

Surname	Centre Number	Candidate Number
Other Names		0



GCSE – NEW

3310U40-1



A16-3310U40-1

MATHEMATICS – NUMERACY
UNIT 2: CALCULATOR-ALLOWED
INTERMEDIATE TIER

FRIDAY, 4 NOVEMBER 2016 – 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 5(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.	4	
2.	11	
3.	6	
4.	6	
5.	10	
6.	6	
7.	5	
8.	6	
9.	14	
10.	12	
Total	80	

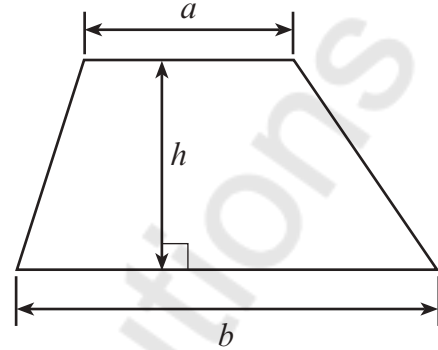
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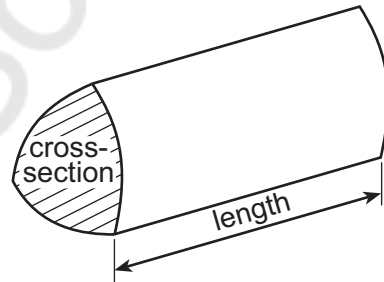
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Formula List – Intermediate Tier

