

Please write clearly in block capitals.

Centre number

Candidate number

Surname _____

Forename(s) _____

Candidate signature _____

GCSE MATHEMATICS

H

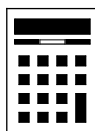
Higher Tier Paper 2 Calculator

Thursday 8 November 2018 Morning Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a calculator
- mathematical instruments.



Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.

For Examiner's Use	
Pages	Mark
2–3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
22–23	
TOTAL	

Advice

In all calculations, show clearly how you work out your answer.



Answer **all** questions in the spaces provided

- 1 What does $(A \cap B)$ represent in $P(A \cap B)$?
Circle your answer.

means "and"

[1 mark]

A or B or both

A but not B

not A and not B

A and B

- 2 P is $(4, 9)$ and Q is $(-2, 1)$
Circle the midpoint of PQ .

to find the midpoint
add the coordinates
and divide by 2.

[1 mark]

(1, 5)

(3, 4)

(3, 5)

(6, 8)

- 3 Which of these is a geometric progression?
Circle your answer.

the link is an enlarged
scale factor

[1 mark]

1 3 5 7 9

1 3 6 10 15

1 4 9 16 25

1 3 9 27 81

tripling each
time

- 4 The bearing of A from B is 310°

Circle the bearing of B from A.

050°

110°

130°

220°

[1 mark]

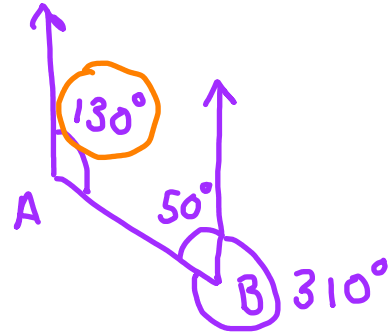
remember

→ always clockwise

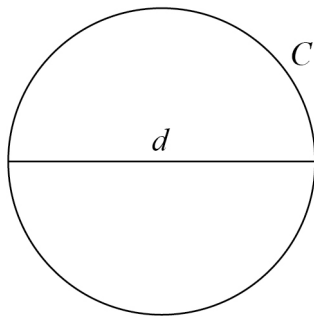
→ 3 figure

→ start at north.

IF UNSURE → SKETCH



- 5 A circle has circumference C and diameter d .



Circumference = πd .

$$C = kd$$

What **value** does the constant k represent?

[1 mark]

Answer _____

π



- 6 Here is some information about 20 trains leaving a station.

	f	x	
Number of minutes late, t	Number of trains	Midpoint	fx
$0 \leq t < 5$	12	2.5	30
$5 \leq t < 10$	7	7.5	52.5
$10 \leq t < 15$	1	12.5	12.5
$t \geq 15$	0	\	0

big giveaway

- 6 (a) Work out an estimate of the mean number of minutes late.

[3 marks]

$$\frac{\text{Total number}}{\text{number}} = \frac{95}{20}$$

Answer 4.75 minutes



6 (b) The station manager looks at the information in more detail.

Number of minutes late, t	Number of trains
$0 \leq t < 2$	12
$2 \leq t < 4$	0
$4 \leq t < 6$	7
$6 \leq t < 8$	0
$8 \leq t < 10$	0
$10 \leq t < 12$	1

He works out an estimate of the mean using this information.

How does his estimate compare with the answer to part (a)?

Tick **one** box.

[1 mark]

- Higher than part (a)
- Same as part (a)
- Lower than part (a)
- Not possible to tell

Turn over for the next question

Turn over ►



7

Work out the values of a and b in the identity

$$5(7x + 8) + 3(2x + b) \equiv ax + 13$$

[4 marks]

Not sure where to start?

