

Write your name here

Surname

Other Names

# Mathematics

## June 2024 Practice Paper 2 (Calculator) Higher Tier

Time: 1 hour 30 minutes

**You must have:** Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator. Tracing paper may be used.

Total Marks

### Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – there may be more space than you need.
- **Calculators may be used.**
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- You must **show all your working.**



### Information

- The total mark for this paper is 80
- The marks for **each** question are shown in brackets – use this as a guide as to how much time to spend on each question.

### Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

## Higher Tier Formulae Sheet

### Perimeter, area and volume

Where  $a$  and  $b$  are the lengths of the parallel sides and  $h$  is their perpendicular separation:

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

Volume of a prism = area of cross section  $\times$  length

Where  $r$  is the radius and  $d$  is the diameter:

$$\text{Circumference of a circle} = 2\pi r = \pi d$$

$$\text{Area of a circle} = \pi r^2$$

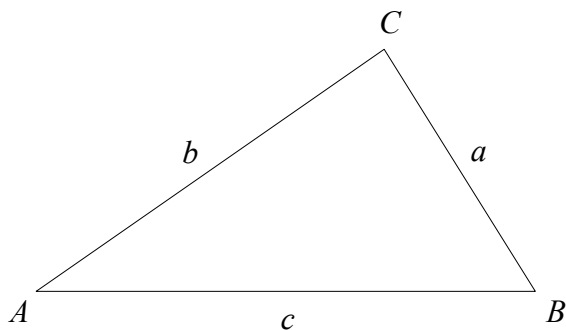
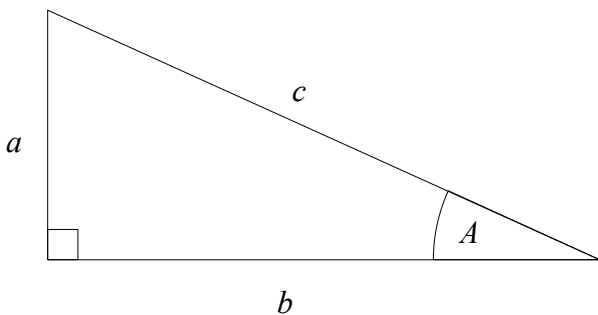
### Quadratic formula

The solution of  $ax^2 + bx + c = 0$

where  $a \neq 0$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

### Pythagoras' Theorem and Trigonometry



In any right-angled triangle where  $a$ ,  $b$  and  $c$  are the length of the sides and  $c$  is the hypotenuse:

$$a^2 + b^2 = c^2$$

In any right-angled triangle  $ABC$  where  $a$ ,  $b$  and  $c$  are the length of the sides and  $c$  is the hypotenuse:

$$\sin A = \frac{a}{c} \quad \cos A = \frac{b}{c} \quad \tan A = \frac{a}{b}$$

In any triangle  $ABC$  where  $a$ ,  $b$  and  $c$  are the length of the sides:

$$\text{sine rule: } \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$\text{cosine rule: } a^2 = b^2 + c^2 - 2bc \cos A$$

$$\text{Area of triangle} = \frac{1}{2}ab \sin C$$

### Compound Interest

Where  $P$  is the principal amount,  $r$  is the interest rate over a given period and  $n$  is number of times that the interest is compounded:

$$\text{Total accrued} = P \left( 1 + \frac{r}{100} \right)^n$$

### Probability

Where  $P(A)$  is the probability of outcome  $A$  and  $P(B)$  is the probability of outcome  $B$ :

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$P(A \text{ and } B) = P(A \text{ given } B) P(B)$$

**END OF EXAM AID**

**1** The height of a building is 310 metres, correct to the nearest metre.

Complete the error interval for the height of the building.

..... m  $\leq$  length  $<$  ..... m

**(Total for Question 1 is 2 marks)**

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**2** Work out  $(3.12 \times 10^{-6}) \div (2.5 \times 10^{-4})$

Give your answer in standard form.

.....  
**(Total for Question 2 is 2 marks)**

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3 Three buses, bus A, bus B and bus C, all use the same bus stop.

