



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.

Advice

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

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	



N 0 V 1 8 8 3 0 0 2 H 0 1

IB/M/Nov18/E4

8300/2H

Do not write outside the box

Answer **all** questions in the spaces provided

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

[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 .

[1 mark]

$(1, 5)$

$(3, 4)$

$(3, 5)$

$(6, 8)$

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

[1 mark]

1 3 5 7 9

1 3 6 10 15

1 4 9 16 25

1 3 9 27 81

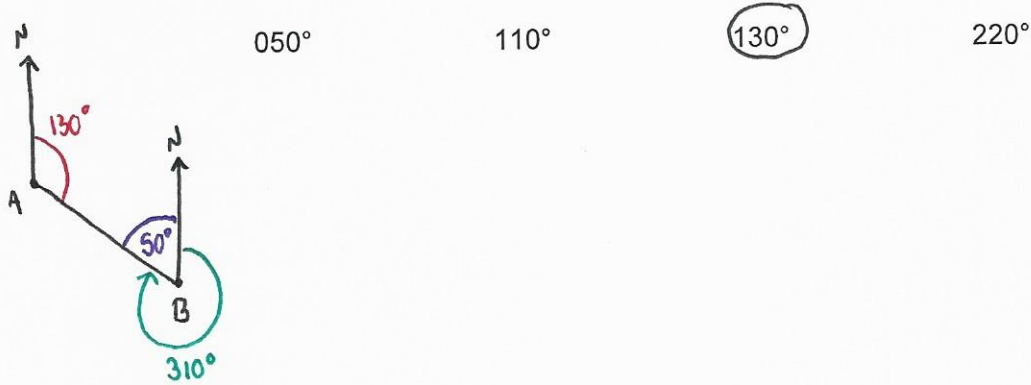
Note: Geometric Means each term is multiplied by the same each time.



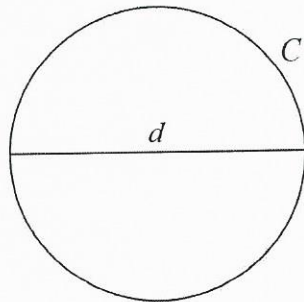
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- 4 The bearing of A from B is 310°
 Circle the bearing of B from A.

[1 mark]



- 5 A circle has circumference C and diameter d .



$$C = kd$$

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

[1 mark]

Answer _____ π _____

5

Turn over ►



6

Here is some information about 20 trains leaving a station.

Number of minutes late, t	Number of trains	Midpoint	
$0 \leq t < 5$	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		

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

[3 marks]

$$\begin{aligned} \text{Estimated Mean} &= \frac{30 + 52.5 + 12.5}{12 + 7 + 1} \\ &= \frac{95}{20} \\ &= 4.75 \text{ minutes} \end{aligned}$$

Answer _____ minutes



Do not write outside the box

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

mp	$mp \times f$
1	12
3	0
5	35
7	0
9	0
11	11

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.

$$\begin{aligned} \bar{x}_{est} &= \frac{58}{20} \\ &= 2.9 \end{aligned}$$

[1 mark]

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

Turn over for the next question

4

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]

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

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

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

$$41x = ax \quad \therefore a = 41$$

$$40 + 3b = 13$$

$$\begin{array}{r} -40 \\ 40 + 3b = 13 \\ \hline 3b = -27 \end{array}$$

$$\begin{array}{r} \div 3 \\ 3b = -27 \\ \hline b = -9 \end{array}$$

$$b = -9$$

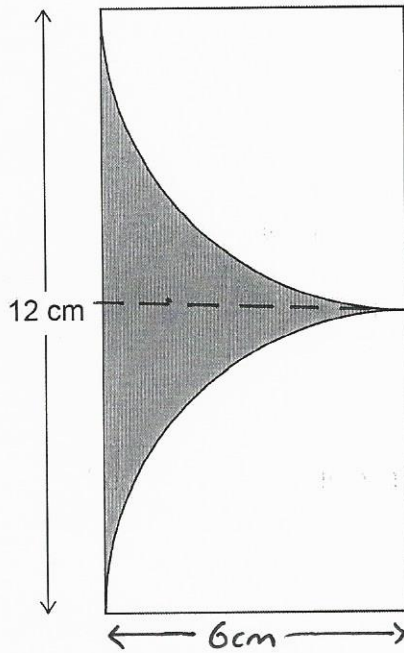
$$a = \underline{41} \quad b = \underline{-9}$$



Do not write outside the box

8

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



Not drawn accurately

Work out the shaded area.