Expand brackets:

$$5(7x + 8) + 3(2x + b) \equiv ax + 13$$

$$35x + 40 + 6x + 3b \equiv ax + 13$$

$$41x + 40 + 3b \equiv ax + 13$$

These must be equal so $a = 41$

$$40 + 3b = 13$$

$$3b = -27$$

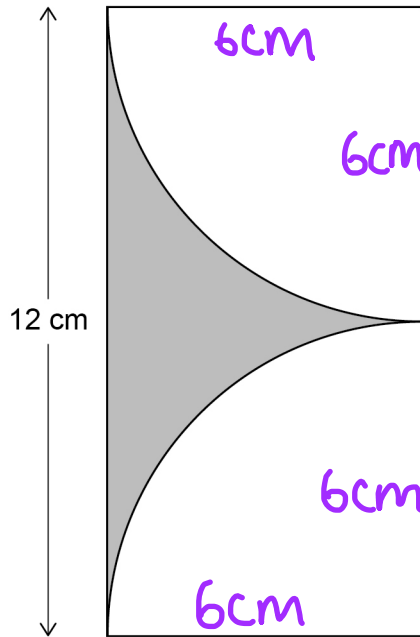
$$b = -9$$

$$a = 41 \quad b = -9$$



8

Two identical quarter circles are cut from a rectangle as shown.



Not drawn
accurately

Gain information
from the diagram.
-if they are
quarters →
what is the
radius?
6cm

Work out the shaded area.

[4 marks]

Area of rectangle - half the area of
a circle.

$$(12 \times 6) - (\pi \times 6^2) \div 2$$

$$72 - 18\pi$$

Answer 72 - 18π cm²



9

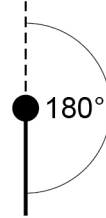
The diagrams show the position of a tap when off and fully on.

The tap is fully on when the angle of turn is 180°

Off



Fully on



When fully on, water flows out of the tap at 14 litres per minute.

The rate at which water flows out is in direct proportion to the angle of turn.

The tap is turned 135°



Need to
compare!

$$180^\circ - 14$$

$$135^\circ - ?$$

The water flows into a tank with a capacity of 79.8 litres.

Will it take **less than** $7\frac{1}{2}$ minutes to fill the tank?

You **must** show your working.

[4 marks]

$$180^\circ = 14 \text{ litres per minute}$$

$$\frac{135}{180} = \frac{3}{4} \rightarrow \text{so at } 135^\circ \rightarrow 10.5 \text{ litres per min}$$

$$79.8 \div 10.5 = 7.6 \text{ minutes}$$

$$= 7 \text{ minutes and } 36 \text{ secs.}$$

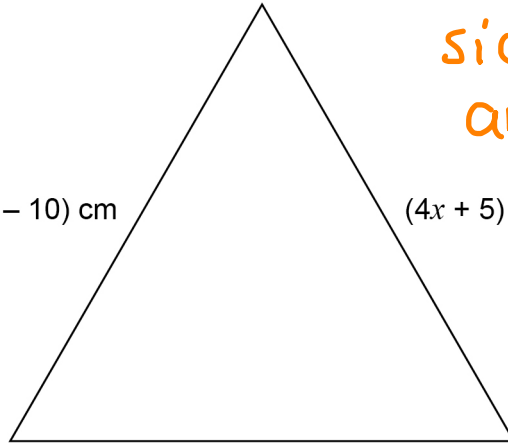
Don't forget to answer the question
No it will take slightly longer



10

This triangle is equilateral.

This means
all the
sides
are equal.

Not drawn
accurately $(6x - 10)$ cm $(4x + 5)$ cm $10(x - 4)$ cm

Is the perimeter of the triangle greater than one metre?

You **must** show your working.

[5 marks]

$$6x - 10 = 4x + 5$$

$$2x = 15$$

$$x = 7.5$$

make two equal to
each other and
solve

$$\text{If } x = 7.5$$

$$10(x - 4) = 10(7.5 - 4) = 35$$

$$35 \times 3 = 105 \text{ cm}$$

Length
of one
side

answer the question.

The perimeter is 105cm, which
is greater than one metre



- 11 An approximation for the value of π is given by

$$4\left(1 - \frac{22}{57} + \frac{22}{85} - \frac{22}{105} + \frac{22}{117} - \frac{22}{242}\right)$$

Use your calculator to show that this approximation is within 0.1 of 3.14

[2 marks]

Key point: pop in calculator (twice to be sure)

$$= 3.041\dots$$

which is within 0.1 of 3.14

$$3.04 \quad \nearrow 3.24$$

- 12 Work out

$$\frac{9.12 \times 10^{10}}{3.2 \times 10^4}$$

Give your answer in standard form.

