Surname	Centre Number	Candidate Number
Other Names		0

GCSE

3310U60-1

A17-3310U60-1

MATHEMATICS – NUMERACY
UNIT 2: CALCULATOR-ALLOWED
HIGHER TIER

WEDNESDAY, 8 NOVEMBER 2017 – MORNING

1 hour 45 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	9	
2.	18	
3.	9	
4.	8	
5.	3	
6.	7	
7.	6	
8.	7	
9.	13	
Total	80	

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. Question numbers must be given for all work written on the continuation page.

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

3310U601
01

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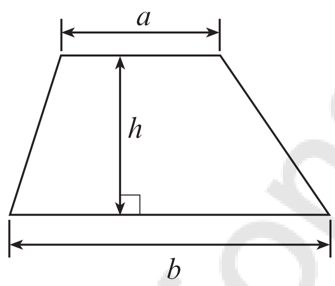
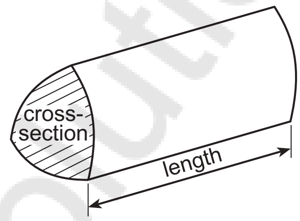
Formula List - Higher Tier

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

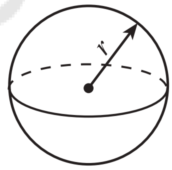


Volume of prism = area of cross-section × length



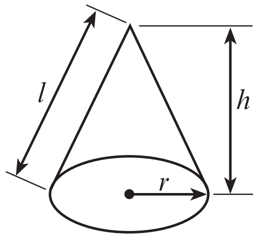
Volume of sphere = $\frac{4}{3}\pi r^3$

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



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

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

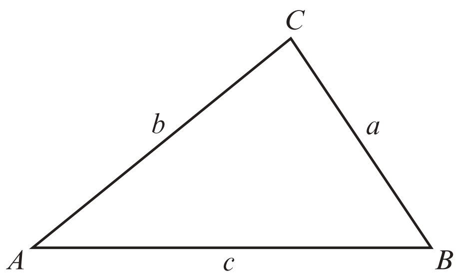


In any triangle ABC

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.

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

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3310U601
03

Examiner only

1. Alptai is a ski resort.
The daily snowfall for January is given in the table below.

Daily snowfall, s (cm)	Number of days
$0 \leqslant s < 5$	10
$5 \leqslant s < 10$	16
$10 \leqslant s < 20$	4
$20 \leqslant s < 30$	0
$30 \leqslant s < 50$	1

31 modal group
15.5
16th

(a) Calculate an estimate for the mean daily snowfall for the 31 days of January. [4]

x	x_m	f	$f \times x_m$
0 – 5	2.5	10	25
5 – 10	7.5	16	120
10 – 20	15	4	60
20 – 30	25	0	0
30 – 50	40	1	40

$\Sigma f = 31$ $\quad \Sigma f x_m = 245$

$\bar{x} = \frac{\Sigma f x_m}{\Sigma f} = \frac{245}{31} = 7.9\text{ cm}$

(b) Circle either TRUE or FALSE for each of the following statements. [2]

The table above shows that there definitely was snowfall on each of the 31 days in January.	TRUE	FALSE
There were 16 days when the daily snowfall was less than 10 cm.	TRUE	FALSE
There was only 1 day with snowfall greater than or equal to 20 cm.	TRUE	FALSE
The modal group also contains the median daily snowfall.	TRUE	FALSE

 (3310U60-1)

Examiner only

(c) For the 28 days of February, the mean daily snowfall in Alptai was 9 cm.
On 1st February, the snowfall recorded in Alptai was 63 cm.
Calculate the mean daily snowfall for the 27-day period 2nd to 28th February. [3]

mean (28 days) = 9cm

1st of February = 63cm

mean = $\frac{\text{Sum of data}}{\text{frequency}}$

Sum of Snowfall for February = mean × fre
= 9 × 28
= 252cm

So, Removing 1st of February

Then, The remaining 27 days will have a total of 252 − 63
189cm

mean (27 days) = $\frac{189}{27}$

mean (27 days) = $\underline{\underline{7\text{cm}}}$

only

3310U601
05

Examiner only

(a) Bronwen and Alvaro decide to keep some alpacas on their farm in Patagonia.