Bus A runs every 10 minutes.

Bus B runs every 12 minutes.

Bus C runs every 14 minutes.

All three buses are at the bus stop at 11 am.

What time will all three buses next be at the bus stop.

.....  
**(Total for Question 3 is 3 marks)**

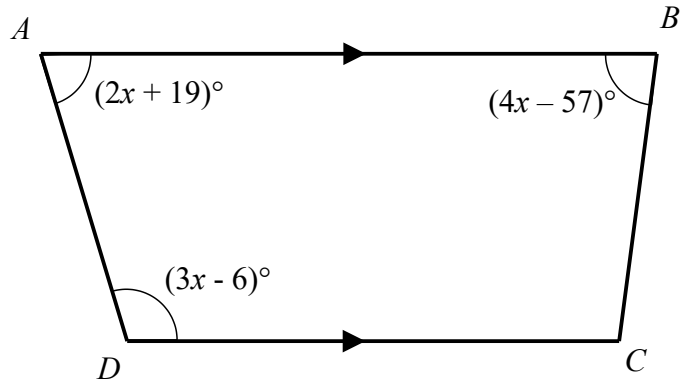
4 The table gives information about the times taken, in seconds, by 20 students to run a race.

<b>Time (<math>t</math> seconds)</b>	<b>Frequency</b>
$20 < t \leq 25$	2
$25 < t \leq 30$	10
$30 < t \leq 35$	5
$35 < t \leq 45$	3

Work out an estimate for the mean time.

..... seconds  
**(Total for Question 4 is 3 marks)**

5  $ABCD$  is a trapezium.



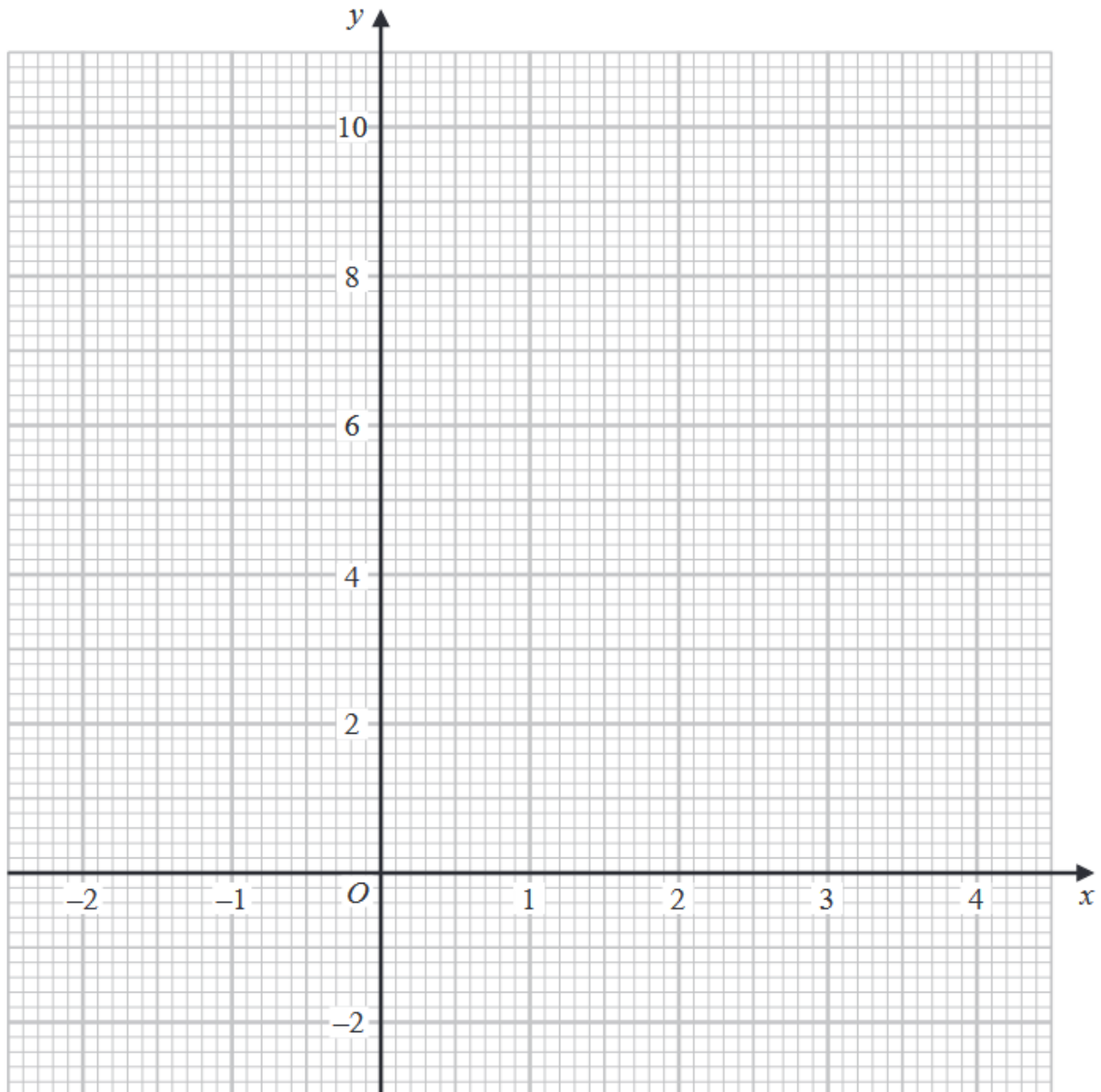
$AB$  is parallel to  $DC$   
Find the size of angle  $BCD$ .

