

Surname	Centre Number	Candidate Number
Other Names		0



GCSE – NEW

3310U60-1



MATHEMATICS – NUMERACY
UNIT 2: CALCULATOR-ALLOWED
HIGHER TIER

THURSDAY, 8 JUNE 2017 – MORNING

1 hour 45 minutes

ADDITIONAL MATERIALS

A calculator will be required for this paper.
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, taking care to number the question(s) correctly.
Take π as 3.14 or use the π button on your calculator.

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 6, the assessment will take into account the quality of your linguistic and mathematical organisation, communication and accuracy in writing.

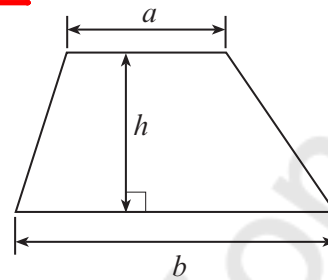
For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	3	
2.	2	
3.	4	
4.	4	
5.	8	
6.	6	
7.	8	
8.	6	
9.	3	
10.	5	
11.	8	
12.	7	
13.	7	
14.	9	
Total	80	



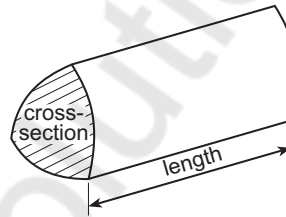
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Formula List - Higher Tier

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

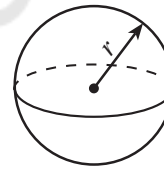


Volume of prism = area of cross-section \times length



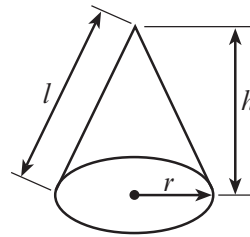
Volume of sphere = $\frac{4}{3}\pi r^3$

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



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

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

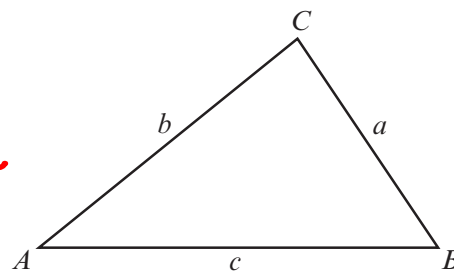


In any triangle ABC

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.



1. Mali's scooter depreciated (decreased) in value by 24% in the **first** year.
In all further years, her scooter depreciated by 13% of its previous year's value.
She originally paid £850 for her scooter.
Calculate the value of Mali's scooter after 7 years. [3]

$$\text{Cost price} = \text{£}850$$

1st year: It depreciates by 24%

$$\text{New value} = (100 - 24)\% \text{ of } 850 = 76\% \text{ of } 850 = \underline{\underline{646}}$$

$$2^{\text{nd}} \text{ year: } (100 - 13\%) \text{ of } 646 = 87\% \text{ of } 646 = \text{£}562.02$$

$$3^{\text{rd}} \text{ year: } (100 - 13\%) \text{ of } 562.02 = 87\% \text{ of } 562.02 = \text{£}488.96$$

$$4^{\text{th}} \text{ year: } (100 - 13\%) \text{ of } 488.96 = 87\% \text{ of } 488.96 = \text{£}425.40$$

$$5^{\text{th}} \text{ year: } (100 - 13\%) \text{ of } 425.40 = 87\% \text{ of } 425.40 = \text{£}370.10$$

$$6^{\text{th}} \text{ year: } (100 - 13\%) \text{ of } 370.10 = 87\% \text{ of } 370.10 = \text{£}321.99$$

$$7^{\text{th}} \text{ year: } (100 - 13\%) \text{ of } 321.99 = 87\% \text{ of } 321.99$$

$$= \text{£}280.13$$

After 7 years, the value of Mali's scooter was £ 280.13

2. Sanjay stacks three boxes in a pile.
The heights of the boxes are 25 cm, 36 cm and 47 cm.
They are all measured correct to the nearest centimetre.
What is the greatest possible height of the stack of the three boxes? [2]

25 cm, 36 cm, 47 cm is nearest cm

To approximate 25 cm: It ranges from 24.5 - 25.5

To approximate 36 cm: It ranges from 35.5 - 36.5

To approximate 47 cm: It ranges from 46.5 - 47.5

$$\text{So, the greatest height} = 25.5 + 36.5 + 47.5$$

$$= 109.5 \text{ cm}$$

Greatest possible height of the stack of three boxes is 109.5 cm

$$\underline{\underline{109.49999 \text{ cm}}}$$



3. *Organics4U* is planning to have its headquarters in Wales.
The manager has instructed Ffion to look for a site for the headquarters.

Here are the instructions that Ffion has been given by her manager.

'Find the point that is

- an equal distance between Wrexham and Aberporth, and
- an equal distance between Caernarfon and Swansea.