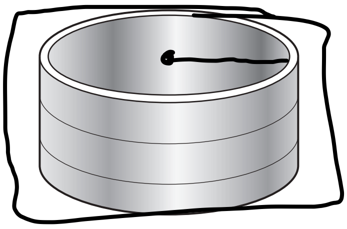
Alvaro knows it is possible to keep between 4 and 6 alpacas on each acre of suitable farmland.
They have 13 hectares of farmland that they want to use to keep the alpacas.
Bronwen knows that 1 acre is 4046·86 m^2 and that 10 000 m^2 = 1 hectare.

Use this information to advise Bronwen and Alvaro on the number of alpacas they could keep on their farmland.
State any assumption that you make.
You must show all your working. [6]

4 – 6 alpacas → 1 acre
Total farm land → 13 hectare *
1 acre → $4046.86 m^2$
$10000 m^2$ → 1 hectare
Total farm land → $13 \times 10{,}000 = 130{,}000 m^2$
Total farm land = $130{,}000 m^2 \times \frac{1 acre}{4046.86 m^2}$
Total Farm Land = 32 acres.
1 acre → 6 alpacas
Total animal = 32×6 = 192 alpacas

Assumption:
We assume ~~that~~ ~~the~~ maximum alpacas 1 acre can take is 6. So, we will get maximum value for the farmland

(b) Bronwen decides to place a cylindrical water container in the small paddock on the farm.



$r = \frac{d}{2} = \frac{1.4}{2}$
$r = 0.7m$

The water container has a diameter of 1·4 metres.

(i) The scale diagram opposite shows the small paddock on the farm.
The small paddock is rectangular, measuring 7 metres by 5 metres.

1 m = 100 cm
r = 0.7 m
$r = 0.7 \times 100 = 70 cm$

 (3310U60-1)