[4 marks]

Area rectangle = $12 \times 6 = 72$

Area $\frac{1}{4}$ circle = $\frac{1}{4} \times \pi \times 6^2 = 28.274$

$\therefore A_{\text{SHADED}} = 72 - (28.274 + 28.274)$
 $= 15.5 \text{ cm}^2$

Answer _____ cm^2

Turn over ►



Do not write outside the box

- 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°



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]

$$\frac{135}{180} = \frac{3}{4}$$

$$\frac{3}{4} \text{ of } 14 = 10.5 \text{ litres per minute}$$

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

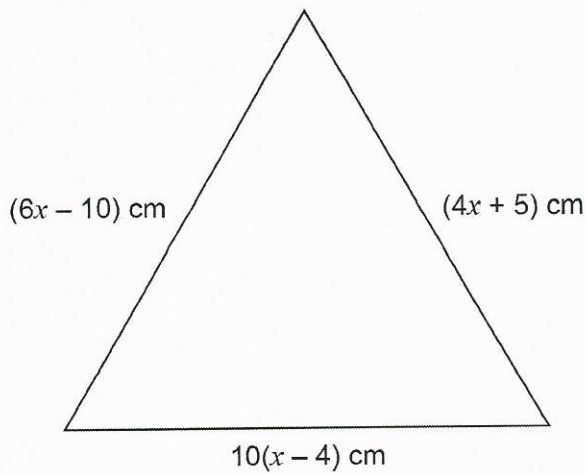
\therefore No, it will take longer



Do not write outside the box

10

This triangle is equilateral.



Not drawn accurately

Is the perimeter of the triangle greater than one metre?

You **must** show your working.

[5 marks]

$$\begin{array}{r} 6x - 10 = 4x + 5 \\ +10 \qquad +10 \end{array}$$

$$6x = 4x + 15$$

$$-4x \quad -4x$$

$$2x = 15$$

$$\div 2 \quad \div 2$$

$$x = 7.5$$

$$6x - 10 = 35$$

$$4x + 5 = 35$$

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

$$35 + 35 + 35 = 105$$

\therefore It is longer than 1 metre.

Turn over ►



- 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]

$$3.041839619$$

$$3.14 - 3.041839619 = 0.098\dots$$

\therefore within 0.1

- 12 Work out

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

Give your answer in standard form.

[2 marks]

$$9.12 \div 3.2 = 2.85$$

$$10^{10} \div 10^4 = 10^{(10-4)} = 10^6$$

Answer 2.85×10^6



Do not write outside the box

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

He claims,

"I can put 48 boxes in the crate."

Evaluate Ashraf's method and claim.

[2 marks]

• Problem on Line 1, 50cm does not divide into 1.2m

• He can fit in $5 \times 4 \times 2$ boxes = 40 boxes

14

The cross section of a prism has n sides.

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

[1 mark]

$2n$

$3n$

$n + 2$

$2n + 3$

7

Turn over ►



15

The volume of a medal is 45 cm^3

The medal is made from copper and tin.

$$D = \frac{M}{V} \quad \therefore M = D \times V$$

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

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]