.....  
(Total for Question 5 is 4 marks)

6 (a) Complete the table of values for  $y = 7 + 2x - x^2$

$x$	-2	-1	0	1	2	3	4
$y$							

(b) On the grid, draw the graph of  $y = 7 + 2x - x^2$  for values of  $x$  from  $-2$  to  $4$  (2)



(c) Use your graph to find estimates of the solutions of the equation  $7 + 2x - x^2 = 0$

.....  
(2)

(Total for Question 6 is 6 marks)

7 Josh drove 39 miles from Luton to Cambridge.  
He then drove 63 miles from Cambridge to Norwich.

Josh's average speed from Luton to Cambridge was 32 miles per hour  
Josh took 80 minutes to drive from Cambridge to Norwich.

Work out Josh's average speed for his total drive from Luton to Norwich.

..... miles per hour

**(Total for Question 7 is 4 marks)**

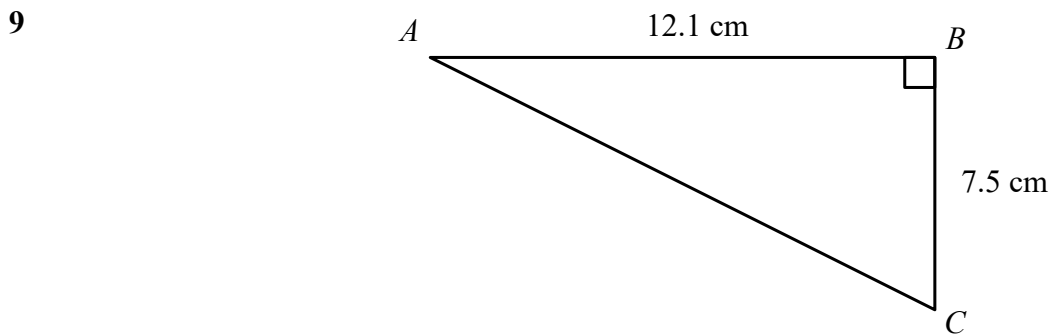
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- 8 Milly invests £2000 in a savings account for 4 years.  
She gets 3.9% per year compound interest.

Work out how much money Milly will have in her savings account at the end of 4 years.  
Give your answer correct to the nearest pound.

£ .....