The new headquarters needs to be within 20 miles of this point.'

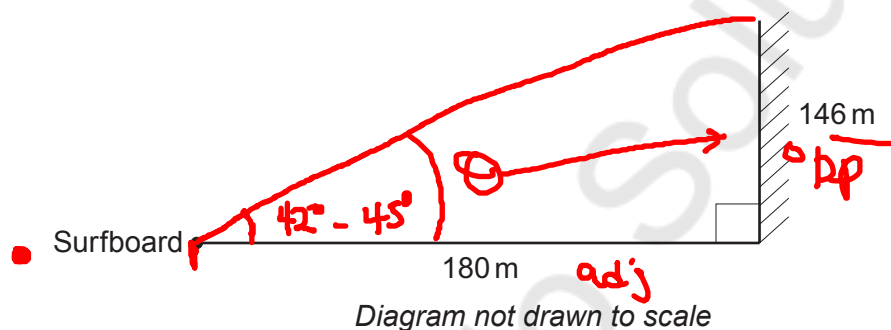
On the map below, shade the region, **in Wales**, that Ffion should identify for her manager. [4]



4.



Ursula is lying on her surfboard 180 metres away from the foot of a vertical cliff. The height of the cliff is 146 metres.



Ursula was told that if the angle of elevation of the top of the cliff from her lying position is between 42° and 45°, it is safe for her to attempt to stand on her surfboard.

Calculate the angle of elevation of the top of the cliff from Ursula's position lying on her surfboard.

State whether it is

- safe for Ursula to attempt to stand, or
- not safe as she is too near the cliff, or
- not safe as she is too far out at sea.

[4]

Angle of elevation using SOH CAH TOA

$$\tan \theta = \frac{\text{opp}}{\text{adj}} = \frac{146}{180} = 0.8111$$

$$\theta = \tan^{-1}(0.8111) = 39.05^\circ$$

So, it is not safe for Ursula to stand up because she is too far from the cliff



5. Marta buys a new television.

- (a) Marta wants to fit the television in a bookcase on the wall. In the shop she forgot to write down the length of the television. She did write down the height and the diagonal of the screen.

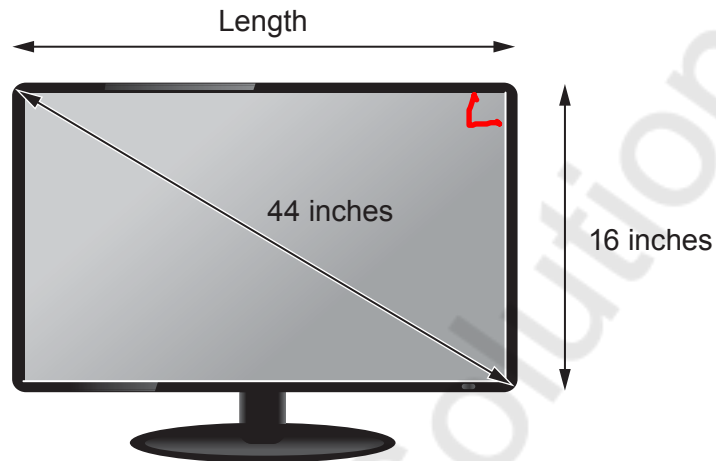


Diagram not drawn to scale

Marta needs to know the length of the screen before she opens the box, in case she wants to return the television.

Calculate the length of the screen.

Give your answer correct to 2 significant figures.

[4]

Applying Pythagoras theorem

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

$$44^2 = 16^2 + b^2$$

$$1936 = 256 + b^2$$

$$-256 \quad -256$$

$$1680 = b^2$$

$$b = \sqrt{1680}$$

$$b = 40.988 \text{ inches}$$

$$b = 41 \text{ to 2sf}$$

Length is 41 inches, correct to 2 significant figures.



- (b) The television was reduced in the sale by 26% of its original price.
It cost Marta £710.40 in the sale.
What was the original price of the television?

[2]

reduce in sale by 26% of original price

$$\text{Cost price} = £710.40$$

Cost price = (100% - 26%) of original price

$$710.40 = 74\% \text{ of } x$$

$$710.40 = 0.74x$$

$$x = \frac{710.40}{0.74}$$

Original price £

960

0.74

$$x = £960$$

- (c) A television uses 1 unit of electricity every 10 hours.
A unit of electricity costs 9.8p.

$$1 \text{ unit} = 9.8 \text{ p}$$

- (i) Calculate the cost of having a television turned on for 24 hours.
Circle your answer.

$$2.4 \text{ unit} = 9.8 \times 2.4$$

[1]

£23.52

£2.35

40.83p

23.52p

2.45p

$$= 23.52 \text{ p}$$

10 hours → 1 unit

$$24 \text{ hrs} = \frac{1}{10} \times 24 \text{ unit}$$

1 hour → $\frac{1}{10}$ unit

$$24 \text{ hours} = 2.4 \text{ unit}$$

- (ii) On average, Marta watches 4 hours of television each day.
On average, how much a week does it cost her to watch television?
Circle your answer.