[2 marks]

$$9.12 \div 3.2 = 2.85$$

$$10^{10} \div 10^4 = 10^6$$

Answer 2.85×10^6



13

Ashraf is going to put boxes into a crate.

The crate is a cuboid measuring 2.5 m by 2 m by 1.2 m

Each box is a cube of length 50 cm

He does these calculations.

volume of crate	=	$2.5 \times 2 \times 1.2$
	=	6 m^3
volume of one box	=	$0.5 \times 0.5 \times 0.5$
	=	0.125 m^3
number of boxes	=	$6 \div 0.125$
	=	48

Explore /
visualise
the box.

He claims,

"I can put 48 boxes in the crate."

Evaluate Ashraf's method **and** claim.

[2 marks]

Capacity may work - but the volume of the crate and box is restricted to its dimensions eg 1.2m width will only fit in two boxes and 20cm of "dead" space

14

The cross section of a prism has n sides.

Circle the expression for the number of edges of the prism.

[1 mark]

$2n$

$3n$

$n + 2$

$2n + 3$



15

The volume of a medal is 45 cm^3

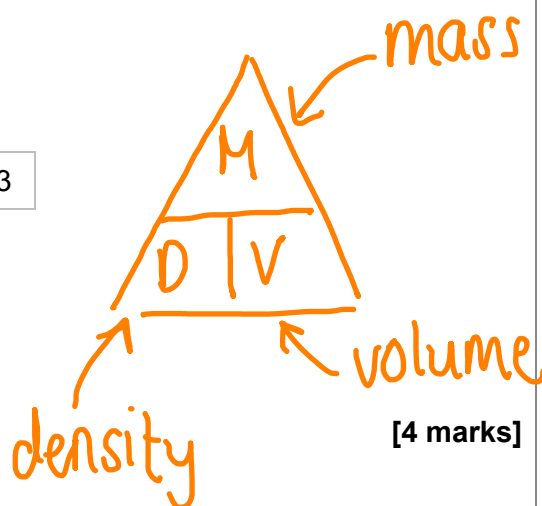
The medal is made from copper and tin.

$$\text{volume of copper : volume of tin} = 22 : 3$$

The density of copper is 8.96 g/cm^3

The density of tin is 7.31 g/cm^3

Work out the mass of the medal.



[4 marks]

$$45 \rightarrow 22:3 \quad \swarrow \text{sharing ratio} \quad \searrow \text{volume for each}$$