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

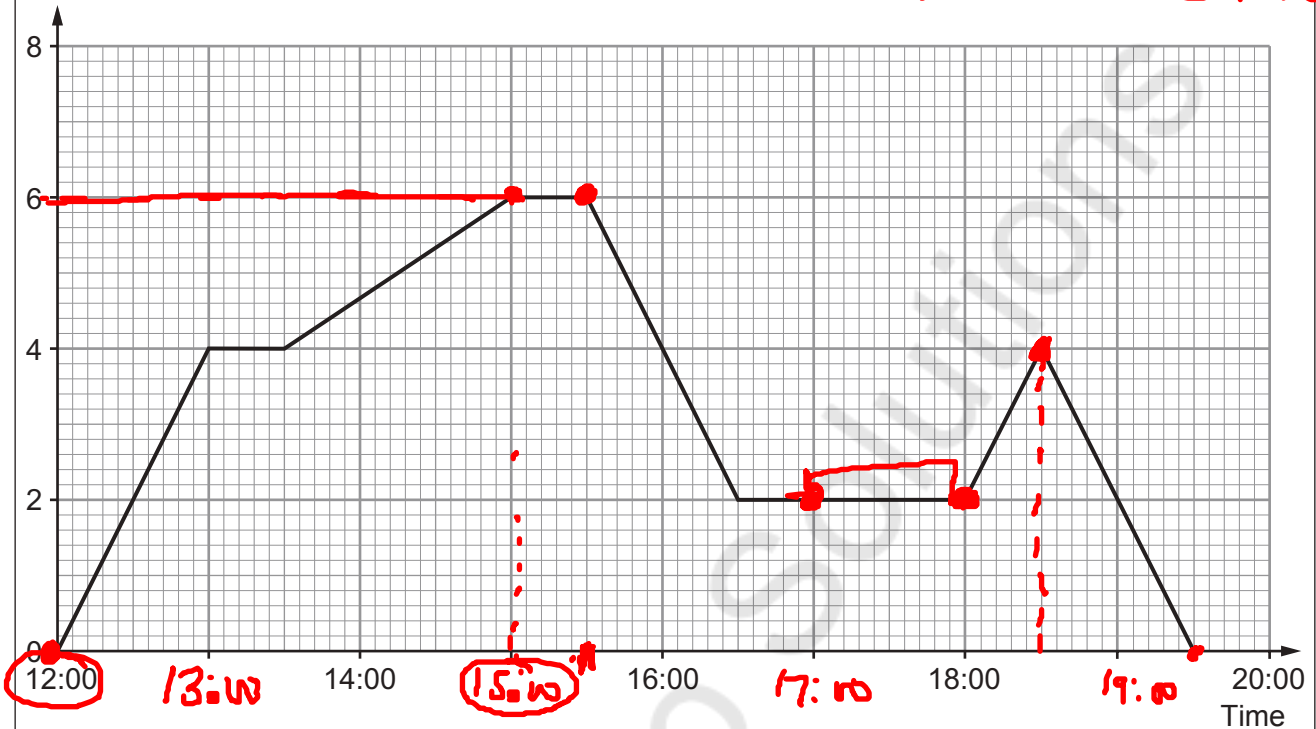


$$\text{Volume of prism} = \text{area of cross-section} \times \text{length}$$



1. The travel graph below shows a journey Gareth made yesterday.

Distance from home (km)



(a) How far away from home was Gareth at 15:00?
Circle your answer.

0 km 2 km 4 km 6 km 8 km

[1]

(b) At what time did Gareth arrive back home?
Circle your answer.

14:00 16:30 18:45 19:15 19:30

[1]

(c) Sometime after 5p.m., Gareth headed for the supermarket.
The supermarket was closed when he got there so he headed straight back home.
At what time did Gareth arrive at the supermarket?
Circle your answer.

17:00 17:30 18:00 18:15 18:30 19:00

[1]

(d) Gareth did not stop for the whole of the time between 15:00 and 15:30.
What could the travel graph tell you about his journey between these times?

[1]

Gareth was at a constant distance (6 km) away from home between 15:00 to 15:30. i.e. Gareth did not travel any distance between these times.



2. (a) 36 000 people took part in a survey to find out their favourite type of TV programme. The pie chart shows the results.



- (i) How many people chose *Drama* as their favourite type of TV programme? You must show your working. [3]

$$\begin{aligned} \text{Angle of Drama} &= 100 \\ \text{No of Drama} &= \frac{\text{Angle of Drama}}{360} \times 36000 \\ &= \frac{100}{360} \times 36,000 = 10,000 \end{aligned}$$

- (ii) How many more people chose *Sport* rather than *News* as their favourite type of TV programme? You must show your working. [3]

$$\begin{aligned} \text{No of news} &= \frac{60}{360} \times 36000 = 6000 \\ \text{No of sports} &= \frac{110}{360} \times 36000 = 11,000 \\ 11,000 - 6000 &= 5000 \\ \text{5,000 people more chose Sport} \\ &\text{rather than News.} \end{aligned}$$



- (iii) Twice as many women as men chose *Talent shows* as their favourite type of TV programme.
Calculate how many women chose *Talent shows*.
You must show your working. [3]

$$\text{Talent show} = \frac{90}{360} \times 36000 = \underline{\underline{9000}}$$

$$\text{men} = x \quad \text{women} = 2x$$

$$x + 2x = 9000$$

$$3x = 9000$$

$$x = \frac{9000}{3} = 3000$$

$$\text{men} = 3000$$

$$\text{women} = \underline{\underline{6000}} *$$

6000 women chose *Talent shows*.

- (b) 1000 people were asked,

'Should news programmes include details of the weather?
Yes or No?'

70% of the people answered 'yes'.

A pie chart is to be drawn to represent the answers to this question.

What size would the angle be to represent the answer 'yes'? [2]

$$\text{Yes} \rightarrow 70\%$$

$$70\% \text{ of full circle } (360^\circ)$$

$$\frac{70}{100} \times 360$$

$$\text{Angle representing 'yes' is } \underline{\underline{252^\circ}} \text{ (Yes)}$$

$$\text{30\%} \Rightarrow \underline{\underline{108^\circ}} \text{ (No)}$$



3. Loretta is paid in euros.
She is checking her tax bill for last year.

The tax rates last year were as follows:

- No tax on the first €3500 of earnings • [No tax]
- Earnings in excess of €3500 and up to €10 500: taxed at a rate of 25% 25%
- Earnings above €10 500: taxed at a rate of 35% 35%

Last year, Loretta's total earnings before tax were €34 500.

How much tax did Loretta pay in total?
You must show all your working.