[1]

27.44p

£27.44

£39.20

39.2p

10.78p

4hr each day

7 days in a week

$$\text{So, Marta watch time} = 4 \times 7 = 28 \text{ hrs}$$

$$1 \text{ hr} = 0.1 \text{ unit}$$

$$28 \text{ hrs} = 0.1 \times 28 = 2.8 \text{ units}$$

$$1 \text{ unit} = 9.8 \text{ p}$$

$$2.8 \text{ unit} = 9.8 \times 2.8 = 27.44 \text{ p}$$



6. In this question, you will be assessed on the quality of your organisation, communication and accuracy in writing.

Elin's old fish tank is leaking.

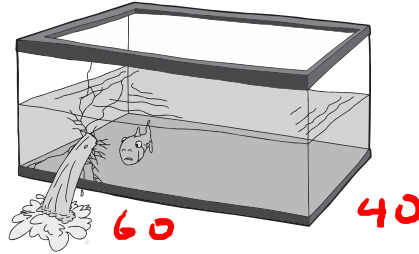


Diagram not drawn to scale

This old fish tank is in the shape of a cuboid.
The base of this tank measures 60 cm by 40 cm.
Before the leak, the height of the water level in Elin's old fish tank was 45 cm.

Elin decides to replace her fish tank with a cylindrical one.

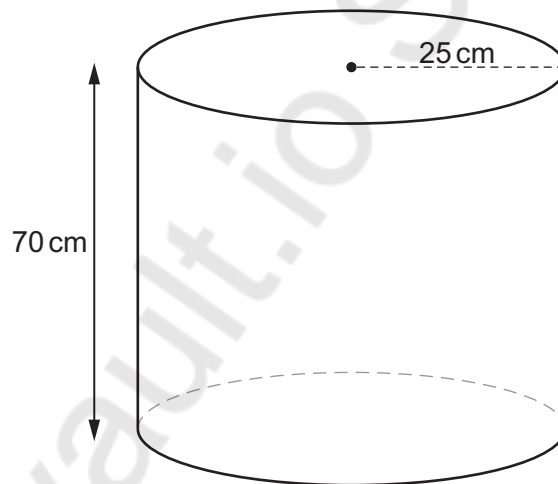


Diagram not drawn to scale

She selects a new cylindrical fish tank that has a radius of 25 cm and a height of 70 cm.

Will all the original contents, including the water and the fish, fit into this cylindrical tank?

You must show all your working.

[4 + 2 OCW]

$$\begin{aligned} \text{Volume of water in the cuboid} &= L \times b \times h \\ &= 60 \times 40 \times 45 \\ &= 108\,000 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} \text{Volume of cylindrical tank} &= \pi r^2 h \\ &= 3.14 \times 25^2 \times 70 \\ &= 137,375 \text{ cm}^3 \end{aligned}$$



The original content in the cuboid
will fit into the cylindrical

tank because the volume of
the cylindrical tank is
greater than the volume of cuboid

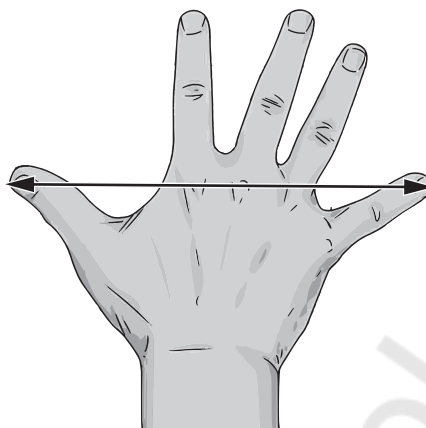
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7. Simon plans to make gloves.

- (a) One morning, Simon decided to carry out a survey to find the mean hand span of people in Wales.



He decided to sample systematically.

He decided to sample from the first 240 people who pass him in the street during the morning.

He wanted to take 20 people's hand span measurements.

Explain how Simon could use systematic sampling to obtain 20 measurements. [1]

So, he needs to divide the sample by 20

$$\frac{240}{20} = 12^{\text{th}}$$

So, he can sample the 12th person in the population or he can sample at random every 12 person



- (b) Yesterday morning, Simon only managed to sample 10 people. He calculated the mean hand span of these 10 people to be 22.8 cm. Yesterday afternoon, Simon recorded the hand spans of a further 20 people. The results for these 20 people are shown in the frequency table below.

Hand span, to the nearest mm	Frequency f	midpoint x	fx
20.0 cm to 20.8 cm	2	20.4	40.8
20.9 cm to 21.7 cm	3	21.3	63.9
21.8 cm to 22.6 cm	10	22.2	222
22.7 cm to 23.5 cm	5	23.1	115.5

Calculate an estimate of the mean of all 30 hand spans that Simon measured yesterday.