$$45 \div (22 + 3) = 1.8 \text{ cm}^3$$

$$\text{Copper} = 1.8 \times 22 = 39.6 \text{ cm}^3$$

$$\text{tin} = 1.8 \times 3 = 5.4 \text{ cm}^3$$

$$\text{Mass} = (39.6 \times 8.96) + (5.4 \times 7.31)$$

$$= 354.816 + 39.474$$

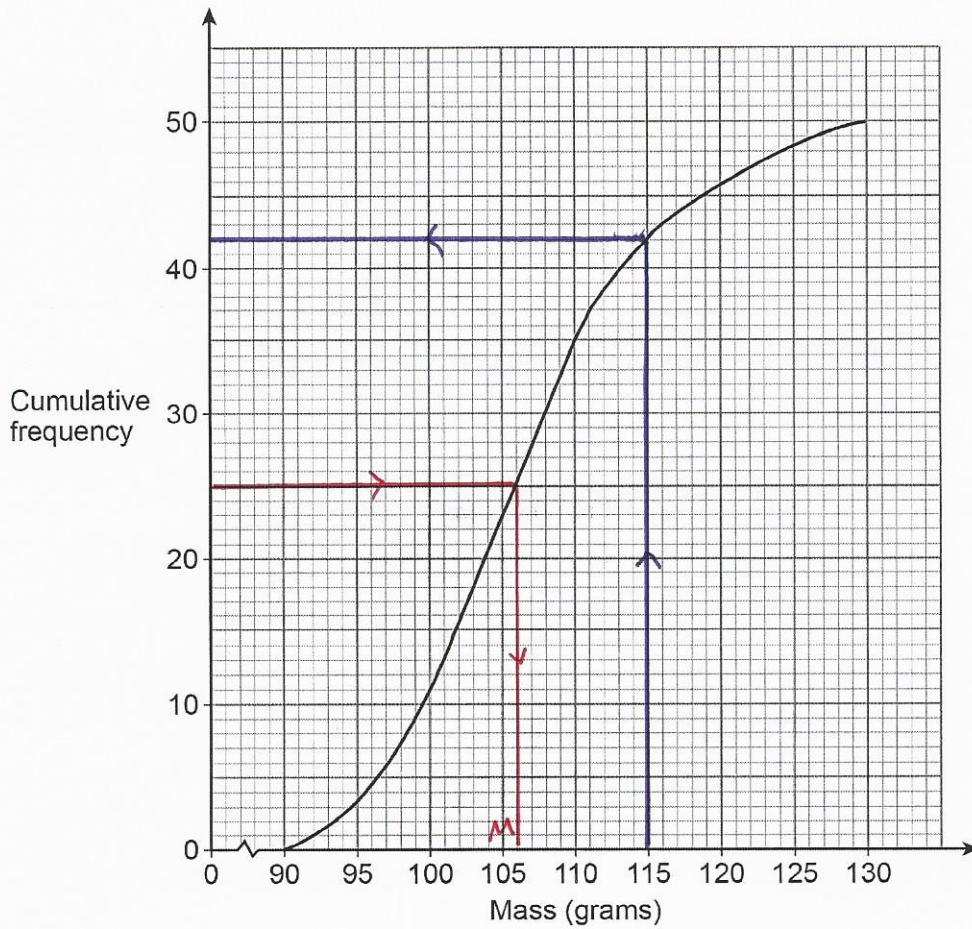
$$= 394.29 \text{ g}$$

Answer _____ grams



Do not write outside the box

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



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

[1 mark]

Answer 106g grams

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

[2 marks]

$$50 - 42 = 8 \quad \frac{8}{50} = 16\%$$

Answer _____

7

Turn over ►



- 17 a is a prime number.
 b is an even number.
 $N = a^2 + ab$

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]

$$P(\text{red}) = \frac{10}{20} = \frac{1}{2}$$

$$P(\text{all red}) = \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$$

Answer _____



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]

This can happen as R,G or G,R

$$P(R,G) + P(G,R)$$

$$\left(\frac{10}{19} \times \frac{3}{18}\right) + \left(\frac{3}{19} \times \frac{10}{18}\right) = \frac{5}{57} + \frac{5}{57}$$

$$= \frac{10}{57}$$

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]

$$4 \times 10 = 40$$

$$2 \times 3 = 6$$

$$\frac{6}{40} \times 100 = 15\%$$

Answer _____ %

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]

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

$$6n + 2n^3 + 6n^3 - 6n$$

$$2n^3 + 6n^3$$

$$8n^3$$

$$(2n)^3$$

\therefore Cube number



Do not write outside the box

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

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

[3 marks]

$$y \propto \frac{1}{\sqrt{x}}$$

$$y = \frac{k}{\sqrt{x}}$$

$$k = y \times \sqrt{x} \qquad \therefore y = \frac{12}{\sqrt{x}}$$

$$k = 4 \times \sqrt{9}$$

$$= 12$$

Answer _____

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

[2 marks]

$$y = \frac{12}{\sqrt{25}} = \frac{12}{5} = 2.4$$

Answer _____

Turn over for the next question

Turn over ►



Do not write outside the box

22

Simplify fully

$$\frac{x^5 - 4x^3}{3x - 6}$$

[3 marks]