[6]

Loretta earning = € 34,500

Case 1: first $\underbrace{3500}$ (No tax)
Tax = 0€

Balance $34,500 - 3500 = €31,000$

Case 2: In excess of $\underbrace{€3500}$ to €10,500
earning extra $10,500 - 3500 = \underline{\underline{€7000}}$

Tax on 7000: 25% of 7000

$$\frac{25}{100} \times 7000 = \underline{\underline{€1750}}$$

Case 3: Above €10,500 tax 35%

$$34500 - 3500 - 7000 = €24,000$$

Tax on € 24,000

$$\frac{35}{100} \times 24,000 = €8400$$

Tax paid = € 10,150

$$\text{Tax} = €0 + €1750 + €8400$$

$$\text{Tax} = \underline{\underline{€10,150}}$$



4. Ewan is going on holiday to India.
He has saved £450 to exchange for Indian rupees.

- (a) The exchange rate on the internet last week was £1 = 99.40 rupees.
Had Ewan been going on holiday last week, how many rupees could he have bought? [2]

Ewan saved £450

Exchange rate [internet] £1 = 99.40 rupees

$$£450 = 99.40 \times 450 = 44,730 \text{ rupees}$$

- (b) Ewan exchanges his money on arrival in India.
The exchange rate is now £1 = 99.72 rupees.

The exchange bureau only has 500 rupee notes.
Ewan wants to buy as many rupees as possible with his £450 savings.

How much of his £450 will Ewan spend buying rupees?
Give your answer correct to the nearest penny.
You must show all your working. [4]

Ewan has £450

Exchange rate £1 = 99.72 rupees

$$£450 = 450 \times 99.72 = 44,874 \text{ rupees.} \checkmark$$

How many 500 rupee notes can be found
in 44,874 rupees

$$\text{No of 500 rupees note} = \frac{44874}{500}$$

$$= 89.748$$

So, Ewan will get 89 500 rupee notes

$$\begin{aligned} \text{Total of 89 500 rupee notes} &= 89 \times 500 \\ &= 44,500 \text{ rupees} \end{aligned}$$

So, £1 = 99.72 rupees

$$44,500 \text{ rupees} = \frac{44500}{99.72}$$

$$£446.25$$

99.72 Turn over.



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

Railcard for 16 to 25 year olds

£30 for a year

Get $\frac{1}{3}$ off all your rail travel

Nerys and Eleri are sisters.
Nerys is 22 years old and Eleri is 27 years old.

The two sisters live in Holyhead.
Their aunt lives in Milford Haven.
They travel by train to visit their aunt 3 times a year.

Nerys buys a 16-25 Railcard to use for these journeys.
They buy single rail tickets for each journey.
The cost of a **single** rail ticket from Holyhead to Milford Haven is £84.50.
The journey home from Milford Haven also costs £84.50 per ticket.

In a year, how much less does Nerys pay than Eleri for the journeys to Milford Haven and back?

You must show all your working.

[5 + 2 OCW]

Cost of rail ticket £84.50

Since they visit aunt 3 times a year, the total journey will be 6 (to and fro).

Case 1. Eleri:

Cost of single travel is £84.50

Eleri travels 6 times

$$\begin{aligned} \text{Total Cost for Eleri} &= 84.50 \times 6 \\ &= \underline{\underline{£507}} \end{aligned}$$

Case 2: Nerys:

Nerys will pay £30 first.

Then she will get $\frac{1}{3}$ off the rail ticket

$$\text{Payment off} = \frac{1}{3} \times 84.50 = 28.17$$

$$\text{Nerys will pay} = 84.50 - 28.17 = \underline{\underline{56.33}}$$

$$\text{Total Cost} = 30 + 6 \times 56.33$$

$$\text{Total Cost} = \underline{\underline{£368}}$$



$$\text{Difference in payment} = 507 - 368 = \pounds 139$$

Nerys pays $\pounds 139$ less than
Flois.

Examiner
only

- (b) Cristiano is 22 years old.
He sometimes travels from Rhyl to Llandudno Junction by train.
The cost of a single rail ticket from Rhyl to Llandudno Junction is $\pounds 7.80$.