[6] 442.2

$$\text{mean} = \frac{\sum fx}{f}$$

$$\bar{x} = \frac{\sum fx}{f} \quad \text{for the first 10 people}$$

$$\sum fx = f \times \bar{x} = 10 \times 22.8 = 228$$

mean of 30 people

$$\bar{x} = \frac{228 + 442.2}{30} = \frac{670.2}{30}$$

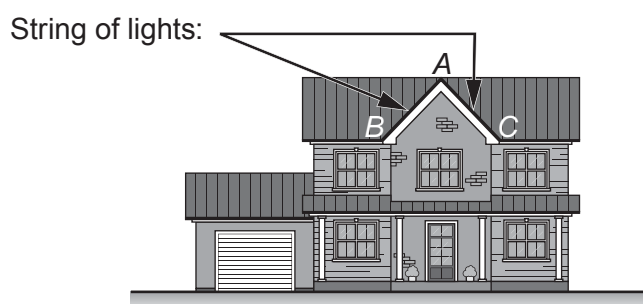
$$\bar{x} = \underline{\underline{22.34}}$$

- (c) What could Simon do to improve his estimate of the mean hand span of people in Wales? [1]

To improve the mean, he needs to expand the sample space or increase the sample by asking more people.



8. The diagram below shows where Levi wants to attach a string of lights to his house.



Levi wants to attach a single string of lights from B to A and then from A to C. The diagram below shows the measurements Levi has taken.

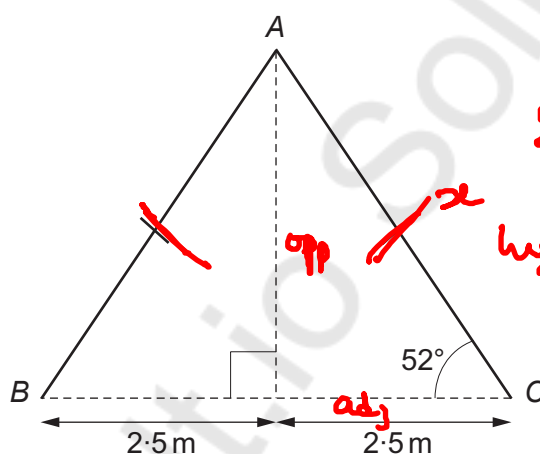


Diagram not drawn to scale

SOH CAH TOA

He spends £410 at the electrical store buying a string of lights. After putting up the lights, Levi finds he has 6 metres of the string of lights left over at one end.

How much did the electrical store charge Levi, per metre, for the string of lights? [6]

$$\text{Cost of light} = £410$$

Applying SOH CAH TOA

$$\cos \theta = \frac{\text{adj}}{\text{hyp}}$$

$$\cos 52 = \frac{2.5}{x}$$

$$x = \frac{2.5}{\cos 52} = \frac{2.5}{0.6157} = 4.06$$

$$\text{So, } AC = AB = 4.06$$



$$\text{Total length} = 4.06 + 4.06 = 8.12\text{m}$$

So, since 6m of wire was left.

The total length of electrical wire bought

$$\text{is } 8.12 + 6 = 14.12\text{m}$$

$$\text{Total Cost } \underline{\underline{\pounds 410}}$$

$$\text{Cost per metre} = \frac{410}{14.12} = 29.04$$

$$\underline{\underline{\pounds 29.04 \text{ / metre}}}$$



9. The table shows the number of Year 11 pupils attending schools in Cwmifan.

School	Cwrt Haf	Cwmifan High	Henclwyd
Number of Year 11 pupils	307 x	239 x	144 x

In total there are 690 Year 11 pupils attending these three schools.

A new youth theatre has been set up in Cwmifan.

On the opening night, a total of 80 Year 11 pupils from these three schools are going to be invited to attend.

Use a stratified sampling method to calculate the number of Year 11 pupils from each school who should be invited.

You must show all your working.

[3]

$$\begin{aligned} \text{For Cwrt Haf} &: P_r(\text{Student in school}) \times 80 \\ &= \frac{307}{690} \times 80 = 35.59 \\ &\equiv 35 \end{aligned}$$

$$\begin{aligned} \text{For Cwmifan High} &= \frac{239}{690} \times 80 = 27.71 \\ &\equiv 28 \end{aligned}$$

$$\begin{aligned} \text{For Henclwyd} &= \frac{144}{690} \times 80 = 16.7 \\ &\equiv 17 \end{aligned}$$

School	Cwrt Haf	Cwmifan High	Henclwyd
Number that should be invited	35	28	17



10. Fatima wants to invest some money in a savings account. She has picked up leaflets from two building societies advertising their high-interest savings accounts.