(Total for Question 8 is 3 marks)



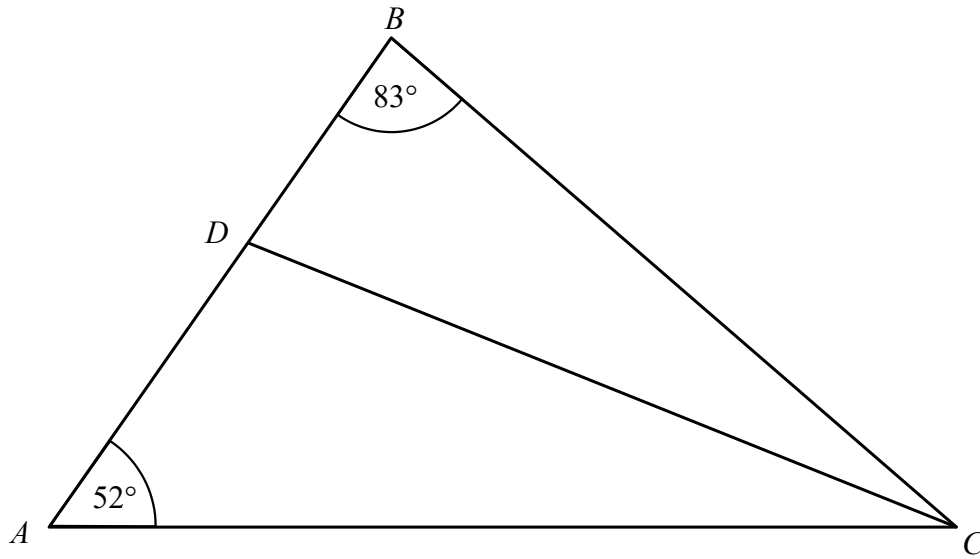
Work out the size of angle  $BAC$ .  
Give your answer correct to 3 significant figures.

.....  
o

(Total for Question 9 is 2 marks)



10 The diagram shows triangle  $ABC$ .



$ADB$  is a straight line.

the size of angle  $BCD$  : the size of angle  $ACD = 2 : 3$

Work out the size of angle  $ADC$ .

.....  
(Total for Question 10 is 4 marks)

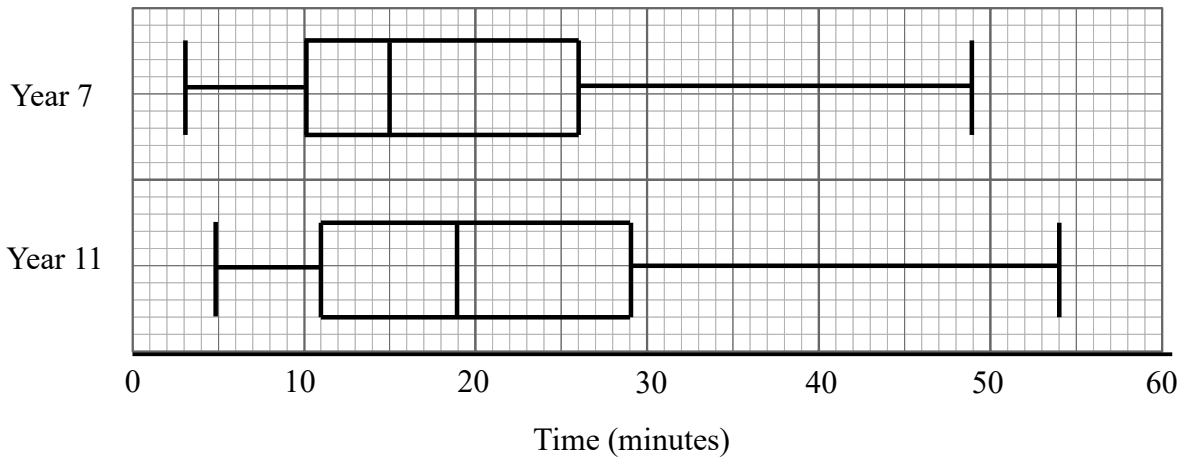
**11** A company has 9 employees available to complete a job.  
It is known that 7 employees can complete the job in 12 days.

Davina says that the 9 employees will be able to complete the job in less than 10 days.

Is Davina correct?  
You must show all your working.