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

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

Answer _____

23

PQR is a straight line.

$$PQ : QR = 3 : 1$$

$$\vec{PQ} = \mathbf{a}$$

Not drawn accurately



Circle the vector \vec{RQ}

[1 mark]

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

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

$$\left(-\frac{1}{3} \mathbf{a} \right)$$

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



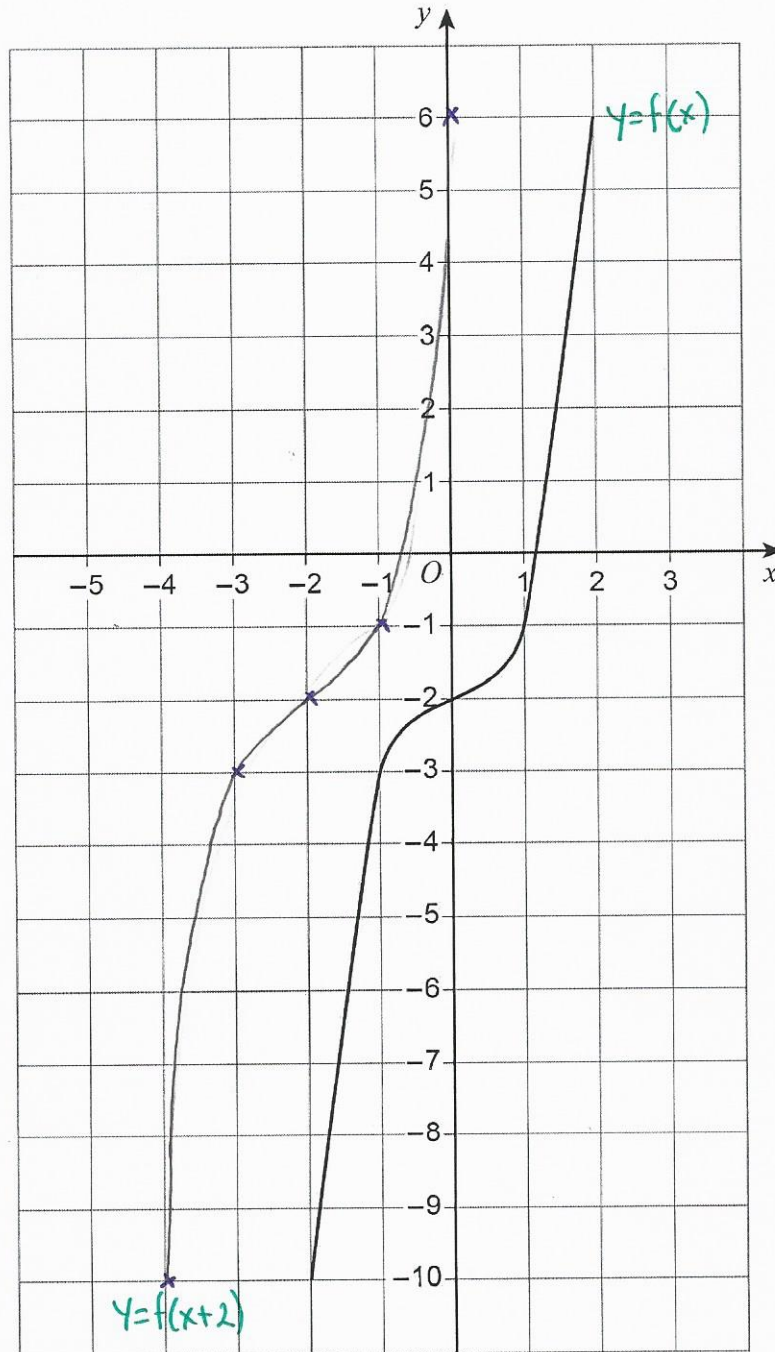
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24

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 $y = f(x + 2)$

↑

Moves every point 2 to the left

Translation of $\begin{bmatrix} -2 \\ 0 \end{bmatrix}$

[2 marks]