'Bannau' account

Nominal annual rate of

$$i = 3.85\% = \frac{3.85}{100} = 0.0385$$

Interest paid monthly

'Eryri' account

Nominal annual rate of

$$3.86\% \quad i = \frac{3.86}{100} = 0.0386$$

Interest paid every
6 months

$$n = 2$$

By comparing AERs, which account will offer Fatima the better interest rate on her investment? You must show all your working. [5]

$$AER = \left(1 + \frac{i}{n}\right)^n - 1 \quad i = 0.0385 \quad n = 12$$

$$AER(\text{Bannau}) = \left[1 + \frac{0.0385}{12}\right]^{12} - 1 = (1.00321)^{12} - 1$$

$$AER(\text{Bannau}) = 1.0392 - 1 = 0.0392$$

$$\text{OR} = 3.92\%$$

$$AER(\text{Eryri}) = \left[1 + \frac{i}{n}\right]^n - 1$$

$$= \left[1 + \frac{0.0386}{2}\right]^2 - 1$$

$$= (1.0193)^2 - 1$$

$$1.039 - 1 = 0.039$$

$$3.9\%$$

Bannau account will offer fatima a better investment because it has a higher



11. A company produces metal badges to be worn by its employees. The badge is made up of two parts. One part is in the shape of a sector of a circle as shown in the diagram.

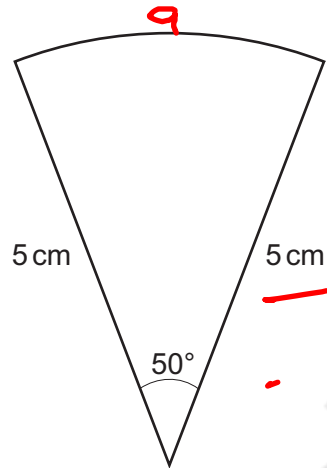


Diagram not drawn to scale

- (a) The perimeter of the sector is decorated with a coloured edging strip. Calculate the length of edging strip needed to decorate the sector. [3]

$$\begin{aligned}
 \text{Perimeter of a sector} &= 2r + \frac{\theta}{360} \times 2\pi r \\
 &= 2 \times 5 + \frac{50}{360} \times 2 \times 3.14 \times 5 \\
 &= 10 + 4.36 \\
 &= \underline{\underline{14.36 \text{ cm}}}
 \end{aligned}$$

- (b) The other part is in the shape of a quarter-circle of radius 3 cm.

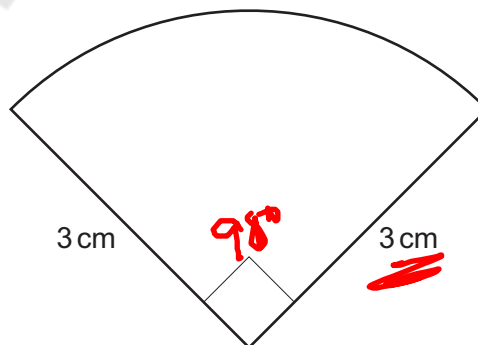


Diagram not drawn to scale



To make the badge, the two pieces are joined together with the sector in front of the quarter-circle, as shown in the diagram.
The badge has a vertical line of symmetry.

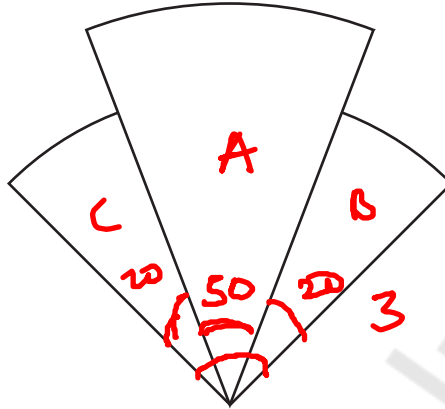


Diagram not drawn to scale

The visible surface of the front of the badge is painted.
Calculate the area that is painted.

[5]

$$\text{Area B} = \text{Area C}$$

$$\begin{aligned} \text{Area of Sector A} &= \frac{\theta}{360} \times \pi r^2 = \frac{50}{360} \times 3.14 \times 5^2 \\ &= 10.90 \text{ cm}^2 \end{aligned}$$

$$\begin{aligned} \text{Area of B} &= \frac{\theta}{360} \times \pi r^2 = \frac{20}{360} \times 3.14 \times 3^2 \\ &= 1.57 \text{ cm}^2 \end{aligned}$$

$$\text{Area of C} = 1.57 \text{ cm}^2$$

$$\begin{aligned} \text{Total Area} &= 10.90 + 1.57 + 1.57 \\ &= \underline{\underline{14.04 \text{ cm}^2}} \end{aligned}$$