2cm → 1m   7m

Examiner only

Scale 2 cm represents 1 m

14cm   7m

1m

1m → 2cm

3m → 6cm

5m

10cm

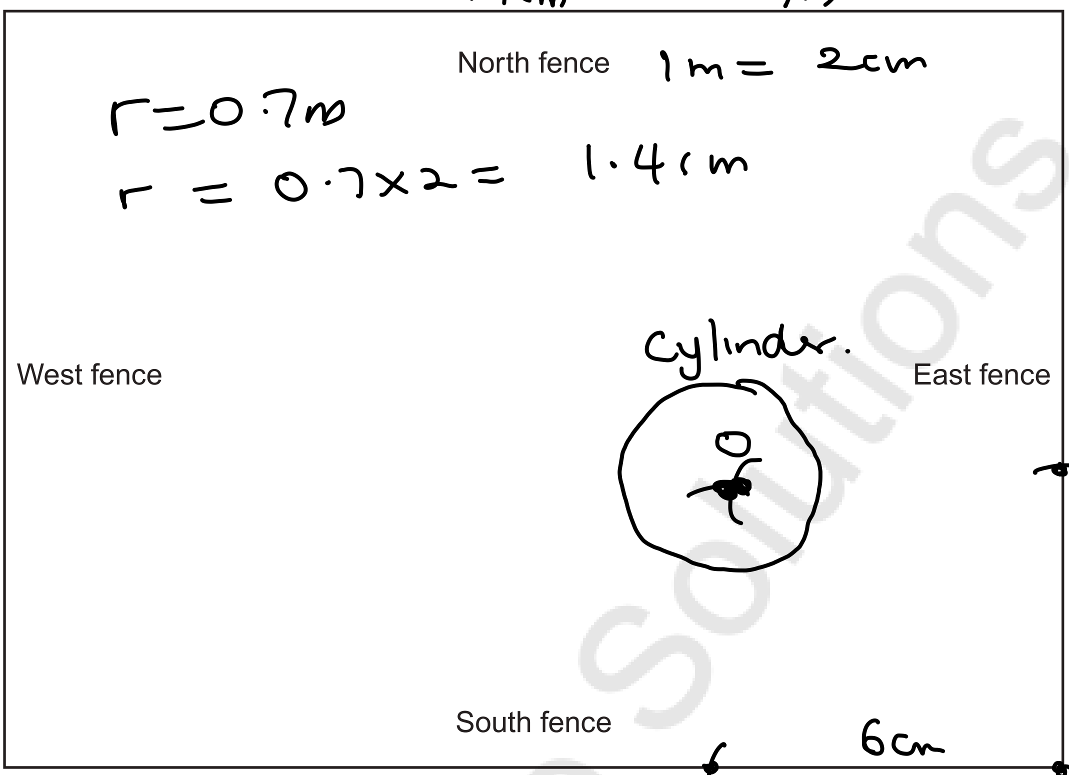
3m

6cm

1·4

6cm

r = 0.7m



Bronwen decides to place the centre of the water container so that it is:
- equidistant from the south fence and the east fence,
- 3 metres from the south fence.

Show the placement of the water container on the scale diagram of the small paddock above.
Your diagram should include an **accurate plan view** of the **water container**. [4]

(ii) The water container holds 900 litres of water when full.
Calculate the height of the water container in centimetres. [4]

Volume of water = 900 litres

1 litre = 1000 cm^3

900 litre = 900×1000 cm^3

900 litre = 900,000 cm^3

$V = \pi r^2 h$

$h = \frac{V}{\pi r^2}$

r = 70 cm

$h = \frac{900,000}{3.14 \times 70^2}$

h = 58.5 cm

The height of the water container is 58·5 cm

Turn over.

Examiner only

(c) The currency widely used in Patagonia is the Argentine peso.

Alvaro sells alpaca fleeces from Patagonia.
His fleeces are priced in Argentine pesos.
Tom lives in Wales and buys fleeces from Alvaro.
Tom pays for the fleeces in pounds.

Tom's purchases are shown in the table below.

	Number of fleeces bought	Price per fleece, in Argentine pesos	Exchange rate
January 2015	80	19.20	£1 = 15.47 Argentine pesos
March 2016	20	22.30	£1 = 15.21 Argentine pesos
April 2017	100	24.50	£1 = 14.93 Argentine pesos

For each of Tom's 3 purchases he paid correct to the nearest penny.

How much did Tom pay for these 200 fleeces, in pounds?
Give your answer correct to the nearest penny.
You must show all your working. [4]

First Case
Fleeces bought = 80
Price per fleece = 19.20
Cost in Pesos = 19.20 × 80
= 1536 peso
£1 = 15.47 Peso
Cost in pounds = $\frac{1536}{15.47}$
£99.29

Second case
Fleece Bought = 20
Price/fleece = 22.30
Cost in Pesos = 20 × 22.30
= 446 peso
Cost in pounds
Cost = $\frac{446}{15.21}$
£29.32

Third Case
Fleece Bought = 100
Price/fleece = 24.50
Cost in peso = 100 × 24.50
= 2450 peso
Cost in pounds
Cost = $\frac{2450}{14.93}$
£164.10

Total cost in pounds = 99.29 + 29.32 + 164.10
= £292.71

£292.71

Tom paid £ .... , correct to the nearest penny

 (3310U60-1)

Examiner only

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

Handmade socks, knitted using pure cashmere wool, are very expensive to buy.

Rowena buys cashmere wool in 20 g balls.
Each ball of cashmere wool costs her £1.42.
She pays her sister £8 to knit each pair of socks.
135 g of cashmere wool is used to knit each pair of socks.

Rowena sells 40 pairs of cashmere socks for £18.95 per pair.
What is her percentage profit?
Give your answer correct to 2 significant figures.
You must show all your working. [7 + 2 OCW]

Cashmere wool is sold in 20g

Each ball of cashmere wool = £1.42

Production cost = £8 per pair Sister

135g of cashmere wool → 1 pair of socks

Selling price of socks → £18.95 / pair

Total Quantity sold → 40

Total Selling Price = 18.95 × 40 = £758

Cashmere wool ball needed = $\frac{135}{20}$ = 6.75 ball

Since cashmere wool is sold in ball, then she needs 7 ball.

Cost of 7 balls = 7 × £1.42 = £9.94

Total cost for a pair of socks = 9.94 + 8 = £17.94

Cost of 40 pairs of socks = 17.94 × 40 = £717.6

Profit = Selling price − Cost price = £758 − £717.6 = £40.4

% Profit = $\frac{\text{Profit}}{\text{Cost Price}} \times 100$

Rowena's percentage profit when selling all 40 pairs of socks is 5.6 %, correct to 2 significant figures.

