GCSE Mathematics
Calculator
Higher Tier
Free Practice Set 5
1 hour 45 minutes

ANSWERS
Marks shown in brackets for each question (2)

A*	A	B	C	D	E
88	75	60	45	25	15

Legend used in answers

Green Box - Working out

5b means five times b
b = − 3 so 5 × − 3 = −15

**Red** Box and ✔ - Answer

48 % ✔

Authors Note

Every possible effort has been made to ensure that everything in this paper is accurate and the author cannot accept responsibility for any errors.

Apart from any fair dealing for the purposes of research or private study as permitted under the Copyright, Designs and Patents Act 1988, this paper may only be reproduced, stored or transmitted in any form or by any means with the prior permission in writing of the author, or in the case of reprographic reproduction in accordance with the terms and licence by the CLA. Enquiries concerning reproduction outside these terms should be sent to the author.

The right of David Weeks to be identified as the author of this work has been asserted by him in accordance with the Copyright, Designs and Patents Act 1988.

1. The conversion graph is used to change between UK pounds (£) and two
different currencies – the Euro (€) the US dollar($)
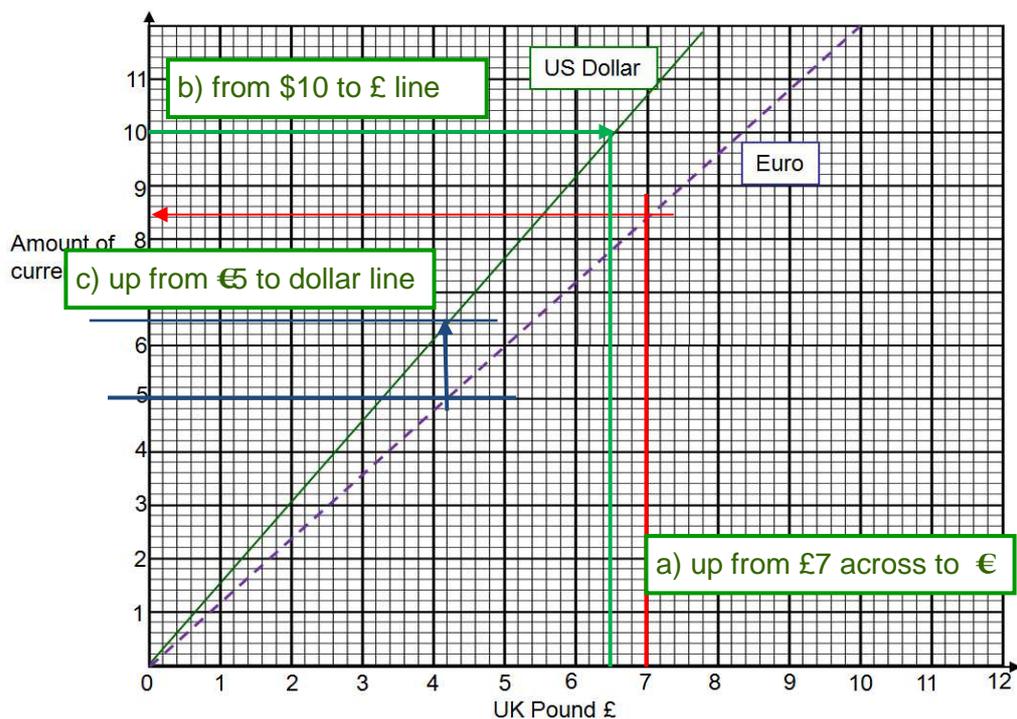
a) Use the graph to change 7 UK pounds into Euros (€)

€. **8.40** (1)
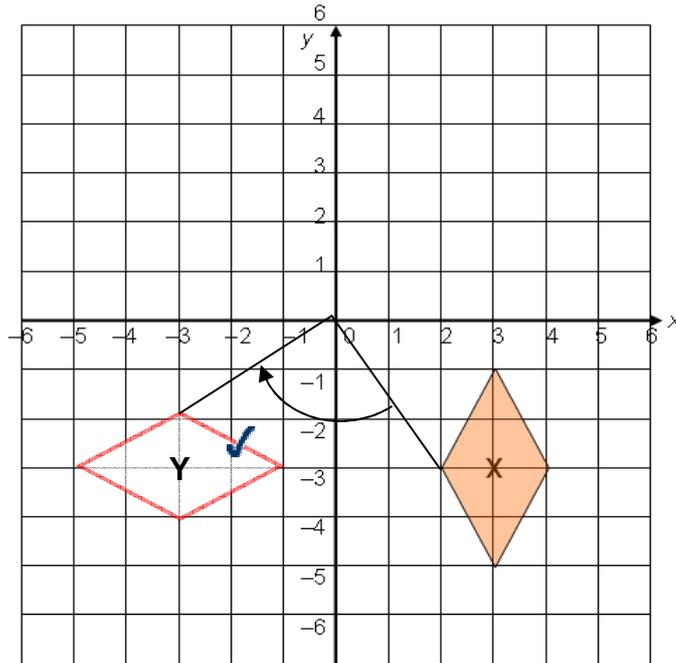
b) What is 10 US dollars ($) in UK pounds (£)

£.... **6.50** (1)

c) What is 5 Euros (€) in US Dollars ($)

$..... **6.40** (1)

2. Rotate shape **X** by 90^0 clockwise about the origin (0, 0). Label it shape Y

(2)

3. The table below shows the number of students in each class who are having one to one maths tuition.

Class	Number of students	Number of students having 1 to 1 maths tuition
S	26	4
T	27	6
U	28	3
V	30	4
W	31	5
X	29	3
Y	29	2
Z	26	4

What percentage of the students in the school is having one to one maths tuition.
Give your answer to the nearest whole number.

