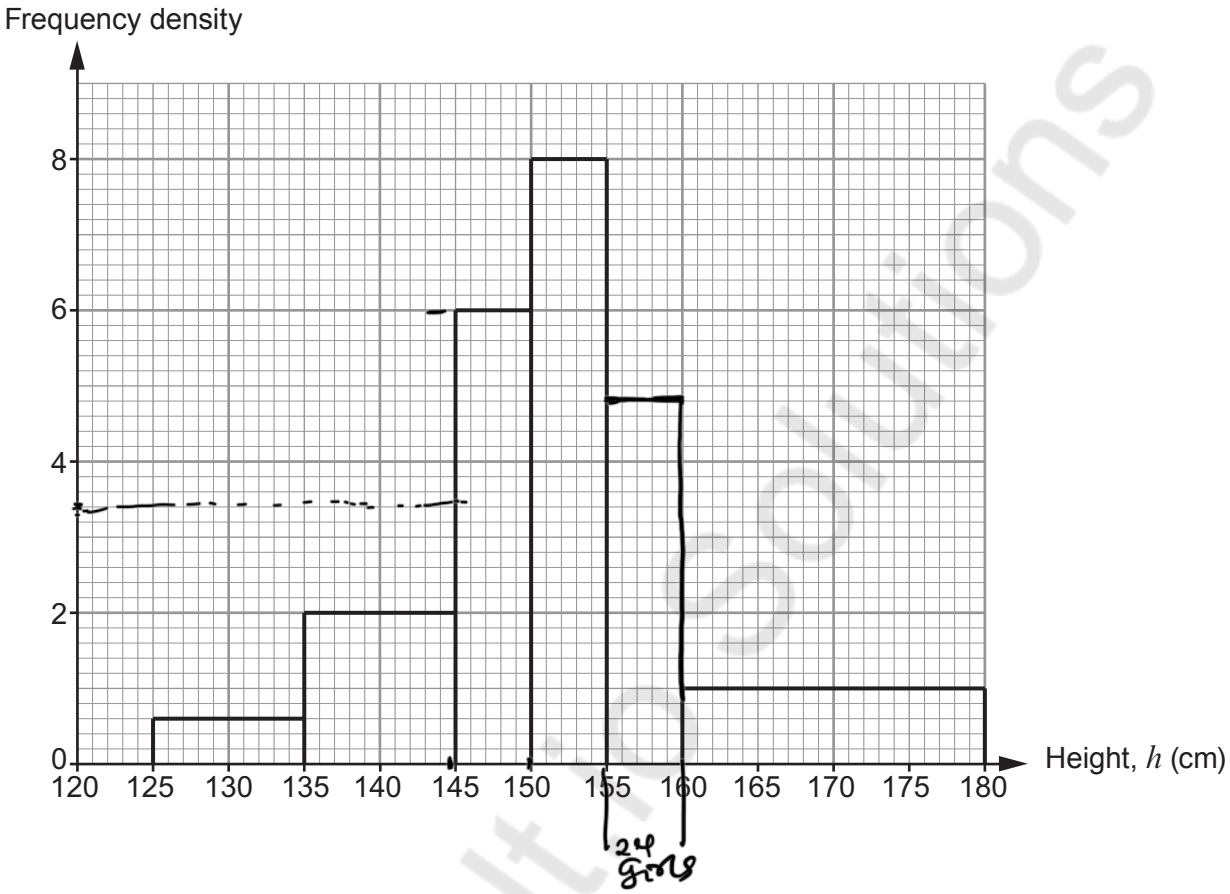
$\frac{1}{3} = \frac{x}{48}$

$x = \frac{48}{3} = 16\text{cm}$

So height of smaller vase = 16cm

Examiner only

13. The heights of all the Year 11 girls at a school were measured.
Nia has started to draw a histogram of the results.



(a) There were 24 girls in Year 11 whose heights were in the group $155 < h \leqslant 160$ cm.
Use this information to complete Nia's histogram. [2]

Using frequency density
$\frac{24}{5} = 4.8$ for the height

Examiner only

(b) Nia has started to do some data analysis on the heights of the Year 11 girls.
She has estimated the median and the upper quartile, as shown in the table below.

Lower quartile	Median	Upper quartile
.....	151·75 cm	156·875 cm

Use the histogram to calculate an estimate of the lower quartile of the heights of the Year 11 girls. [6]

Using values from the histogram

$10 \times 0.6 + 10 \times 2 + 5 \times 6 + 5 \times 8 + 24 + 20 \times 1$

$= 140$

So, we search for height in the group of 145 – 150 (cos FD's chanted)

corresponds to height 6

So, $6x = 21$

$x = \frac{21}{6} = 3.5$

So, lower quartile = 146.5 cm

Examiner only

14. The diagram shows the simplified model of part of an engine.
It shows a belt which runs around three circular cogs.
The engine rotates Cog 1.
Cog 1 rotates the belt, which then makes Cogs 2 and 3 rotate.