12. A plan view of Lowri's garden is shown below.

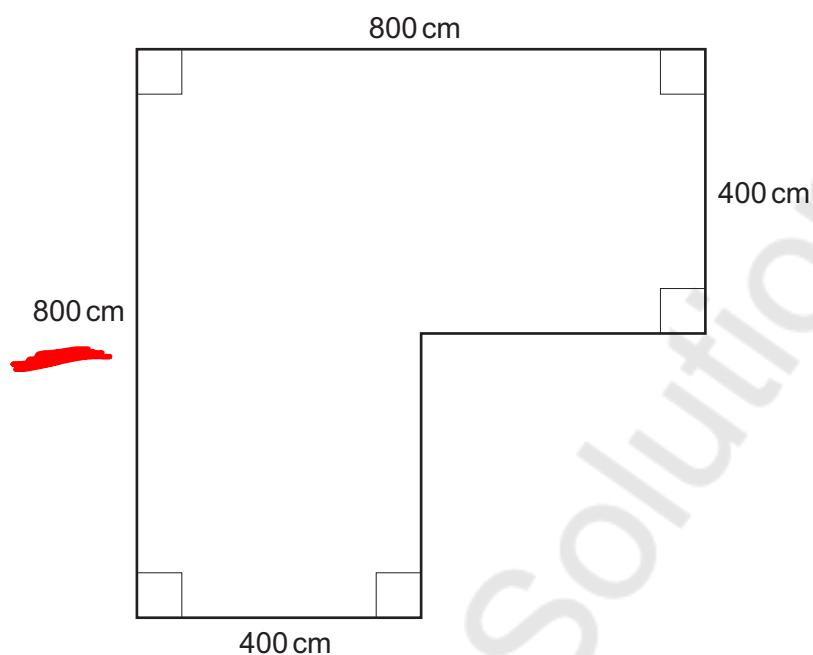
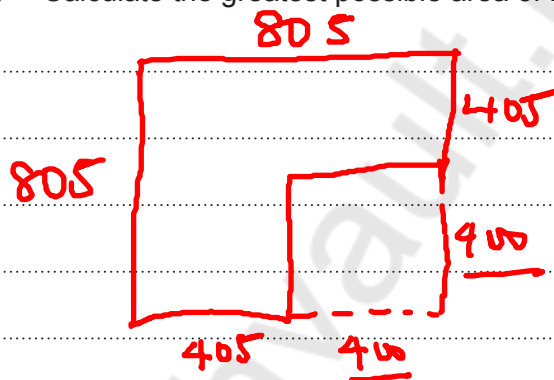


Diagram not drawn to scale

All the measurements are correct to the nearest 10 cm.

(a) Calculate the greatest possible area of Lowri's garden.

[4]



Greatest dimension
 $800 \text{ cm} \rightarrow 795 - 805$
 $400 \rightarrow 395 - 405$

Area of big square - Area of small square

$$805^2 - 400^2$$

$$648025 - 160,000$$

$$488025 \text{ cm}^2 //$$



- (b) Lowri plans to spread grass seed over her garden using a spreading tool. Over **each square metre**, the spreading tool spreads 30g of grass seed, correct to the nearest 5g. ~~25~~

Lowri has exactly 1.5 kg of grass seed.
Can she be **certain** that she has enough grass seed?
You must show all your calculations.

$$1 \text{ kg} = 1000 \text{ g}$$

[3]

$$1 \text{ m}^2 \rightarrow 30 \text{ g [nearest 5g]}$$

$$\text{Exact grass} \rightarrow 1.5 \text{ kg} = \underline{\underline{1500 \text{ g}}}$$

$$30 \text{ g} \rightarrow \underline{27.5} - \underline{32.5 \text{ g}}$$

$$1 \text{ m}^2 \rightarrow 32.5 \text{ g}$$

$$1 \text{ cm} = 0.01 \text{ m}$$

$$\text{Area} = 488025 \text{ cm}^2$$

$$1 \text{ cm}^2 = (0.01 \text{ m})^2$$

$$\text{Area} = 48.8025 \text{ m}^2$$

$$1 \text{ cm}^2 = 0.0001 \text{ m}^2$$

$$\text{So, } 48.8025 \text{ m}^2 \rightarrow \underline{\underline{1586.08 \text{ kg}}}$$