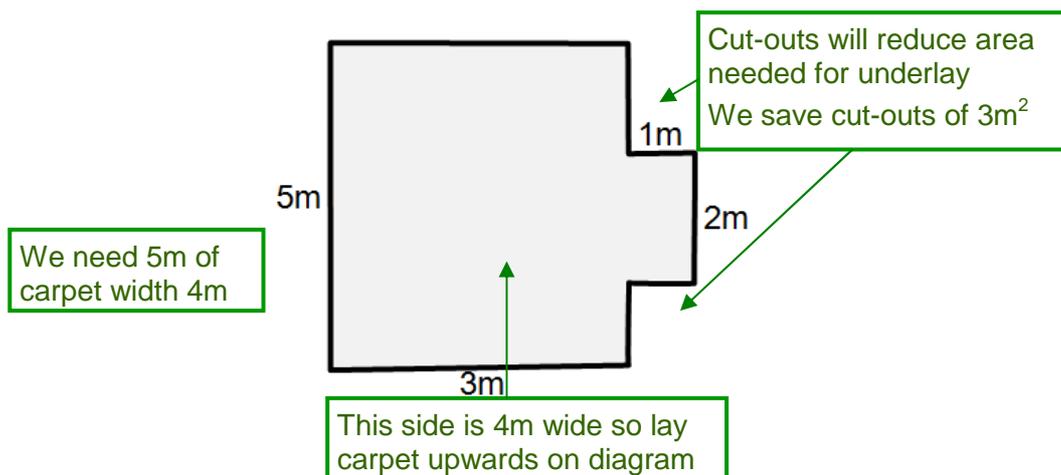Add up the total number of students = 226

Add up the number of students having 1 to 1 tuition = 31

226 ÷ 31 = 13.7

14

(3)

4. A plan of a bedroom is shown.

Cut-outs will reduce area needed for underlay
We save cut-outs of $3m^2$

1m

5m

2m

We need 5m of carpet width 4m

3m

This side is 4m wide so lay carpet upwards on diagram

Carpet comes in a 4 metre roll and costs £15 per square metre.
Underlay goes under the carpet and comes in 1 metre squares.
Underlay costs £6 per square metre.

Gripper rod which go around the perimeter of the room hold the carpet in place
Gripper rods cost 50 pence per metre.

The carpet fitter charges £50 to fit the carpet.

Work out the total cost of fitting a carpet

4m × 5m = $20m^2$ carpet. Cost = 20 × 15   = £300

We don't need $20m^2$ of underlay as it comes in $1m^2$
We can save cut-outs of $3m^2$ so we need $17m^2$

$17m^2$ underlay costs 17 × 6   = £102

Perimeter is 5 + 3 + 3 + 1 + 2 + 1 + 3 = 18m
Gripper-rods cost 50p/m   0.50 × 18   = £9

Total cost   = £300 + £102 + £9 + £50   = £461

461 (6)

5. a) Using the equation shown below, complete the table of values.

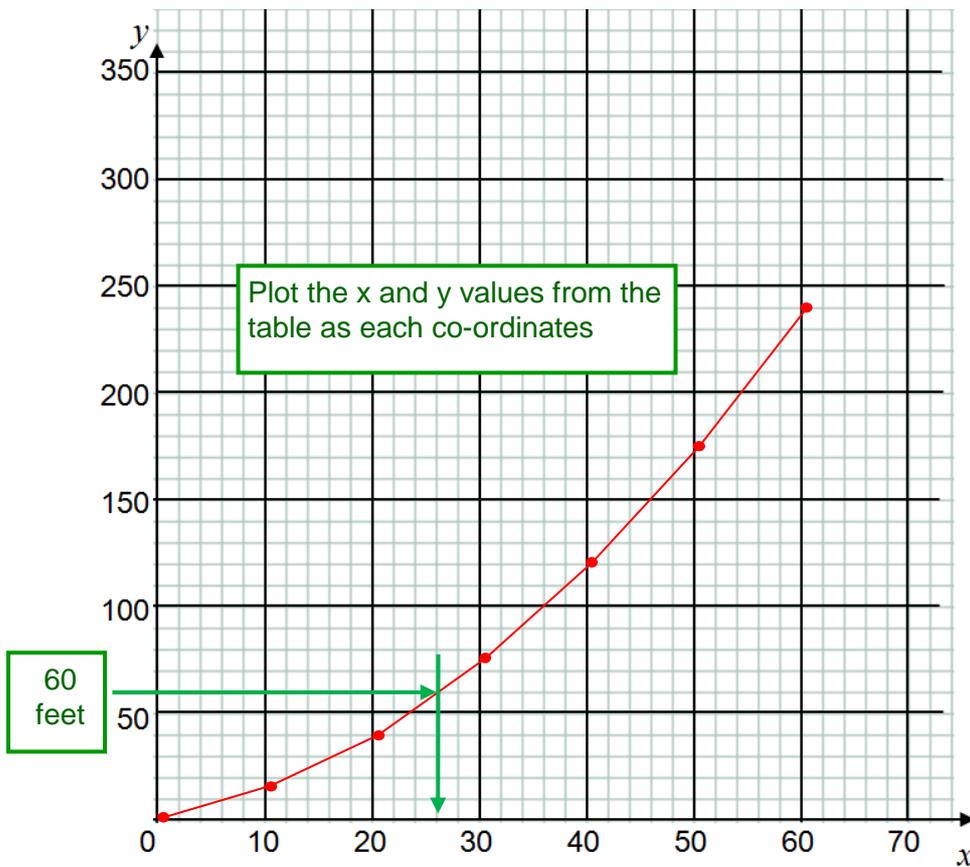$$y = x \left(\frac{x}{20} + 1 \right)$$

x	0	10	20	30	40	50	60
y	0	15	**40** ✔	75	120	**175** ✔	240

(1)