% Profit = $\frac{40.4}{717.6} \times 100$ = 5.6%

3310U601
09

Examiner only

Bethan has a plan of her rectangular lawn, which she has labelled *ABCD*.
She wants to cut out a triangular flowerbed from her lawn, labelled *GHD*.
Bethan decides that *AG* : *GD* should be 1 : 2 and that *DH* = *HC*.

She has made a sketch shown below.   AD : GD = 1 : 2

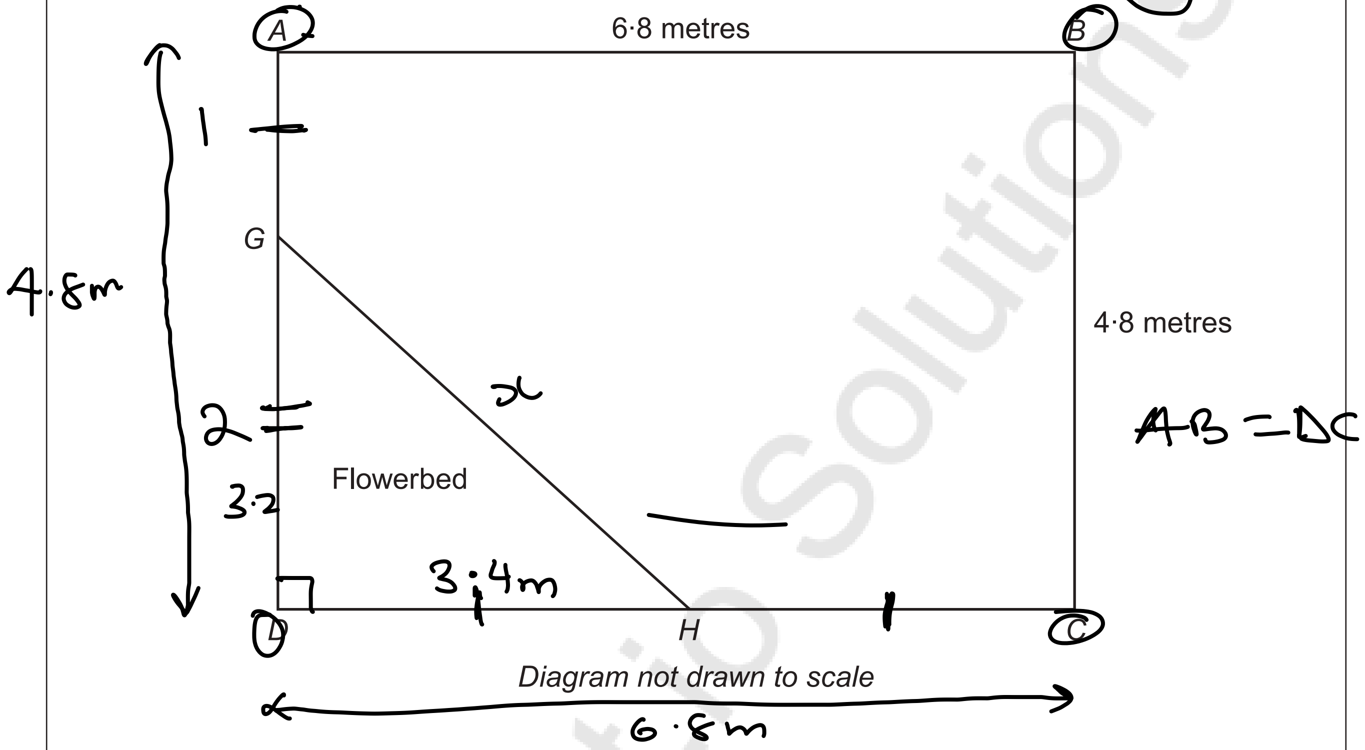


Diagram not drawn to scale

(a) Calculate the length of *GH*. [4]