$$45 \div 25 = 1.8$$

$$\text{Copper} \rightarrow 1.8 \times 22 = 39.6$$

$$\text{Tin} \rightarrow 1.8 \times 3 = 5.4$$

Density \times Volume

$$39.6 \times 8.96 = 354.816$$

$$5.4 \times 7.31 = \underline{39.474} +$$

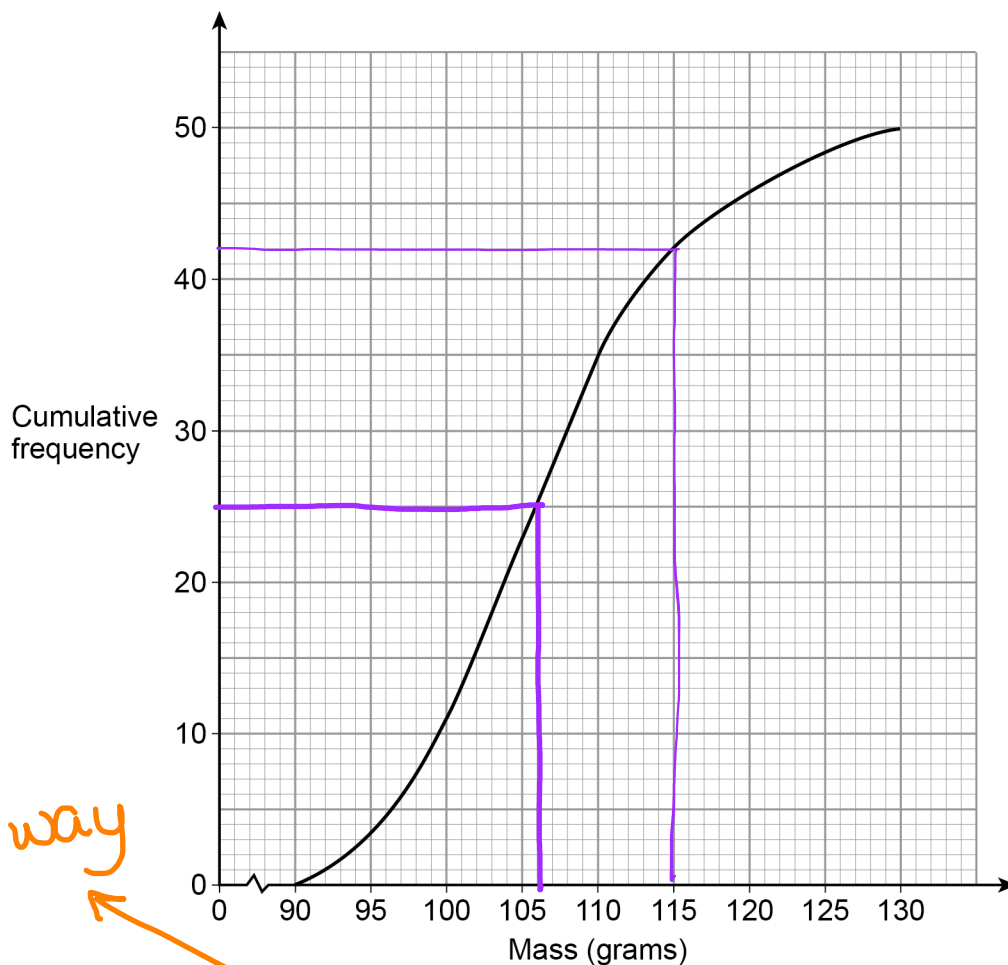
total mass

so we
need to
combine

Answer 394.29 grams



16 The cumulative frequency graph shows information about the masses of 50 apples.



half way

16 (a) Use the graph to estimate the median mass of the apples.

[1 mark]

needs to be %, frac or dec

Answer 106 grams

16 (b) Estimate the proportion of the apples that have a mass greater than 115 grams.

[2 marks]

Above 115 $\rightarrow 50 - 42 = 8$

so $\frac{8}{50} = \frac{4}{25}$

Answer $\frac{4}{25}$

7

Turn over ►



17

 a is a prime number. b is an even number.

$$N = a^2 + ab$$

$$ab \rightarrow \text{even}$$
$$a^2 \rightarrow \text{odd or even}$$

Circle the correct statement about N .

[1 mark]

could be
even or odd

always even

always prime

always odd

18

A bag contains 20 discs.

10 are red, 7 are blue and 3 are green.

18 (a)

Marnie takes a disc at random before putting it back in the bag.

Nick then takes a disc at random before putting it back in the bag.

Olly then takes a disc at random.

Work out the probability that they all take a red disc.

[2 marks]

Red AND Red AND Red

$$\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$$

Answer $\frac{1}{8}$ 

18 (b)

All 20 discs are in the bag.

Reggie takes three discs at random, one after the other.

After he takes a disc he does **not** put it back in the bag.