Nerys advises Cristiano to buy a Railcard.
Cristiano says,

$$\text{Discount} = \frac{1}{2} \text{ of } 7.8 = 2.6$$

It is not worth paying $\pounds 30$ for the Railcard.

$$\text{Cost} = 7.8 - 2.6$$

$$\text{Cost} = 5.2$$

How many times in a year would Cristiano have to travel to make it worthwhile for him to buy a Railcard? [3]

Number of time traveled = x

Normal Cost with Railcard = $7.8 \times x \pm \pounds 7.8x$

Cost using Railcard

$$\text{Cost} = 30 + x \times 5.2 \quad x > \frac{30}{2.6}$$

$$\text{Cost} = 30 + 5.2x$$

$$7.8x > 30 + 5.2x \quad x > 11.5$$

$$-5.2x \quad -5.2x$$

$$2.6x > 30$$

After 12
time

Turn over.



$$x = 11$$

Normal cost, $7.8 \times 11 = \text{€}85.8$ *

Road & cut = $30 + 5.2 \times 11 = \text{€}87.2$

10

Examiner
only

6.



- (a) The total area of all the woodlands in Wales is **303 000 hectares**.

Individual woodlands that have an area of 2000 hectares or more make up 76% of the total area of all the woodlands in Wales.

Complete the following statement.

'Woodlands with areas of **less than** 2000 hectares in Wales cover a total area of 72 720 hectares.'

[3]

Total Area = 303,000 hectares

Individual has area of 2000 hectares

2000 more has 76% of Total Area

2000 less has 24% of Total Area

24% of 303,000

$$\frac{24}{100} \times 303,000 = 72,720 \text{ hectares}$$



- (b) The price of softwood changes each year.
The price has increased by 6% per annum for each of the last 5 years.
Before this, the price had decreased by 2% per annum.
Seven years ago the price of softwood was £34 per m^3 .

Calculate the current price of softwood.

[3]

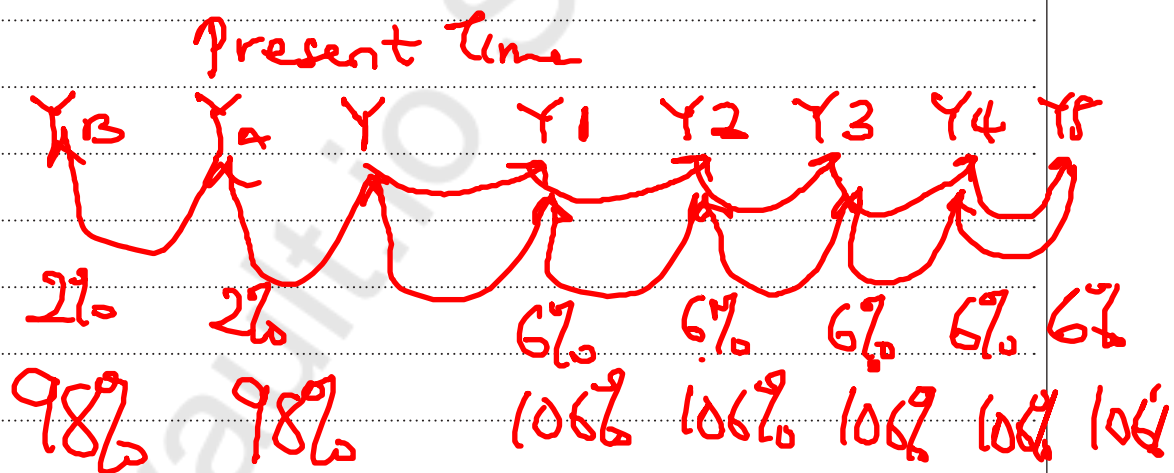
Increase of price 6% per annum
Time = 5 years

Price decrease 2% per annum
Time = 7 years ago

Price softwood = £34 / m^3

106%

106
100



$$\text{Current Price} = 34 \times 0.98^2 \times 1.06^5$$

$$\text{Current Price} = £43.7 / \text{m}^3$$

Current price of softwood is £ per m^3



$$a+b = b+a \quad 12$$

$$2y + 2x$$

Examiner only

7. (a) The Headteacher of Ysgol Bro Gwyn investigates building a new bike shed.