20 × (20 ÷ 20 + 1) = 20 × 2 = 40   50 × (50 ÷ 20 + 1) = 50 × 3½ = 175

b) Plot the co-ordinates on the graph paper below and join up the points

(2)

Plot the x and y values from the table as each co-ordinates

60 feet

The stopping distance S (in feet) of a car is calculated using this formula :

$$S = \frac{x^2}{20} + x$$

This is the same as the graph shown above

x is the speed in mph.

b) Estimate the speed of a car with a stopping distance of 60 feet

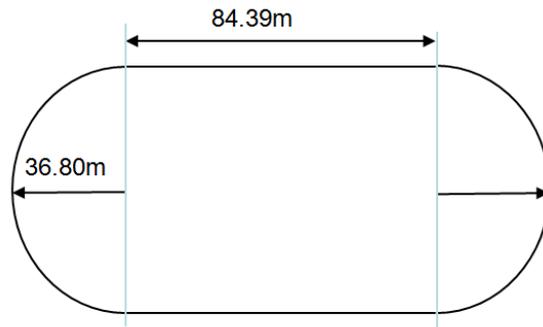Use 60 feet on vertical y axis to find speed on horizontal x-axis

26 ✔ ...mph

(2)

6. In 2012, the United Kingdom hosted the Olympic Games in London.
The standard running track is made from two semi-circles at each end joined by two straights.

For the inside running lane, the radius of each circle is 36.80m and the two straights are 84.39m each as shown below.

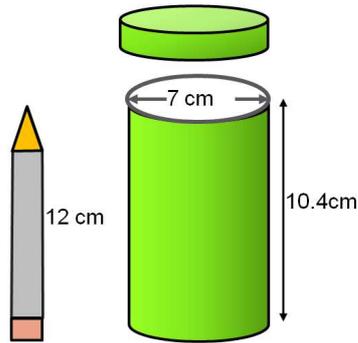Show that the perimeter is 400m.

2 sides: 84.39 × 2 = 168.78m

Two semi-circle ends make a circle.
Perimeter of a circle = π × diameter = 3.142 × 36.08 × 2 = 226.72m

168.78 + 226.72 = 400.00m

(3)

7. Sylvia had a pencil-case in the shape of a cylinder with the dimensions shown.
The pencil case had a tight top that fitted snugly.
She wanted to put a 12 cm pencil in her pencil-case.

a) Work out if the pencil will fit in the pencil-case diagonally with the top on.
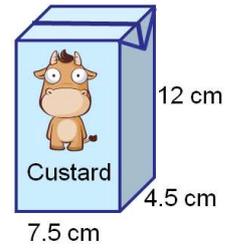Ignore the width of the pencil.
Show all your working

Use Pythagoras to see if the hypotenuse is at least 12 cm

Hypotenuse^2 = 10.4^2 + 7^2 = 108.16 + 49 = 157.16
$\sqrt{157.16}$ = 12.53

The 12cm pencil will fit as the diagonal distance is 12.5cm

(3)

8. A carton of custard is in the shape of a cuboid as shown.
The carton measures 12 cm high, 7.5 cm wide and 4.5 cm deep.

12 cm

Custard

4.5 cm

7.5 cm

a)   Work out the volume of the carton.

Volume = height × width × depth
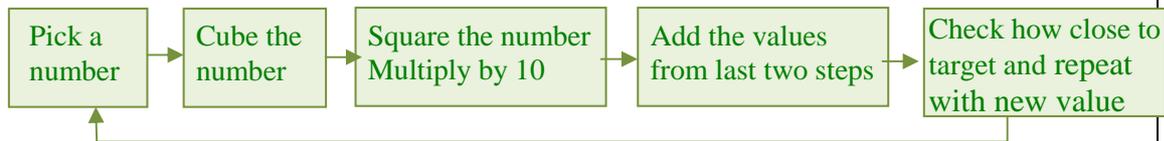12   ×   7.5   ×   4.5

.... **405** ✓ cm³

(2)

The custard company wants to design a new larger carton to hold 1000cm³ of custard.

The base of the carton is a square and the height is 10cm *more* than the width as shown.

The volume of a cartoon is given by

$V = x^3 + 10x^2$ where x is the base width

| Pick a number	Cube the number	Square the number Multiply by 10	Add the values from last two steps	Check how close to target and repeat with new value

b)   Using trial and improvement work out x for a volume V of 1000cm³
Give your answer to one decimal place.
You must show **all** your working.