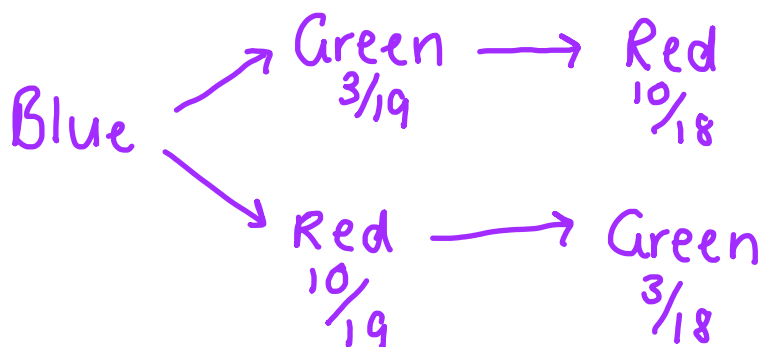
Reggie's first disc is blue.

Work out the probability that all three discs are different colours.

[3 marks]

tree diagrams?

Blue is certain, so we need to look at the 2nd and 3rd discs.



"AND" - multiply "OR" - add

$$\begin{array}{l} \text{Green and Red} \quad \text{OR} \quad \text{Red and Green} \\ \left(\frac{3}{19} \times \frac{10}{18}\right) + \left(\frac{10}{19} \times \frac{3}{18}\right) \\ \frac{30}{342} + \frac{30}{342} = \frac{60}{342} \end{array}$$

Simplify if possible $\rightarrow \frac{10}{57}$

Answer _____

6

Turn over ►



19

Lunch

Choose one starter and one main course

There are **four starters** and **ten main courses** to choose from.**Two of the starters** and **three of the main courses** are suitable for vegans.What percentage of the possible lunches have **both** courses suitable for vegans?

[3 marks]

How many combinations can you choose?

$$4 \text{ starters} \times 10 \text{ mains} = 40$$

How many combinations for vegans?

$$2 \text{ starters} \times 3 \text{ mains} = 6$$

Answer the question $\rightarrow \frac{6}{40} = 0.15 = 15\%$ Answer 15% %

20

 n is a positive integer.

Prove algebraically that

$$2n^2 \left(\frac{3}{n} + n \right) + 6n(n^2 - 1)$$

is a cube number.

[3 marks]

$$\cancel{6n^2} + 2n^3 + 6n^3 - 6n$$

$$\cancel{6n} + 2n^3 + 6n^3 - \cancel{6n}$$

$$2n^3 + 6n^3 = 8n^3$$

$$2^3 \checkmark \rightarrow \text{cubed}$$

YES!
==the final
expression
should
be cubed

- 21 y is inversely proportional to \sqrt{x}
 $y = 4$ when $x = 9$

Inversely proportional is
 $y = \frac{k}{x}$

- 21 (a) Work out an equation connecting y and x .

[3 marks]

$$y = \frac{k}{\sqrt{x}} \quad \text{now use the example}$$

$$4 = \frac{k}{\sqrt{9}} \quad 4 = \frac{k}{3} \quad 12 = k$$

Now we have k , the new equation
 can be written.

Answer $y = \frac{12}{\sqrt{x}}$

- 21 (b) Work out the value of y when $x = 25$

[2 marks]

$$y = \frac{12}{\sqrt{x}} \rightarrow y = \frac{12}{\sqrt{25}}$$

$$y = \frac{12}{5}$$

Answer $\frac{12}{5}$ or $2\frac{2}{5}$ or 2.4

Turn over for the next question



22 Simplify fully $\frac{x^5 - 4x^3}{3x - 6}$ ← fraction - need to look for common factors! [3 marks]

No current common factors that are obvious so we need to factorise:

$$\frac{x^5 - 4x^3}{3x - 6} = \frac{x^3(x^2 - 4)}{3(x - 2)} = \frac{x^3 \cancel{(x - 2)}(x + 2)}{3 \cancel{(x - 2)}}$$

Answer $\frac{x^3(x + 2)}{3}$

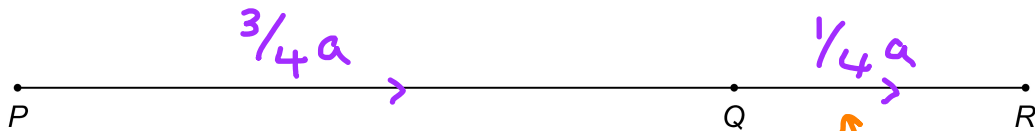
still no common factor - further factorise

cancel common factors

23 PQR is a straight line.
PQ : QR = 3 : 1
 $\vec{PQ} = a$

put on the line make a fraction of whole

Not drawn accurately



Circle the vector \vec{RQ}

in the opp direction

[1 mark]