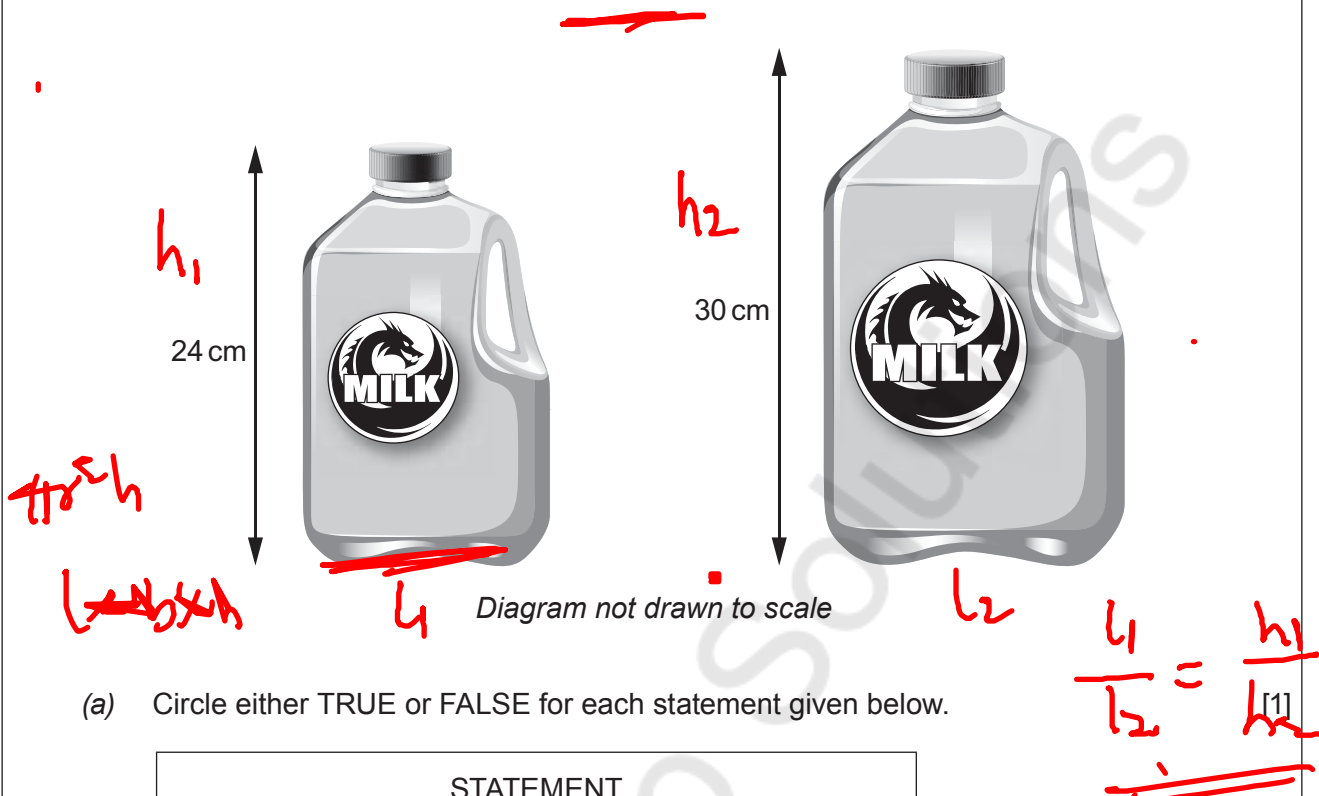
It is not certain that she has

enough grass since 1586.08 g is

greater than $\underline{\underline{1500 \text{ g}}}$



13. The front views of two mathematically similar milk cartons are shown below.



(a) Circle either TRUE or FALSE for each statement given below.

STATEMENT		
The ratio of the lengths of the cartons is the same as the ratio of the heights of the cartons.	<input checked="" type="radio"/> TRUE	<input type="radio"/> FALSE
The ratio of the volumes of the cartons is the same as the ratio of the heights of the cartons.	<input type="radio"/> TRUE	<input checked="" type="radio"/> FALSE

(b) It is claimed that the larger carton contains double the amount of milk contained in the smaller carton.
Show that this claim is not true.
Explain your answer. [3]

So, ratio in length $\frac{l_1}{l_2} = \frac{h_1}{h_2} = \frac{24}{30}$

$l_1 : l_2 = 24 : 30 = 4 : 5$

$V_1 : V_2 = 64 : 125$

Since 64 is not double of 125

then, the claim is not true



- (c) Another similar milk carton has a label with an area that is one quarter of the area of the label on the carton of height 24 cm.