Target = 1000

Make a guess for x.
Start with 5cm

Target not reached – try bigger x

Custard
1 litre

$x + 10$cm

x cm

x cm
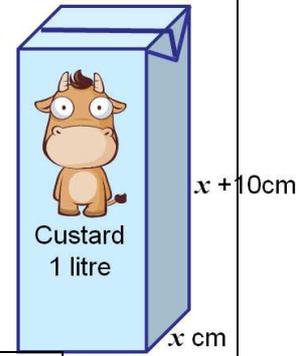
x	x^3	$10x^2$	V=
5	5 × 5 × 5 = 125	5 × 5 × 10 = 250	125+250=375
7	7 × 7 × 7 = 343	7 × 7 × 10 = 490	343+490=833
8	8 × 8 × 8 = 512	8 × 8 × 10 = 640	512+640=1152
7.5	7.5×7.5×7.5 = 421.9	7.5×7.5×10 = 562.5	421.9+562.5=984.4
7.6	7.6×7.6×7.6 = 439	7.6×7.6×10 = 577.6	434+577.6=1016.6

Too low or high try x between 7 and 8

Closest

(4)

$x = $ ..... **7.5** ✓ cm

9. The formula below converts temperature in degrees Centigrade to degrees Fahrenheit

$$F = \frac{C \times 8}{5} + 32$$

F = temperature in Fahrenheit
C = temperature in Centigrade

a) Convert $90°C$ to $°F$

Put 90 in place of C in the formula:

$$F = \frac{90 \times 8}{5} + 32 = F = \frac{720}{5} + 32 = F = 144 + 32$$

.... **176°** (2)

b) David measured the temperature of some water. It was 128° F.
Calculate the temperature in °C

Put 128 in place of F in the formula:

$$128 = \frac{C \times 8}{5} + 32 \quad so \quad 128 - 32 = \frac{C \times 8}{5}$$

$$96 = \frac{C \times 8}{5} \qquad so \quad 96 \times 5 = C \times 8 \quad so \quad 480 = 8C$$

.... **60°** (2)

10. A party of teachers travelled by car from Toddington to Ripon to attend a conference.

They drove 288 **km** at an average speed of 60 **mph**.

They stopped on route for a 25 minute break.
They needed to be at the conference 10 minutes before it started at 12:00

Using 5 miles = 8 kilometres, what is the latest time they must leave Toddington.
Give your answer in terms of the 24 hour clock.

288 km → miles Multiply by 5 and divide by 8 288km = 180miles

Speed is 60 miles per hour so we cover 180miles in 3 hours.
Add on 25 min break + 10mins early gives 3 hours 35 mins
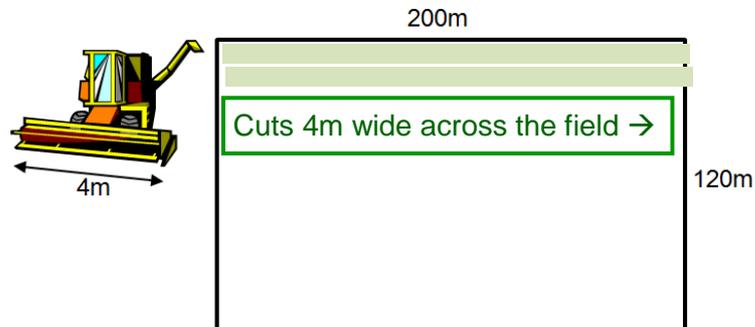
Working backwards from 12:00 gives latest start as 08:25

.... **08:25**

(3)

11. A farmer needed to harvest the crops in a field.

The field was 200m by 120m
The farmer used a combine harvester with a blade cutting width of 4m for each cut *across* the field

200m

Cuts 4m wide across the field →

120m

4m

a) How many cuts would the farmer need to make to harvest the field

To find the number of cuts divide 120 by 4m
as we are cutting horizontally across the field

30 ✓

cuts **(2)**

The combine harvester had a speed of 4.8km per hour.

b) How long would it take the farmer to harvest crops in the field.
Give your answer in hours and minutes

Use the speed-distance–time triangle to work out the time

distance

speed   time

Distance : 30 cuts each 200m long gives 6000m = 6km

Time = distance ÷ speed make sure everything is in km
        6km   ÷ 4.8km/hr = 1.25 hours

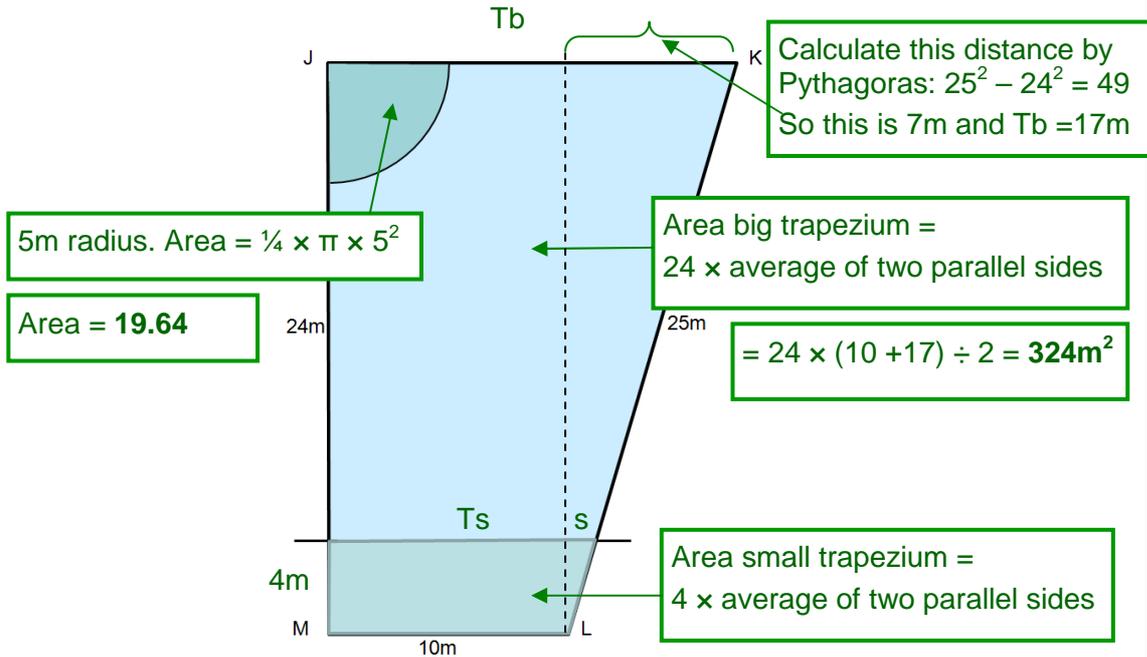1.25 hours is 1 hour and a quarter (15mins) NOT 1 hour 25 min