Applying pythagoras theorem

$GH^2 = GD^2 + DH^2$

$GH^2 = 3{\cdot}2^2 + 3{\cdot}4^2$

$GH^2 = 10{\cdot}24 + 11{\cdot}56$

$GH^2 = 21{\cdot}8$

$GH = \sqrt{21{\cdot}8}$

$GH = \underline{4{\cdot}67\text{m}}$

Using ratio

$GD = \frac{2}{3} \times 4{\cdot}8$

Examiner only

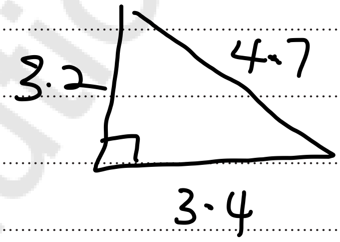
(b) The flowerbed, *GHD*, is to have a flexible edging strip placed around its perimeter. The edging strip costs £3.50 per metre and can only be bought in strips of complete metres.

- How much will the edging strip cost Bethan?
- What length of strip will be left over? Give your answer in centimetres.

[4]

Cost of edge strip = £3.50 / metre

Perimetr of the flowerbed



Perimetr = 3.2 + 4.7 + 3.4

= 11.3m.

So, to complete the edge strip, he needs to buy 12m long edge strip.

Cost = £3.50 / metre

Total Cost = 3.50 × 12

1m = 100cm

= £42

Excess lenght = 12m − 11.3m = 0.7m

0.7m = 0.7 × 100 = 70 cm

Cost £ 42

70 cm left over

3310U601 11

(3310U60-1)

Turn over.

Examiner only

Teleri needs £8000 to pay a deposit for a new house.
She already has £7500.

$\frac{0 \cdot 31}{100}$

Teleri decides to invest the £7500 in a bank account that pays interest at a rate of 0·31% every month.
She does not plan to make any further payments into this account.

Calculate the number of months Teleri will need to wait until she has enough money in the account to pay the deposit of £8000. [3]

Needs $\longrightarrow$ £8000 for house

Bank Balance $\longrightarrow$ £7500

Principal $P = £7500$

Rate $r = 0 \cdot 31\% = 0 \cdot 0031$

Amount ~~A~~ £8000

$t = ?$

Compound Interest

$A = P(1+r)^t$

$8000 = 7500(1+0 \cdot 0031)^t$ $\quad \div 7500$

$\frac{8000}{7500} = \frac{\cancel{7500}(1 \cdot 0031)^t}{\cancel{7500}}$

$1 \cdot 06\bar{6} = 1 \cdot 0031^t$

$\frac{1 \cdot 067 = 1 \cdot 0031^t}{}$

$t = ?$

$t = 10$

Take ln of both side

$\ln 1 \cdot 06\cancel{7} = \ln 1 \cdot 0031^t$

$\ln 1 \cdot 067 = t \ln 1 \cdot 0031$

$\frac{\ln 1 \cdot 067}{\ln 1 \cdot 0031} = t = \cdot$

$t = \frac{0 \cdot 0649}{0 \cdot 0031}$

$= 20 \cdot 94$

$t = \underline{\underline{21}}$

After 21 months

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Examiner only

The diagram below shows the locations of the ports of Lindat, Molk and Nuir.
Lindat is due south of Nuir, and Nuir is due west of Molk.