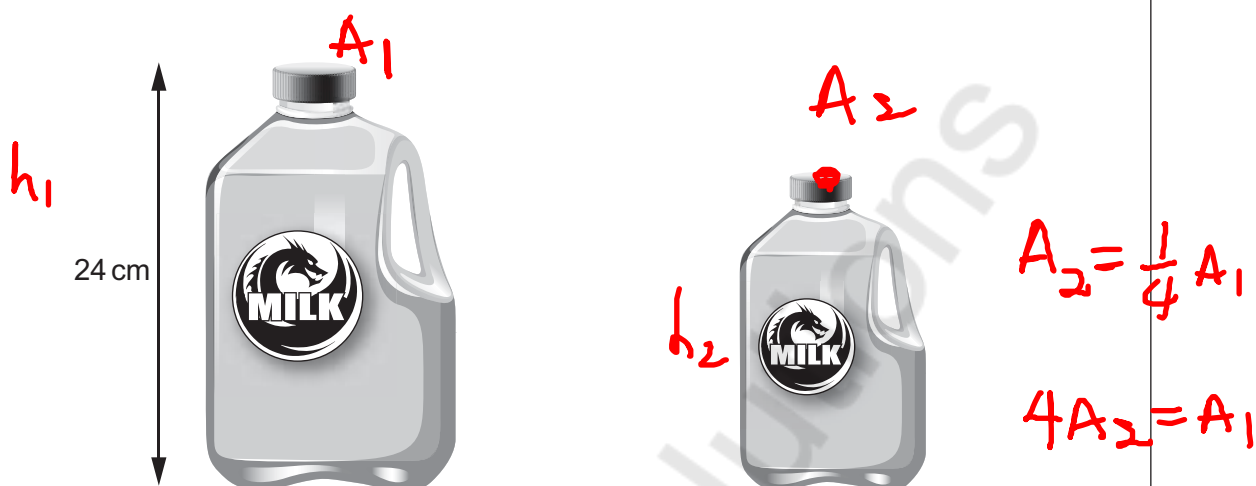


Diagram not drawn to scale

Calculate the height of this new carton.

[3]

$$h_1 : h_2 = \sqrt{A_1 : A_2}$$

$$24 : h_2 = \sqrt{4A_2 : A_2}$$

$$\frac{24}{h_2} = \sqrt{\frac{4A_2}{A_2}}$$

$$\frac{24}{h_2} = 2$$

$$\frac{24}{2} = \frac{2h_2}{2}$$

$$h_2 = \underline{\underline{12 \text{ cm}}}$$



14. The diagram shows a 5 m wide section of road that has a uniform gradient. The shaded area represents level ground. Two cyclists, Delyth and Ioan, approach this section of road.

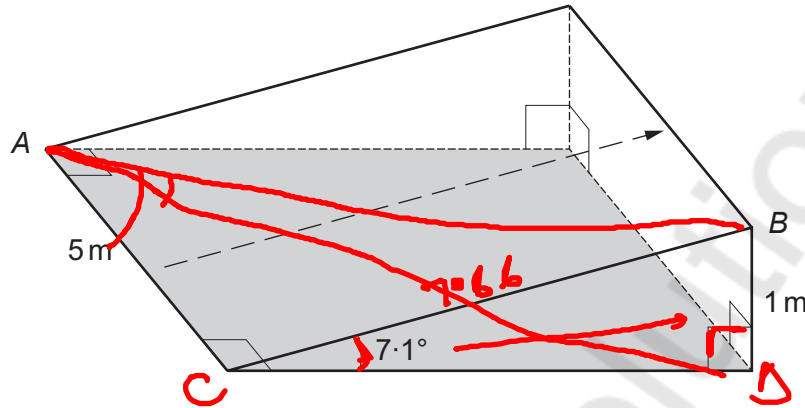


Diagram not drawn to scale

Delyth cycles straight up the middle of the road as shown by the arrow.

Ioan thinks this section of road is too steep to cycle straight up, so he decides to cycle from A to B in a straight line.

- (a) How far does Ioan cycle in going from A to B?

[6]

Find CB , using \sin of $\angle A$

$$\sin \theta = \frac{\text{opp}}{\text{hyp}}$$

$$\sin 7.1 = 0.1236$$

$$\sin 7.1 = \frac{1}{CB}$$

$$CB = \frac{1}{\sin 7.1} = \frac{1}{0.1236} = 8.09 \text{ m}$$

Applying Pythagoras theorem

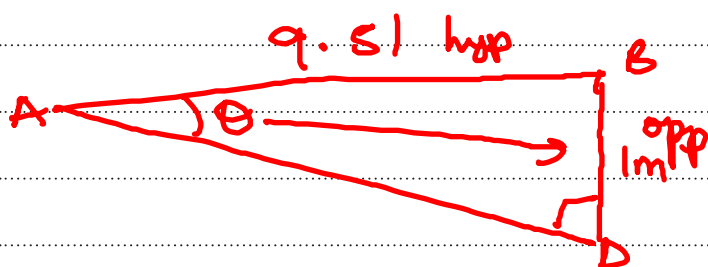
$$AB^2 = CB^2 + AC^2 = 8.09^2 + 5^2$$

$$AB^2 = 65.4481 + 25 = 90.4481$$

$$AB = \sqrt{90.4481} = 9.51 \text{ m}$$



- (b) Show that loan's route up this section of road is less steep than Delyth's route. You must show all your working. [3]



$$\sin \theta = \frac{\text{opp}}{\text{hyp}} = \frac{1}{9.51} = 0.1052$$

$$\sin \theta = 0.1052$$

$$\theta = \sin^{-1}(0.1052) = 6.04^\circ$$

Therefore, loan's route is less steep than Delyth's because 6.04° is less than 7.1° .

END OF PAPER



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