1 ✓   **15** ✓   **(3)**

. hr   min

12. The plan of a swimming pool is shown below. . One dimension is missing.

Tb

J

K

Calculate this distance by Pythagoras: $25^2 - 24^2 = 49$
So this is 7m and Tb = 17m

5m radius. Area = $\frac{1}{4} \times \pi \times 5^2$

Area = **19.64**

Area big trapezium =
24 × average of two parallel sides

24m

25m

= 24 × (10 +17) ÷ 2 = **324m²**

Ts   s

4m

Area small trapezium =
4 × average of two parallel sides

M   L

10m

One area of the pool is for toddlers to paddle and another area is for adults only.

The toddlers paddling area is within 5 metres of the corner J
The adult area is within 4 metres of the side ML

The area that is left over shows where children are allowed to swim.

Calculate the area where children are allowed to swim.
Give your answer to 3 significant figures

Area for children =
area of big trapezium − area of quarter circle − area of small trapezium

For the bottom trapezium we need to work out the length of Ts.

Use similar triangles as this triangle is a smaller copy of the large triangle.
Scaling factor is 1/6.   s = 7 ÷ 6 =   1.1667 and Ts = 10 + 1.1667

Area bottom trapezium = 4 × (10+11.1667)÷2 = **42.333m²**

7

S = 7× 1/6
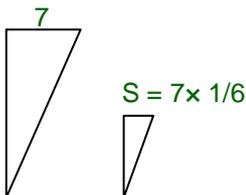
Area = 324 − 19.64 − 42.33m² = 262m²

262 .m²   **(8)**

13. Eleanor wanted to work out how much the monthly repayments would be on her *fixed interest rate* mortgage.

She found a formula on the internet

$$M = \frac{P\,[\,i\ \times (1+i)^n\,]}{[(1+i)^n - 1]}$$

M = The monthly payment
P = The amount of money being borrowed
n = The number of months of the mortgage
i = The interest per month and is calculated by converting the interest rate to a decimal and then dividing by 12.

a) Calculate the monthly repayments on a mortgage of £100,000 at an interest rate of 4% over 25 years.
Give your answer to the nearest £

P = 100,000; n = 25 × 12 = 300; i = 0.04 ÷ 12 = 0.003333

$$M = \frac{100000[\,0.00333\ \times (1.00333)^{300}\,]}{[(1.00333)^{300} - 1]}$$

$$M = \frac{100000[\,0.00333\ \times 2.711\,]}{1.711}$$

$$M = \frac{100000[\,0.00333\ \times 2.711\,]}{1.711}$$
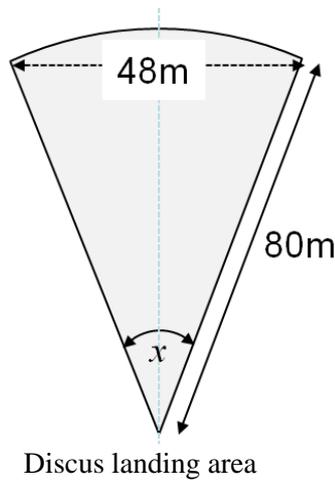
$$M = \frac{902.78}{1.711}$$

£ .... **528** ✓ **(5)**

b) Using your answer to a) work out the total amount paid over the 25 years.
Give your answer to the nearest thousand

£ ...... **158, 000** ✓ **(1)**

14. In the Olympic Games the landing area for the discus event is a sector of a circle.

The length of the sector is 80m (L) and the two sector lines, at a distance of 80m, are spaced 48m apart. (W)
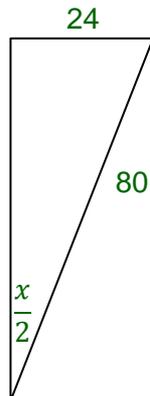

Discus landing area

a) What is the ratio of the width W to the length L
Give your answer in its simplest form.