**(Total for Question 11 is 3 marks)**

**12** The box plots show the time it took year 7 and year 11 students to travel to school on one day.



Compare the distribution of the times it took the year 7 and year 11 students to travel to school.

.....

.....

.....

.....

**(Total for Question 12 is 2 marks)**

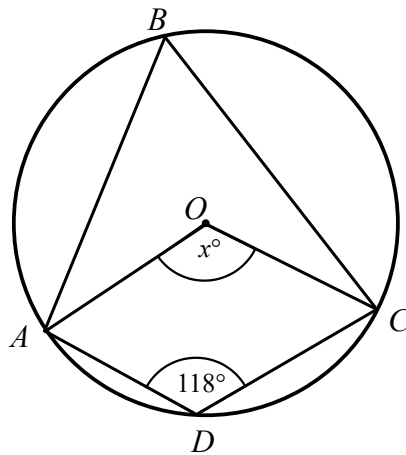
13 In a restaurant there are 7 starters, 9 main courses and 6 desserts on the menu.

Work out the total number of ways of choosing a starter, a main course and a dessert.

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(Total for Question 13 is 2 marks)

14



$A$ ,  $B$ ,  $C$  and  $D$  are points on the circumference of a circle, centre  $O$ .

Angle  $ADC = 118^\circ$

Angle  $AOC = x^\circ$

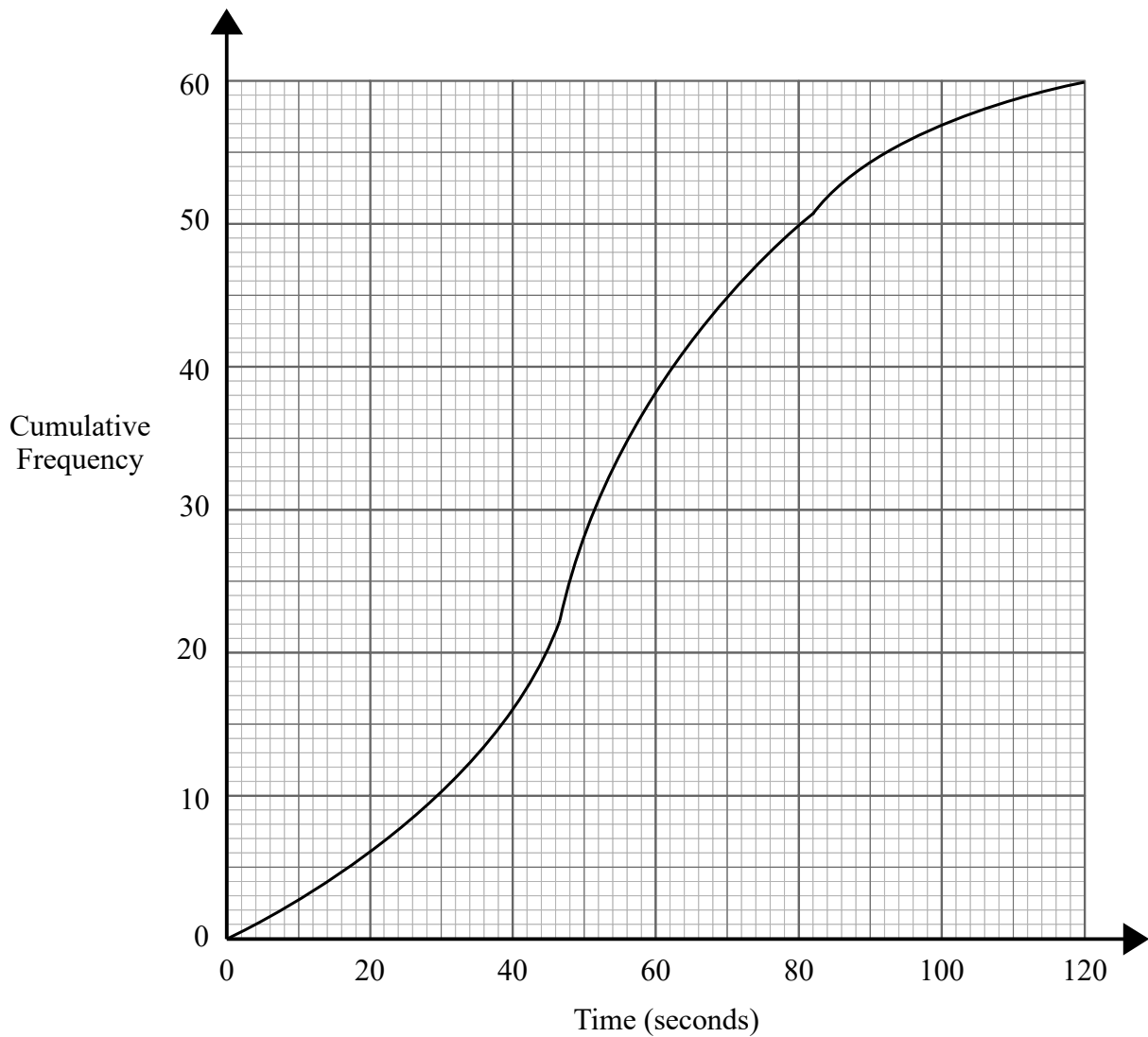
Work out the value of  $x$ .