Bike sheds are built on a rectangular base of width x metres and length y metres.

(i) Which is the correct expression for the perimeter of the bike shed?
Circle your answer. [1]

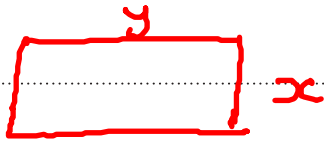
xy metres

xy square metres

$x + y$ metres

$2x + y$ metres

$2x + 2y$ metres



$$P = 2(L + W) = 2(y + x)$$

$$P = 2x + 2y$$

(ii) The Headteacher is given a formula for working out the number of bikes, b , that can be stored in a bike shed that has a base of width x metres and length y metres.

He is told the formula only works when

- x and y are whole numbers
- x is greater than 3
- y is greater than 5

$$x > 3$$

$$y > 5$$

The formula is as follows:

$$b = \frac{6xy}{5}$$

$$b = \frac{6xy}{5}$$

- According to the formula, how many bikes can be stored in a bike shed 5 metres wide and 8 metres long?

Circle your answer. [1]

3

7

42

48

240

$$b = \frac{6xy}{5}$$

$$x = 5 \quad y = 8$$

$$b = \frac{6 \times 5 \times 8}{5} = 48$$

- A bike shed x metres wide and y metres long can hold b bikes. According to the details the Headteacher has been given, what is the formula for calculating the length, y metres?

Circle your answer. [1]

$$y = \frac{b-5}{6x}$$

$$x = \frac{6b}{5y}$$

$$y = \frac{b+5}{6x}$$

$$y = \frac{5b}{6x}$$

$$y = \frac{6x}{5b}$$

$$b = \frac{6xy}{5}$$

Cross multiply

$$b \times 5 = 6xy \times 1$$

$$5b = 6xy$$

$$6xy = 5b$$

$$y = \frac{5b}{6x}$$

$$6x$$



- (b) The Headteacher decides to place signs around the school site to stop pupils using their bikes on grassed areas.

He introduces a new sign to pupils in the school newsletter.
The size of the sign in the newsletter is shown below.

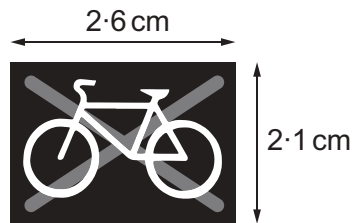


Diagram not drawn to scale

A mathematically similar new sign is placed near the side of the playing field.



Diagram not drawn to scale

It is 33.6 cm high.
How wide is this sign?

[2]

$$2.1 \text{ cm} \longrightarrow 33.6 \text{ cm}$$

$$? \text{ cm} \longrightarrow \frac{33.6}{2.1} = 16 \text{ cm}$$

$$2.6 \text{ cm} \longrightarrow 16 \times 2.6 = 41.6$$

Width is 41.6 cm



8. The wire window guard shown below is to be made.



Diagram not drawn to scale

The length of the sides of each small wire square shown is 3.3 cm.

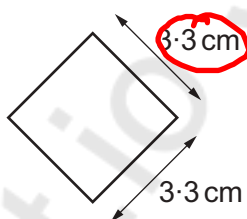


Diagram not drawn to scale

Llinos considers the length of the diagonal of each small square.

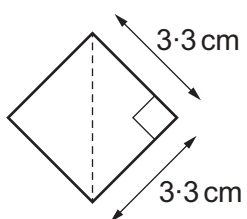


Diagram not drawn to scale

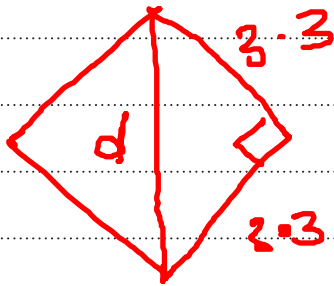
She says,

The height of the window guard is equal to 9.5 diagonals of the square.
The width of the window guard is equal to 11 diagonals of the square.



- (a) Calculate the length of the diagonal of a small square.
Give your answer correct to 1 decimal place.