$\frac{1}{3} a$

$\frac{1}{4} a$

$-\frac{1}{3} a$

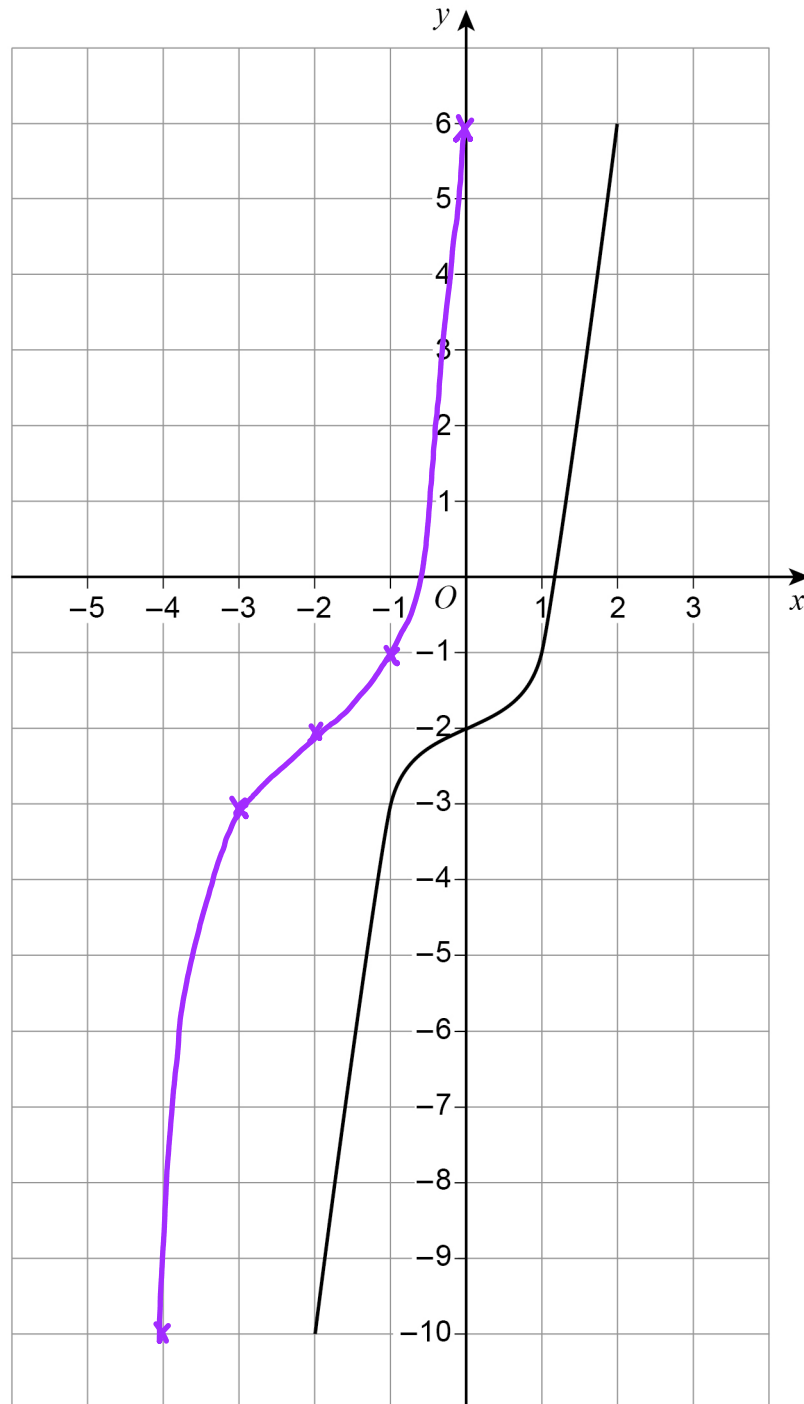
$-\frac{1}{4} a$



24

Here is a sketch of $y = f(x)$

The curve passes through the points

 $(-2, -10)$ $(-1, -3)$ $(0, -2)$ $(1, -1)$ $(2, 6)$ 

On the grid, sketch the curve

$y = f(x + 2)$

do the opposite
in the
bracket

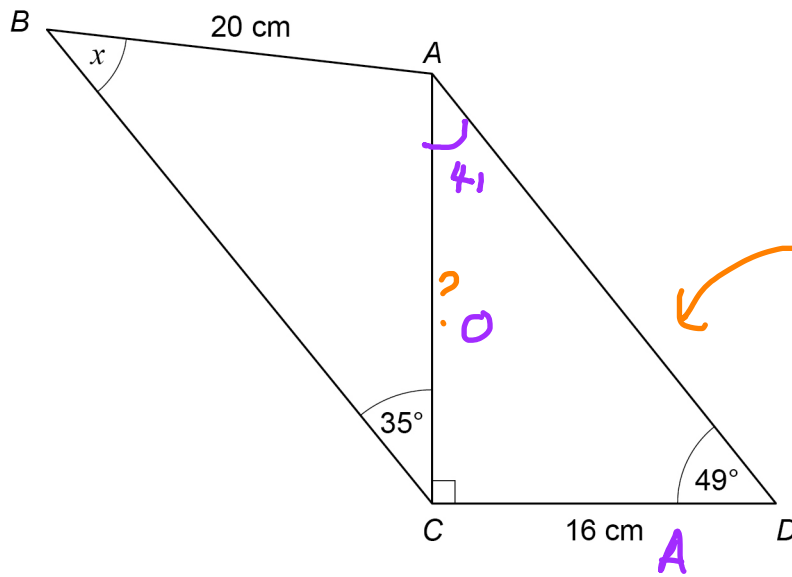
[2 marks]

6

Turn over ►



25

 ABC and ACD are triangles.Not drawn
accuratelyright
angle
triangle.Work out the size of angle x .

[5 marks]

Any information you can immediately add? $\hat{C}AD = 41^\circ$

Calculate AC using trig $\text{T} \hat{\text{A}}$
 $16 \times \tan 49 = 18.41 \text{ cm}$

Calculate x using sine rule

$$\frac{\sin 35}{20} = \frac{\sin x}{18.41} \quad 18.4 \times \frac{\sin 35}{20} = \sin x$$

$$\sin^{-1}(0.527\dots) = x$$

Answer 31.8 degrees



26

$$f(x) = \frac{x}{x+2}$$

$$g(x) = x^2 - 2$$

Work out $fg(x)$ Give your answer in the form $a + bx^n$ where a , b and n are integers.

[3 marks]

$$f(x) = \frac{x}{x+2} \rightarrow \frac{x^2-2}{x^2-2+2} = \frac{x^2-2}{x^2}$$

Split up the fraction

$$\frac{x^2}{x} - \frac{2}{x^2} = 1 - \frac{2}{x^2} = 1 - 2x^{-2}$$

Answer $1 - 2x^{-2}$

write
this as a
negative
power of
 x

27

The point $\left(3, \frac{1}{64}\right)$ lies on the curve $y = k^x$ where k is a constant.Show that the point $\left(\frac{1}{2}, \frac{1}{2}\right)$ lies on the curve.

[3 marks]

$$\frac{1}{64} = k^3$$

take the cube root

$$\frac{1}{4} = k \quad \text{so} \quad y = \left(\frac{1}{4}\right)^x$$

Now show that $\frac{1}{2} = \frac{1}{4}^{(1/2)} \quad \frac{1}{2} = \sqrt{\frac{1}{4}}$