SOH

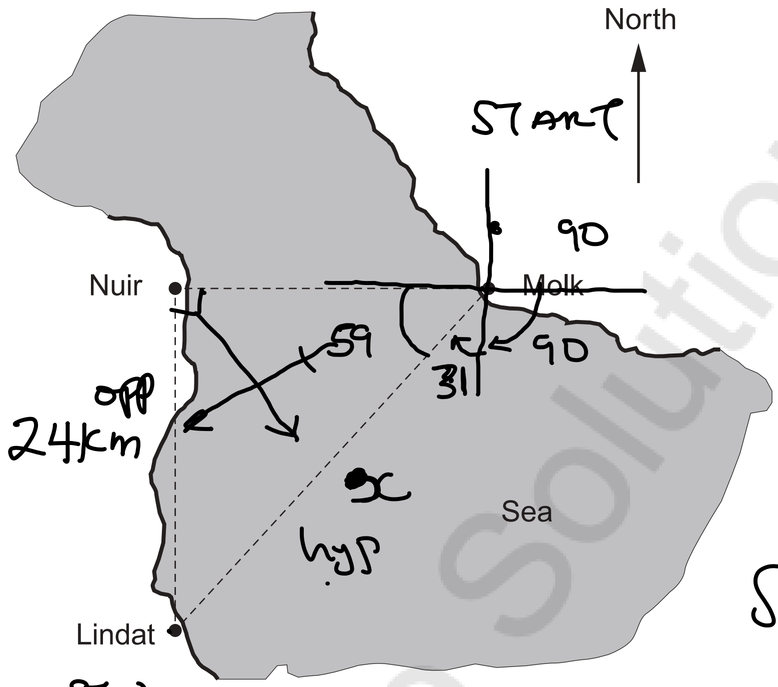


Diagram not drawn to scale

Distance from molk to Lindat

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

$\sin 59 = \frac{24}{x}$

$x \times \sin 59 = 24$

$x = \frac{24}{\sin 59} = \frac{24}{0.8572}$

Agnetha lives in Molk.
She travels from Molk to Lindat by ship.

- Lindat is 24 km due south of Nuir.
- The ship sails directly to Lindat on a bearing of 211°.
- The ship has an average speed of 20 km/h.
- The ship leaves at 11:45 a.m.

Calculate Agnetha's arrival time in Lindat. [7]

A.S = 20km/hr   Time Agnetha leave is 11:45am

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

So, Distance from molk to Lindat ≡ 28km

$A.S = \frac{D}{T}$ $20 \times T = 28$

$20 = \frac{28}{T}$ $T = \frac{28}{20} = 1.4$ hour

 (3310U60-1)

Examiner only

Time he left molk 11:45am
He spent 1.4 hrs
1.4 hrs = 84 mins
60 mins + 24 mins
1 hr 24 mins

Time he arrived
11:45 am + 1 hr 24 mins

12:45 pm + 24 mins
12:45 pm + 15 mins + 9 mins
1:00 pm + 9 mins

$\boxed{1:09\ pm}$

 (3310U60-1) Turn over.

Examiner only

Iestyn opened a savings account on 1 August 2017, investing £2800.
On 1 October 2017, he viewed his savings account online.
The table below shows all the transactions that had taken place since he opened the account.

12m = 1Y

1m = 1Y/12

Date	Details	Paid in (£)	Paid out (£)	Balance (£)
01/08/17	Account opened	2800.00		2800.00
31/08/17	Interest	14.00		2814.00
30/09/17	Interest	14.07		2828.07

S.I = 14

P = 2800

R = ?

T = 1 month

$T = \frac{1}{12}$ year

(a) Calculate the nominal interest rate per annum. [3]

S.I = Simple Interest
P = Principal
R = Rate (%)
T = Time (year)

Principal = £2800

$S.I = \frac{PRT}{100}$

$14 = \frac{2800 \times R \times 1}{100 \times 12}$

$14 \times 100 \times 12 = 2800R$

$\frac{14 \times 100 \times 12}{2800} = R$

R = 6% OR 0.06

(b) Calculate the AER the account was paying.
Give your answer as a percentage, $\boxed{\text{correct to 2 decimal places}}$. [3]

$AER = (1 + i/n)^n - 1$

$i = R = 6\% = 0.06$

n = The number of time the ~~interest~~ Principal is compounded

n = 12

$AER = \left(1 + \frac{0.06}{12}\right)^{12} - 1 = (1.005)^{12} - 1$

$= 0.06168$

AER =

$AER = 0.06168 \times 100$

$AER = 6.17\%$

61.6

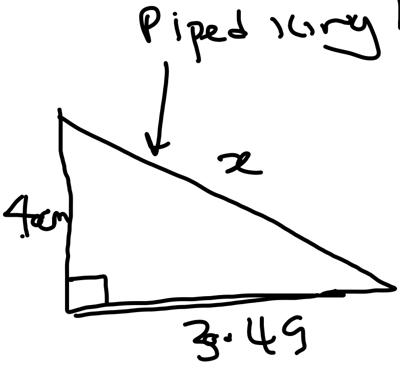
6.168%

6.2%

Examiner only

A baker makes cake slices to sell in her shop.
All of the cake slices are identical. They have been cut from a cylindrical cake of radius 10 cm and depth 4 cm.

Piped icing is placed on the curved surface of each cake slice, as shown in the diagram.
It connects opposite vertices of this curved surface, and follows the shortest path between these vertices.