You must show all your working.

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(Total for Question 14 is 3 marks)

- 15 The cumulative frequency graph gives information about the time, in seconds, each of 60 people took to complete a puzzle.



Use the graph to complete the frequency table to give information about the time,  $t$  seconds, each of the 60 people took to complete the puzzle.

Time taken	Frequency
$0 < t \leq 20$	
$20 < t \leq 40$	
$40 < t \leq 60$	
$60 < t \leq 80$	
$80 < t \leq 100$	
$100 < t \leq 120$	

(Total for Question 15 is 2 marks)

16 Here are 9 cards.  
Each card has a number on it.



Emma takes two cards at random.  
Work out the probability that the sum of the two cards is an odd number.

.....  
**(Total for Question 16 is 3 marks)**

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17 (a) Using  $x_{n+1} = \sqrt{6x_n - 1}$

with  $x_0 = 5$

(a) Find the values of  $x_1$ ,  $x_2$  and  $x_3$

$x_1 =$  .....

$x_2 =$  .....

$x_3 =$  .....

(3)

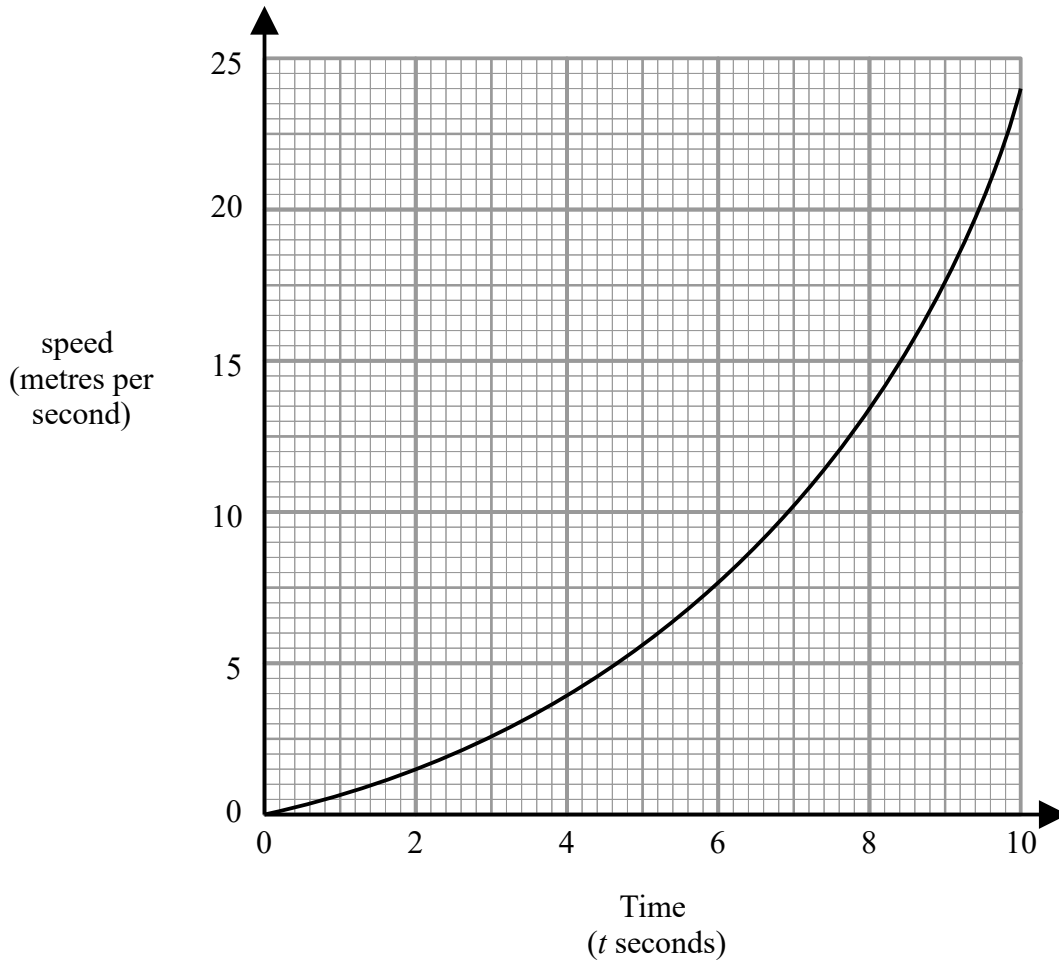
(b) Explain the relationship between the values of  $x_1$ ,  $x_2$  and  $x_3$  and the equation  $x^2 - 6x + 1 = 0$