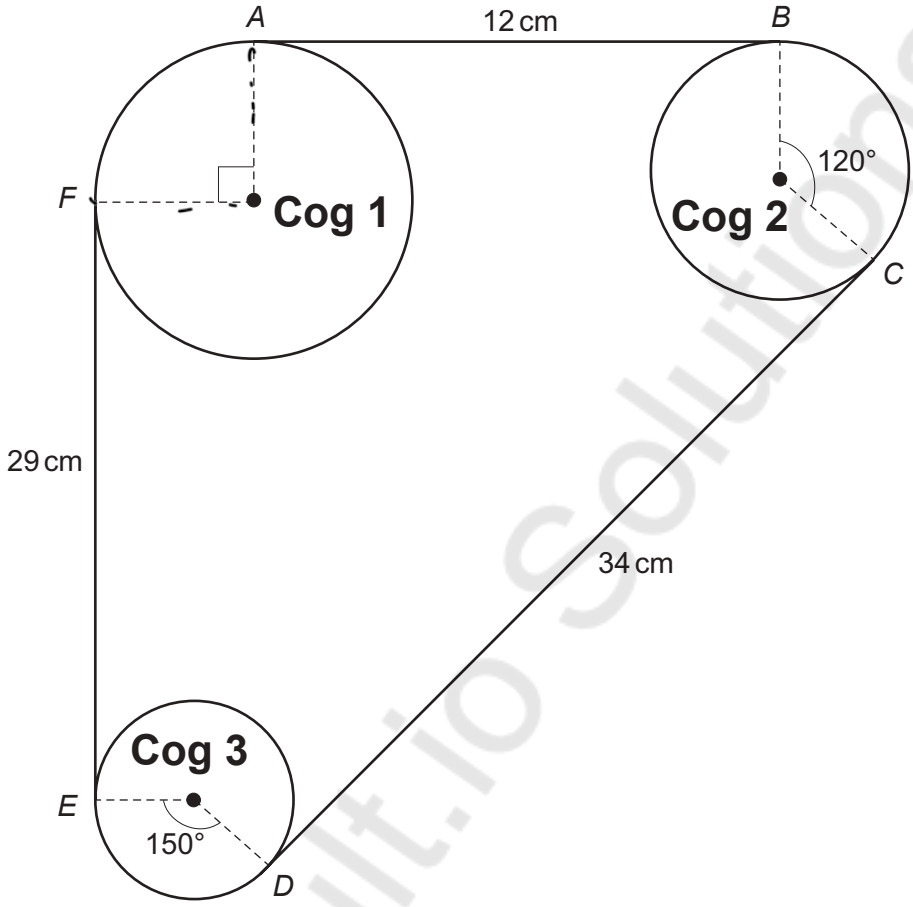


Diagram not drawn to scale

AB, *CD* and *EF* are straight sections of the belt.
AB = 12 cm, *CD* = 34 cm and *EF* = 29 cm.
The belt bends around the outer edges of the circular cogs, represented by the arcs *BC*, *DE* and *AF*.
The dimensions of the cogs are:

- radius of Cog 1 = 6 cm
- radius of Cog 2 = 4·5 cm
- radius of Cog 3 = 3 cm

(a) What is the length of arc *AF* in terms of π?
Circle your answer. [1]

2π 3π 6π 4π $\frac{3\pi}{2}$

Arc AF = 3π

Examiner only

(b) Calculate the total length of the belt.
Give your answer in terms of π in its simplest form. [4]

$\frac{120}{360} \times 2\pi \times 4.5 + \frac{150}{360} \times 2\pi \times 3$

$= 3\pi + \frac{5}{2}\pi$

$= \frac{11\pi}{2}$

length of belt $= 12 + 34 + 29 = 75$ cm

$75 + \frac{17\pi}{2} = \frac{150 + 17\pi}{2}$

Total length of the belt = $\frac{150 + 17\pi}{2}$ cm

(c) Elen notices that when Cog 3 makes two revolutions, Cog 1 makes only one revolution, because the radius of Cog 3 is half the radius of Cog 1.

In one minute, Cog 3 makes 2400 revolutions.
Calculate the number of revolutions **Cog 2** will make in one minute. [3]

Using $\frac{3}{4.5} \times 2400$ ie $\frac{\text{radius of 3}}{\text{radius of 2}} \times$ revs of 3 in one min

$= 1600$ revs

END OF PAPER Thank you

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

Examiner only