W:L   48:80 → 6:10 → 3:5

3:5

.... **(1)**

b) Calculate the angle marked as x
Give your answer to 1 decimal place

24

80

$\frac{x}{2}$

$\sin\frac{x}{2} = 0.3 \quad x = 2\sin^{-1} 0.3 = 34.9$

34.9

.. ° **(3)**

c) What is the area of the discus sector to 3 significant figures

Area of complete circle = $A = \pi r^2 = \pi \times 80 \times 80 = 20106$

We have a fraction of a circle which $\frac{34.9}{360} \times 20106$
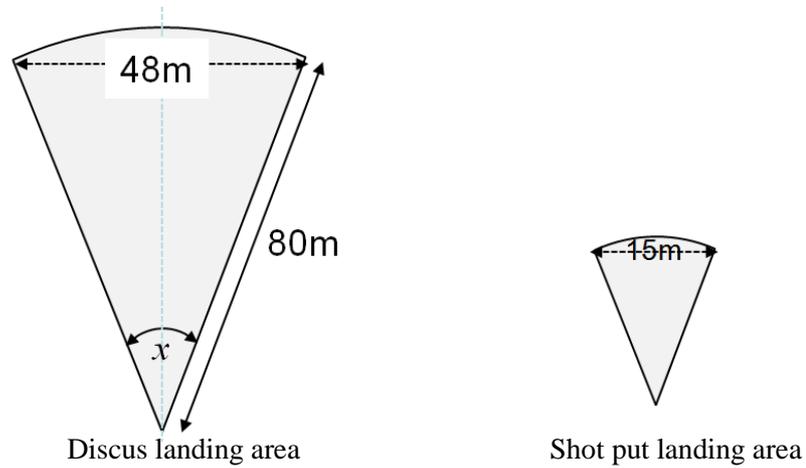
1950

.. m² **(3)**

d)   The shot put is a *similar* sector as the discus, but the two sector lines, are
      spaced 15m apart.

      What is the area of the shot put sector to 3 significant figures

Discus landing area   Shot put landing area

Similar sectors – find the scaling factor for length SF_L

Compare known sides: 15:48 gives SF (length) of 0.3125

SF_A (area) = SF_L^2 = 0.0976

Area shot put = 1950 × 0.0976

190 m^2 **(3)**

15. At a car boot sale, Laura bought some plates and cups.

At the car boot sale in Leicester she bought 2*p plates* and 3*c cups*.
In total she bought 66 items.

At the car boot sale in Nottingham she bought 3p *plates* and 2*c cups*.
In total she bought 69 items.

a) State this information as a pair of simultaneous equations.

Leicester: number of plates + number cups is 66 → 2p + 3c = 66
Nottingham: number of plates + number cups is 69 → 3p + 2c = 69

2p + 3c = 66 and 3p + 2c = 69 ✓

(1)

b) Use your simultaneous equations to work out how many cup and plates she bought at Leicester.

2p + 3c = 66 × 2 → 4p + 6c = 132
3p + 2c = 69 × 3 → 9p + 6c = 207
Subtract   − 5p   = − 75 → p = 15
Sub p=15 in i)   → 30 + 3c = 66   → c = 12
Leicester: 2p = 30, 3c = 36

Number of Plates .... **30** ✓

Number of Cups ..... **36** ✓

(2)

The price she paid for the cups was the same at both locations.
The price she paid for the plates was the same at both locations

For the 66 items at Leicester she paid £36.00
For the 69 items at Nottingham she paid £39.00

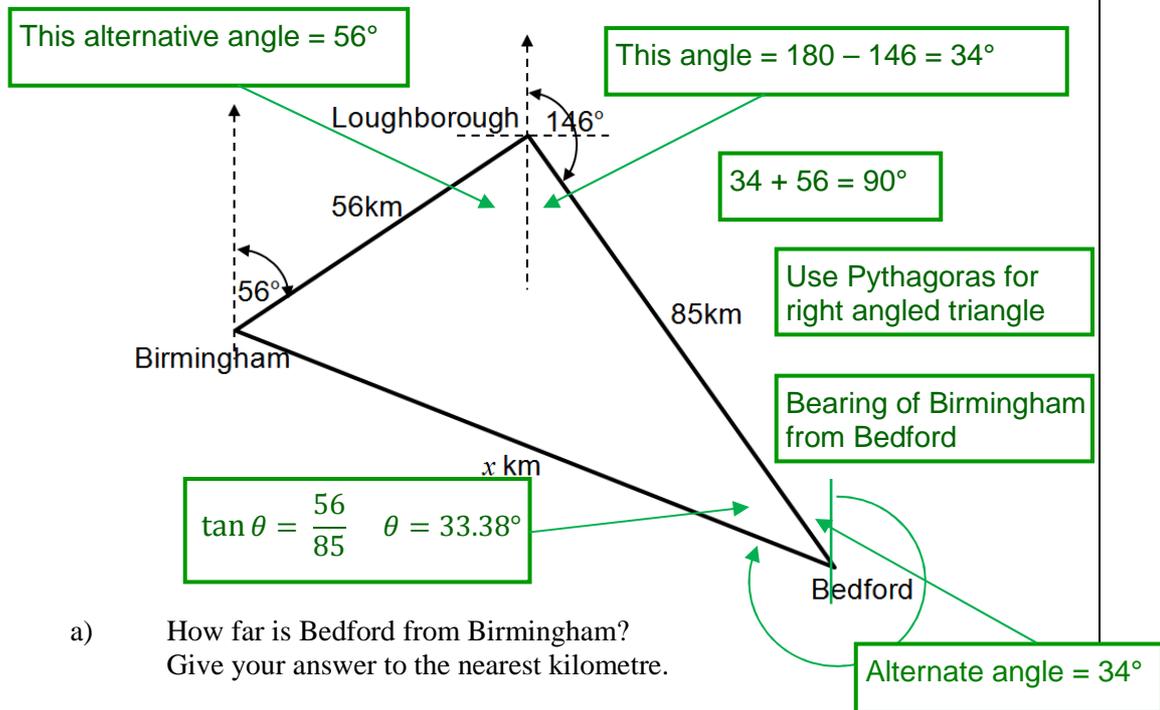c) Work out how much she paid per cup and per plate.