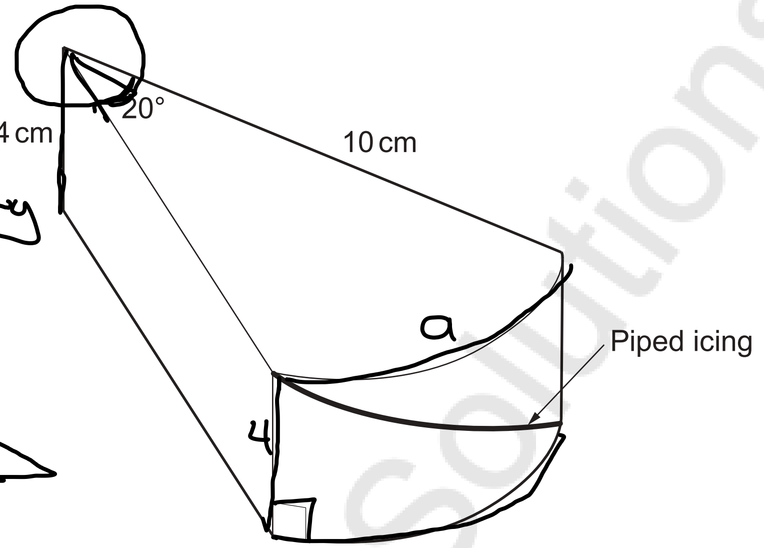


Diagram not drawn to scale

What length of piped icing will be needed to decorate all the slices that make up a whole cylindrical cake? [7]

Using lengnt of an arc to find side a

$a = \frac{\theta}{360} \times 2\pi r = \frac{20}{360} \times 2 \times 3.14 \times 10$

$a = 3.49\text{cm}$

So, using pythagoras theorem

$x^2 = 4^2 + 3.49^2$

$x^2 = 16 + 12.1801 = 28.1801$

$x = \sqrt{28.1801} = 5.31\text{cm}$

Total number of slices $= \frac{360}{20} = 18$ slices

Length of piped icing needed for a whole cake = 95.58 cm

1 slice → 5.31cm
18 slices → 5.31 × 18 = 95.58cm

Turn over.

Examiner only

An engineering company employs 85 staff.
The company plans to carry out a survey on staff health. *
It will conduct the survey using a sample of 15 of its staff, stratified by job type.

85 staff

(a) Circle either TRUE or FALSE for each statement given below. Sampling [2]

STATEMENT		
Choosing every 4th person on an alphabetical list of office staff is a suitable method of randomly choosing the office staff required for the sample.	TRUE	FALSE
Numbering the cleaning staff, placing the numbers in a hat and drawing out numbers at random is a suitable method of choosing the cleaners required for the sample.	TRUE	FALSE
There are 9 managers employed by the company. The calculation to find the number of managers in the sample is $\frac{9}{85} \times 15 = 1{\cdot}59$. 5 9 This answer means there will **definitely** be 2 managers in the sample.	TRUE	FALSE
The proportion of the staff in each job type in the sample will be **exactly** the same as the proportion of the staff in each job type in the company as a whole.	TRUE	FALSE

3 3 3 3 3

Examiner only

(b) 50 engineers are employed by the company.
Use the following extract from a table of random digits to choose 9 engineers for the sample.
You must start with the first number in the list.
Describe clearly how you are using the numbers to select the sample. [3]