[3]



Apply Pythagoras theorem

$$d^2 = 3.3^2 + 3.3^2$$

$$d^2 = 10.89 + 10.89$$

$$d^2 = 21.78$$

$$d = \sqrt{21.78}$$

$$d = \underline{4.7\text{cm}}$$

$$d = 4.666\dots$$

- (b) Calculate the area of the window guard.
You must show all your working.

[3]



$$A = L \times w$$

$$A = 51.7 \times 44.65$$

$$A = \underline{\underline{2308.41\text{cm}^2}}$$

$$w = \text{Height} = 9.5 \times d = 9.5 \times 4.7$$

$$w = 44.65\text{cm}$$

$$L = \text{Length} = 11 \times d = 11 \times 4.7$$

$$L = 51.7\text{cm}$$

$$A = \underline{\underline{2308.41\text{cm}^2}}$$



9. Gwenda enjoys road running.

(a) She keeps a record of her run each day this week.

Day	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
Distance	4.6 km	5.4 km	2.2 km	6.2 km	7.2 km	2.2 km	3.4 km
Time	26 mins	31 mins	12 mins	35 mins	40 mins	14 mins	22 mins

Last week, her average speed for the week was 9.6 kilometres per hour.

Calculate Gwenda's percentage improvement in her average speed from last week to this week. You must show all your working. [6]

$$A.S = 9.6 \text{ km/hr}$$

$$A.S = \frac{\text{Total Distance}}{\text{total time taken}}$$

$$\text{Total Distance} = 4.6 + 5.4 + 2.2 + 6.2 + 7.2 + 2.2 + 3.4 = 31.2 \text{ km}$$

$$\text{Total Time taken} = 26 + 31 + 12 + 35 + 40 + 14 + 22 = 180 \text{ mins}$$

$$1 \text{ hr} = 60 \text{ mins}$$

$$3 \text{ hrs} = 180 \text{ mins} \quad t = 3 \text{ hrs}$$

$$A.S = \frac{31.2}{3} = 10.4 \text{ km/hr}$$

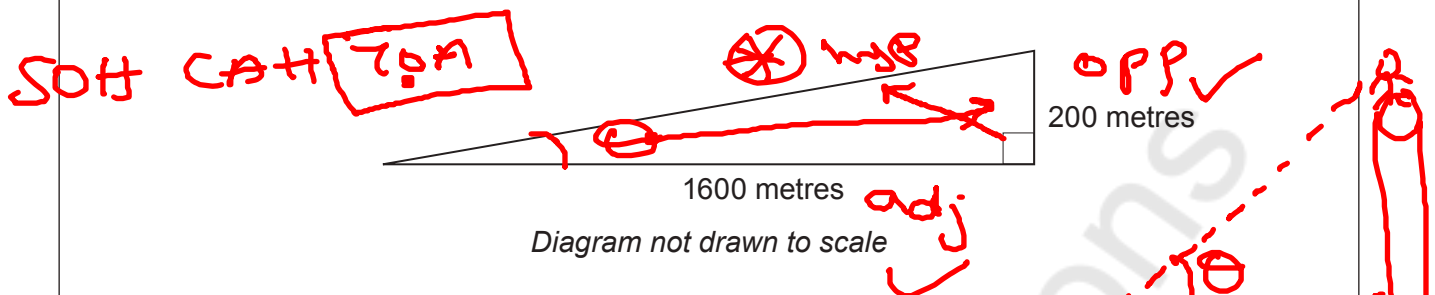
Percentage improvement is 8.33%

$$\% \text{ Increase} = \frac{\text{Increase}}{\text{Actual value}} \times 100 = \frac{0.8}{9.6} \times 100$$

$$\text{Increase} = 10.4 - 9.6 = 0.8$$



- (b) The diagram shows the cross-section of one part of her run.