30 plates + 36 cups costs £36 × 2 →   60 plates + 72 cups costs £72
45 plates + 24 cups costs £39 × 3 → 135 plates + 72 cups costs £117
Subtract   − 75 plates   costs − £45
Each plate costs 60p.
Sub in i)   → 30 × 60p + 36 cups costs = £36   → 36 cups cost = £18
Each cup costs 50p

Each cup costs £ **0.50** ✓

Each plate costs £ **0.60** ✓

(2)

16. A helicopter flies from Birmingham on a bearing of 056° for 56 km to Loughborough.

It then flies 85 km on a bearing of 146° to Bedford.

This alternative angle = 56°

This angle = 180 − 146 = 34°

Loughborough 146°

56km

34 + 56 = 90°

56°

85km

Use Pythagoras for right angled triangle

Birmingham

Bearing of Birmingham from Bedford

x km

$\tan\theta = \dfrac{56}{85}$ $\theta = 33.38°$

Bedford

Alternate angle = 34°

a) How far is Bedford from Birmingham?
Give your answer to the nearest kilometre.

$a^2 + b^2 = x^2$ → $x = \sqrt{85^2 + 56^2} = 101.79$

102 . km   **(3)**

b) What is the bearing of Birmingham from Bedford.
Give your answer to the nearest degree.

Bearing = 360 − 34 − 33.4 = 284.8°

293 ° **(2)**

17. ABCD is a cyclic quadrilateral.
Angle AOB is 104° , DCB is 95°
O is the centre of the circle.
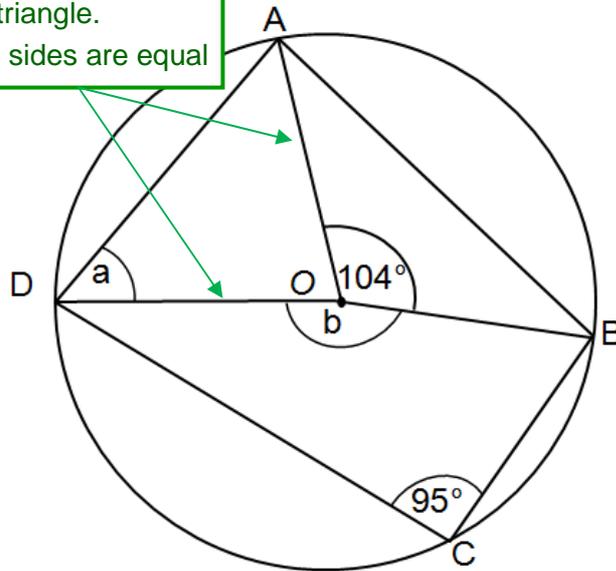
Isosceles triangle.
These two sides are equal

A

D

a

O 104°

b

B

Diagram not
accurately drawn

95°

C

a) Work out the size of the angle DOB marked 'b'
Give a reason for your answer

DAB = 180 – 95 = 85° opposite angle in cyclic quadrilateral
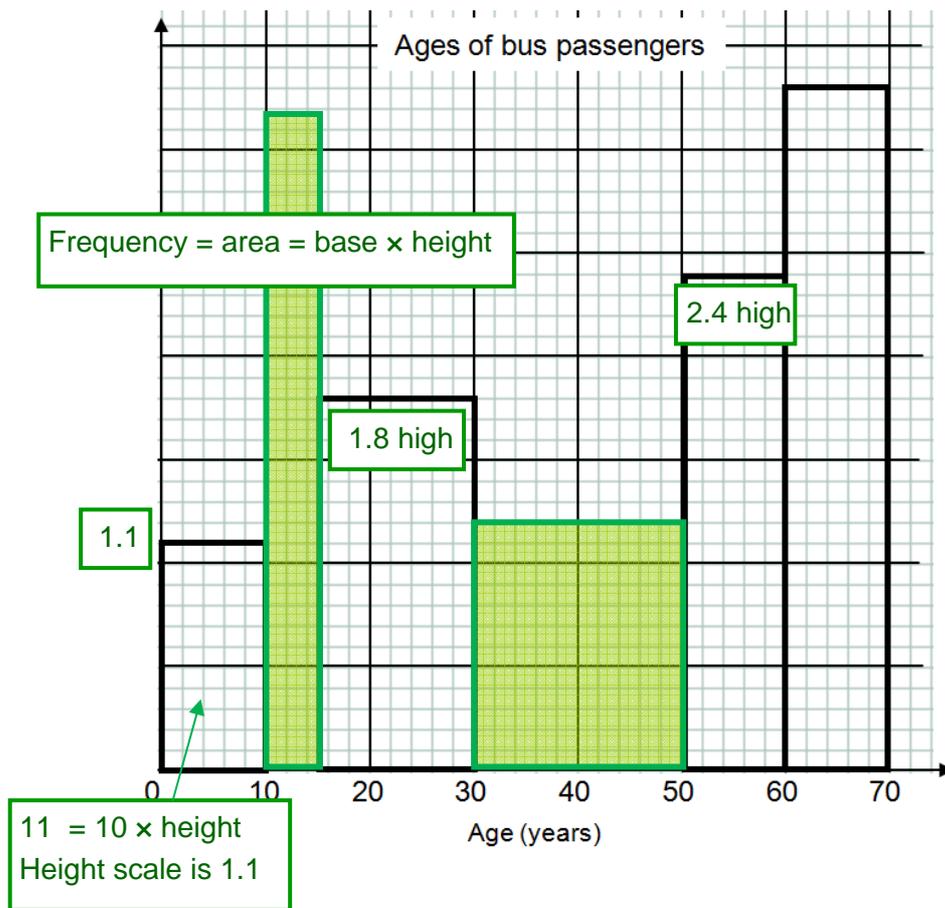DOB (b) is 2 × DAB = 170° angle at centre is twice angle at circumference