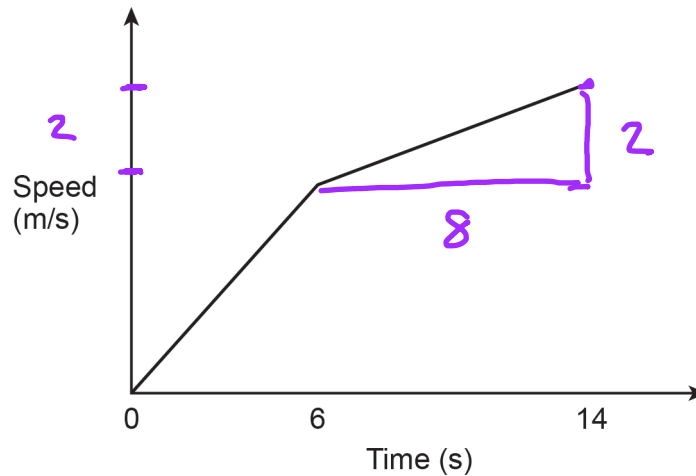
28 Izzy runs an 80-metre race in 14 seconds.

During the first 6 seconds her speed increases at a constant rate.

During the last 8 seconds her speed increases at a different constant rate.

Her speed at 14 seconds is 2 m/s more than her speed at 6 seconds.

Here is a sketch of her speed-time graph.



Not drawn
accurately

28 (a) Work out her acceleration during the last 8 seconds.

State the units of your answer.

[2 marks]

$$\begin{aligned} \text{Acceleration} &= \text{Speed} \div \text{time} \\ &= 2 \div 8 = \frac{1}{4} \end{aligned}$$

Answer $\frac{1}{4} \text{ m/s}^2$

↖ ↗
mark for each
here!
—



28 (b) When Izzy finishes the 80-metre race, her speed is v m/s

Work out the value of v .

[4 marks]

Area under the curve represents distance
- 80m

Look at what you have

$$\text{Total area} = 8h + 3h + 8 = 80$$

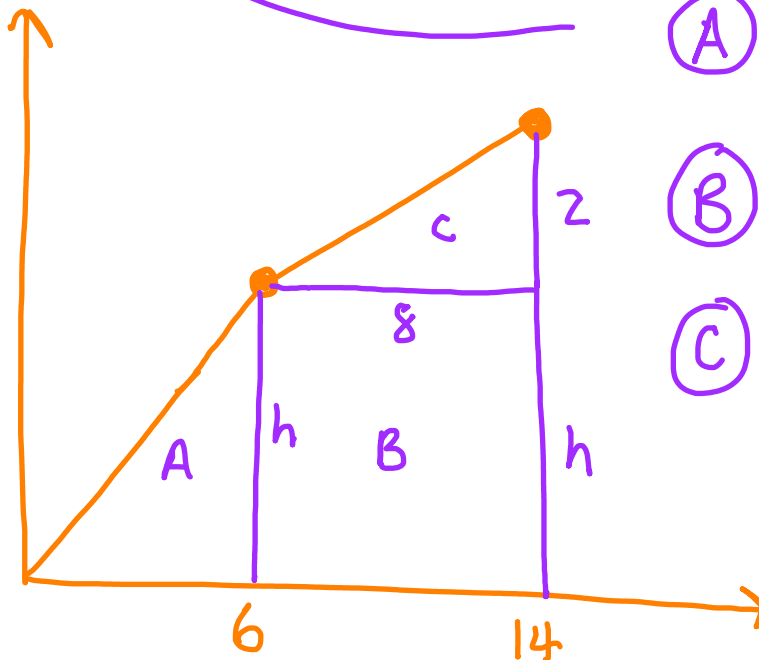
$$72 = 11h$$

$$72/11 = h \quad \text{to find } v, \text{ we need to}$$

$$6 \frac{6}{11} = h \quad \text{add } 2 \text{ m/s} = 8 \frac{6}{11}$$

Answer $8 \frac{6}{11}$ m/s

END OF QUESTIONS



$$\textcircled{A} = \frac{6h}{2} = \textcircled{3h}$$

$$\textcircled{B} = 8h$$

$$\textcircled{C} = \frac{2 \times 8}{2} = \textcircled{8}$$



There are no questions printed on this page

*Do not write
outside the
box*

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