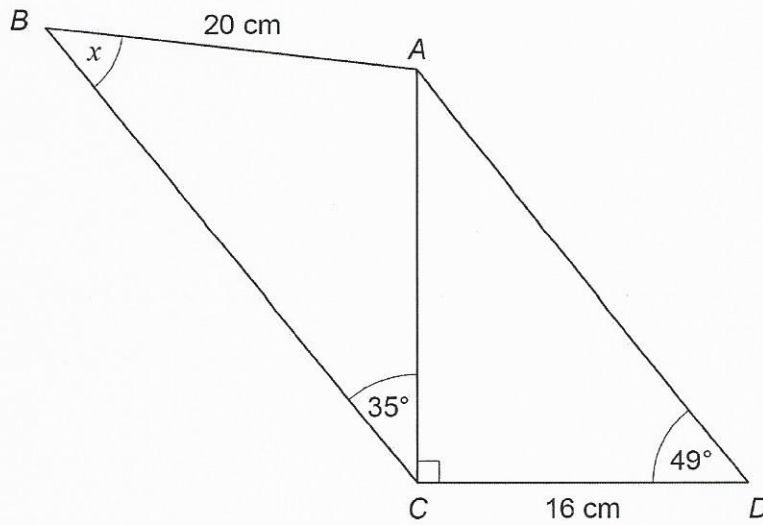
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Turn over ►



25

ABC and ACD are triangles.



Not drawn accurately

Work out the size of angle x .

[5 marks]

$$\tan 49 = \frac{AC}{16}$$

$$AC = 16 \times \tan 49$$

$$= 18.41$$

$$\frac{\sin x}{18.41} = \frac{\sin 35}{20}$$

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

$$= 0.528$$

$$\therefore x = \sin^{-1}(0.528) = 31.9^\circ$$

Answer _____ degrees



Do not write outside the box

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]

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

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

Answer _____

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

Show that the point $(\frac{1}{2}, \frac{1}{2})$ lies on the curve.

[3 marks]

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

Substitute in $(\frac{1}{2}, \frac{1}{2})$

$$\therefore k = \sqrt[3]{1/64}$$

$$\frac{1}{2} = (\frac{1}{4})^{1/2}$$

$$= \frac{1}{4}$$

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

\therefore It is on the curve

$$y = \frac{1}{4}x$$

Turn over ►



Do not write outside the box

28

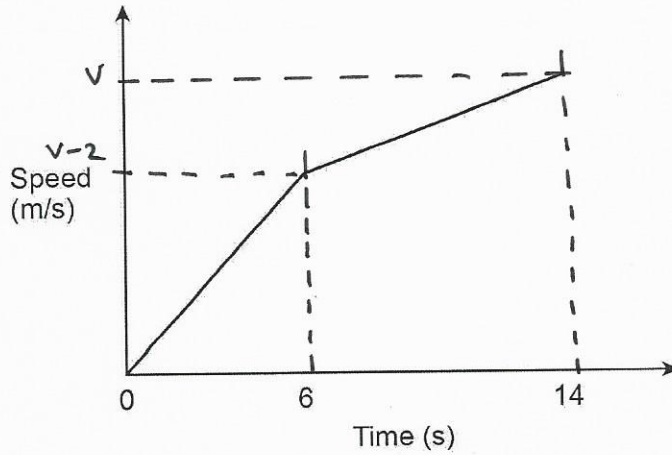
Izzy runs an 80-metre race in 14 seconds.

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. *← Given by gradient*

State the units of your answer.

[2 marks]

$$\frac{\Delta y}{\Delta x} = \frac{2}{8} = 0.25 \text{ ms}^{-2}$$

Answer _____



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

Work out the value of v .

[4 marks]

Distance = Area under curve

$$80 = \left[\frac{1}{2} \times 6 \times (v-2) \right] + \left[\frac{1}{2} (v+v-2) \times 8 \right]$$

$$80 = [3v - 6] + [8v - 8]$$

$$80 = 11v - 14$$

$$+14 \qquad \qquad +14$$

$$94 = 11v$$

$$\div 11 \quad \div 11$$

$$8.5 = v$$

Answer $v = 8.5 \text{ ms}^{-1}$

END OF QUESTIONS