170

...° **(2)**

b) Work out the size of the angle ADO, marked 'a'
Give a reason for your answer

AOD = is 360 – 170 – 104 = 86°
△DOA is isosceles because it has two radii of the circle
ADO + DAO = 180 – 86 = 94 and ADO = 47° as both angles are equal

47

...° **(2)**

18. The table and histogram show information about the age of passengers on a bus.

Ages of bus passengers

Frequency = area = base × height

2.4 high

1.8 high

1.1

11 = 10 × height
Height scale is 1.1

Age (years)

a) Use the histogram to complete the table

Time (t years)	Frequency
0< t ≤ 10	11
10< t ≤ 15	16
15< t ≤ 30	**15 × 1.8 = 27**
30< t ≤ 50	24
50< t ≤ 60	**10 × 2.4 = 24**
60< t ≤ 70	33

Use this info to work out the y - scale

16 = 5 × height
Height = 3.2

24 = 20 × height
Height = 1.2

(2)

b) Use the table to complete the histogram

(2)

19. Sylvia runs 100 metres in a time of 25.6 seconds

The distance of 100 metres was measured to the nearest metre.
The time of 25.6 seconds was measured to the nearest tenth of a second.

a) What is the **upper** bound for the distance of 100 metres

100.5

.... m **(1)**

b) What is the **lower** bound for the time of 25.6 seconds

25.55

......................s **(1)**

c) Calculate the **lower** bound for Sylvia's average speed
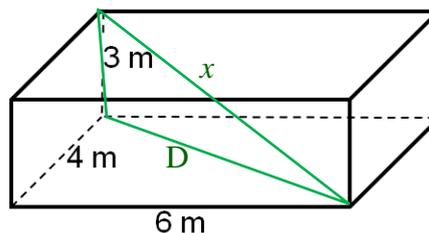Show all the figures on your calculator display

Speed = distance ÷ time.
To find lowest speed use lowest distance and highest time

Speed = 99.5 ÷ 25.65 = 3.8791423

3.8791423

..m/s **(2)**

20. The floor of a room is 6 m by 4 m, and its height is 3 m.

a) Find the distance from a corner point on the floor to the opposite corner point on the ceiling. Give your answer correct to 1 decimal place

Work out diagonal D as $\sqrt{4^2 + 6^2} = \sqrt{52}$

Work out diagonal x as $\sqrt{3^2 + \sqrt{52}^2} = \sqrt{61}$

7.8

.... **(4)**

21. A six sided shape is shown below with all the corners as right angles. Measurements are in centimetres.
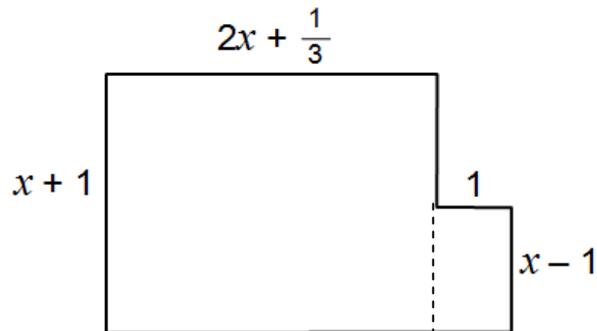
$$2x + \frac{1}{3}$$

$x + 1$ 1

$x - 1$

Diagram not accurately drawn

The area of the shape is 18 cm^2

a) Show that $3x^2 + 5x - 28 = 0$

Area A = $\left(2x + \frac{1}{3}\right)(x + 1) = 2x^2 + \frac{1}{3}x + 2x + \frac{1}{3}$

Area B = $(1)(x - 1) = x - 1$

Area A+B = $2x^2 + \frac{1}{3}x + 2x + \frac{1}{3} + x - 1 = 18$

$2x^2 + 3\frac{1}{3}x - \frac{2}{3} = 18 \rightarrow 2x^2 + 3\frac{1}{3}x - \frac{56}{3} = 0$

$2x^2 + 3\frac{1}{3}x - \frac{2}{3} = 18 \rightarrow 6x^2 + 10x - 56 = 0 \rightarrow 3x^2 + 5x - 28 = 0$

(4)

b) Find the height of the shape

$3x^2 + 5x - 28 = 0 \rightarrow (3x - 7)(x + 4) = 0$

$x = \frac{7}{3}$ 0r $- 4$ Ignore $- 4$ as this cannot be a distance

Height = x + 1 = $\frac{10}{3}$

Height is .... $\frac{10}{3}$ ....cm   **(3)**