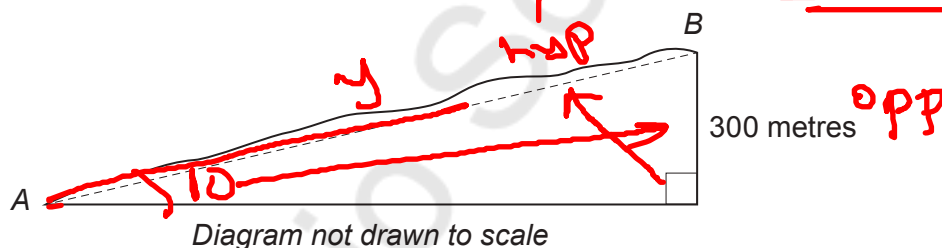


Calculate the angle of elevation of the road.

$$\tan \theta = \frac{\text{opp}}{\text{adj}} = \frac{200}{1600} \quad \theta = \tan^{-1}(0.125)$$

$$\tan \theta = 0.125 \quad \theta = \underline{\underline{7.125^\circ}}$$

- (c)



Gwenda runs on another section of uneven road from A to B. The rise in this section of the road is 300 metres. The angle of elevation of B from A is 10° .

- (i) Calculate an estimate of how far Gwenda has run. State any assumption you have made.

$$\sin \theta = \frac{\text{opp}}{\text{hyp}} = \frac{300}{y} \quad y \sin 10 = 300$$

$$\sin 10 = \frac{300}{y} \quad y = \frac{300}{\sin 10} = \underline{\underline{1727.63m}}$$

Assumption: We assume that the uneven road from A to B is a straight line

- (ii) What is the impact of your assumption on your answer?

The road may be longer because of bumps



10. Rhodri has carried out an experiment to measure the diameters of 20 spherical dust particles, in microns.

Here are his results.

Diameter, d (microns)	Frequency	x_m	$f x_m$
$1 \leq d < 2$	2	1.5	3
$2 \leq d < 4$	6	3	18
$4 \leq d < 5$	8	4.5	36
$5 \leq d < 9$	4	7	28
			<u>85</u>

Handwritten calculations: $\frac{1+2}{2} = \frac{3}{2}$, $\frac{2+4}{2}$, $\frac{4+5}{2}$, $\frac{5+9}{2}$

- (a) (i) Calculate an estimate of the mean diameter of a dust particle. [4]

$$\bar{x} = \frac{\sum f x_m}{\sum f} = \frac{85}{20}$$

$$\bar{x} = 4.25$$

- (ii) Rhodri measures the diameters of another 25 dust particles.

Rhodri is told,

'The ratio of dust particles with diameters less than 4 microns to those with diameters greater than or equal to 4 microns is 7 : 8.'

He finds this fact is true when he considers all 45 dust particles.

How many of the extra 25 dust particles have a diameter of less than 4 microns? You must show your working. [3]

Diameter < 4 : Diameter $> 4 = 7 : 8$
 Ratio = 7 : 8 is true for 45 particles
 Diameter less than 4 is : $\frac{7}{15} \times 45$
 $= 21$
 Diameter less than 4 = 21
 Diameter greater than 4 = $45 - 21 = 24$

The first 4 particles diameter less than 4 = 8



Therefore, diameter less than from the extra 28 particles is $21 - 8 = \underline{\underline{13}}$

19

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- (b) Rhodri studies a cylindrical cell under his microscope.
The height of the cell is 2 microns.
The circumference of the cell is 5 microns.

Calculate the volume of the cell he sees under the microscope.
Give your answer in microns³, correct to 1 significant figure.

[5]

$$h = 2 \text{ microns}$$

$$P = 5 \text{ microns}$$



Volume of prism = Base Area \times height

$$V = \pi r^2 \times h = \pi r^2 h$$

Circumference of a circle = $2\pi r$

$$5 = 2\pi r$$

$$\frac{5}{2\pi} = r \quad ; \quad r = \frac{5}{2\pi}$$

$$V = \pi r^2 h$$

$$V = \pi \times \left(\frac{5}{2\pi}\right)^2 \times 2$$

$$V = \pi \times \frac{25}{2\pi^2} \times 2 = \frac{25}{2\pi} \text{ microns}^3$$

$$\pi = 3.14 \quad = \frac{25}{2 \times 3.14} = 3.98 \text{ microns}^3$$

Volume is 4 microns³ $\approx 4 \text{ microns}^3$

END OF PAPER