29974 55479 07248 33999 17038 02475 49979 01218

Total engineers employed = 50

Assume the engineers are number 01 – 50

01, 02, 03, 04, 05, . . . 50

First number is 29,

Systematic sampling : Leaving two successive numbers

29, 45, 79, 24, 39, 17, 80, 75, 97, 12,

−50 −50 −50 −50

29, 45, 29, 24, 39, 17, 30, 25, 47, 12

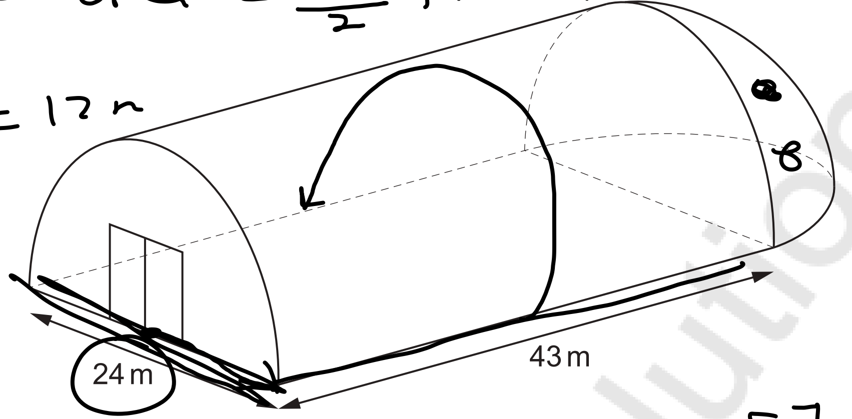
29, 45, 24, 39, 17, 30, 25, 47, 12

Examiner only

(c) The engineering company has a storage building, as shown below.
The building is in the form of half a cylinder, with half a hemisphere attached at one end.

Total Surface area $= \frac{\pi r^2}{2} + \pi r h + \pi r^2$

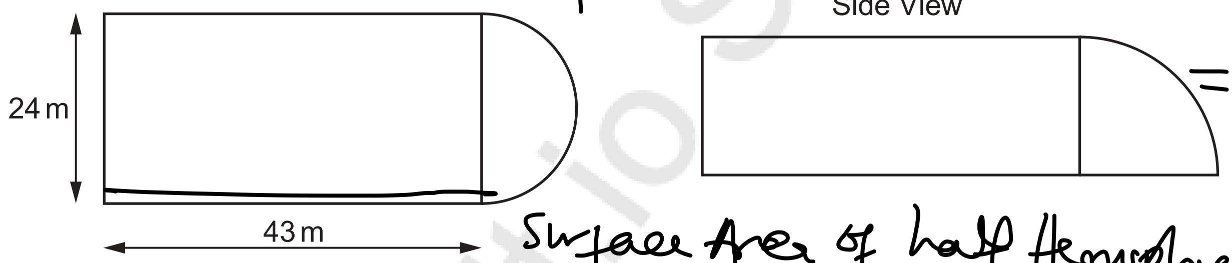
$r = \frac{d}{2} = \frac{24}{2} = 12\text{ m}$



$\frac{2\pi r h}{2}$

Surface Area of ~~Hemisphere~~ Sphere $= 4\pi r^2$

Surface Area of Hemisphere $= \frac{4\pi r^2}{2}$
$= 2\pi r^2$



Surface Area of half Hemisphere $= \frac{2\pi r^2}{2}$
$= \pi r^2$

Diagrams not drawn to scale

The company needs to paint all the exterior surfaces of the building, including the doors.

The measurements on the diagram are given **correct to the nearest metre**.
The paint comes in tins that cover an area of 40 m^2, **correct to the nearest m²**.

Calculate the smallest number of tins that would guarantee having enough paint to cover these exterior surfaces. [8]

1 paint $\longrightarrow 40\text{ m}^2$ $\qquad r = 12\text{ m}$

$TSA = \frac{\pi r^2}{2} + \pi r h + \pi r^2$ $\qquad \pi = 3.14$

$h = 43\text{ m}$

To the nearest metre

$d = 24\text{ m} \Longrightarrow 23.5\text{ m}$ to 24.5 m.

$r = d/2 \Longrightarrow 11.75\text{ m}$ to 12.25 m

$h = 43\text{ m} \Longrightarrow 42.5\text{ m}$ to 43.5 m.

 (3310U60-1)

$\text{Maximum Area} = \frac{\pi r^2}{2} + \pi r h \cancel{+ \pi r^2}$

Examiner only

$TSA(\max) = \frac{3.14 \times 12.25^2}{2} + 3.14 \times 12.25 \times 43.5 + 3.14 \times 12.25^2$

$TSA(\max) = 235.6 + 167\cancel{3}3.23 + 471.2$

$TSA(\max) = 2380.03\ m^2$

Total surface area of the shape = $2380.03 m^2$

1 paint $\longrightarrow$ 40m2 39.5 to 40.5

Min (Paint Area) = $39.5 m^2$

Total Paint Tin = $\frac{2380.03}{39.5}$

Total Paint Tins needed = 60.25

= 61 Tins

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

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