.....  
.....  
.....  
.....

(2)

**(Total for Question 17 is 5 marks)**

18 The graph below shows the speed of a car, in metres per second,  $t$  seconds after it starts moving.



- (a) Calculate an estimate for the gradient of the graph when  $t = 7$   
You must show how you get your answer.

.....  
(3)

- (b) Describe what the gradient in part (a) represents.

.....  
.....  
(1)

(Total for Question 18 is 4 marks)

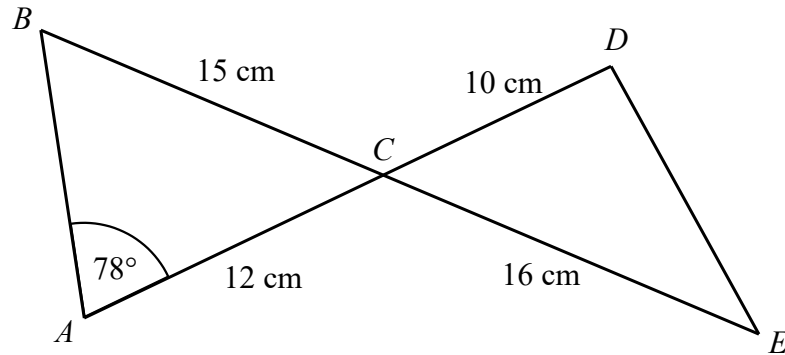
**19** Show that  $\frac{2x}{x-3} - \frac{3x-1}{x+3} + 1$  can be written in the form  $\frac{ax+b}{x^2-9}$   
where  $a$  and  $b$  are integers.

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**(Total for Question 19 is 4 marks)**



- 20 Here is a shape formed from two triangles  $ABC$  and  $CDE$   
 $ACD$  and  $BCE$  are straight lines.



$AC = 12$  cm    $BC = 15$  cm    $CE = 16$  cm    $CD = 10$  cm  
Angle  $BAC = 78^\circ$

Work out the length of  $DE$   
Give your answer correct to 3 significant figures.

..... cm

(Total for Question 20 is 5 marks)

**21** Solve algebraically the simultaneous equations

$$x^2 + 2y^2 = 10$$

$$3x - 2y = 8$$

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**(Total for Question 21 is 5 marks)**

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**22** A solid cube has a length of 4.8 cm, correct to 1 decimal place.  
The cube has a mass of 220 grams, correct to 2 significant figures.

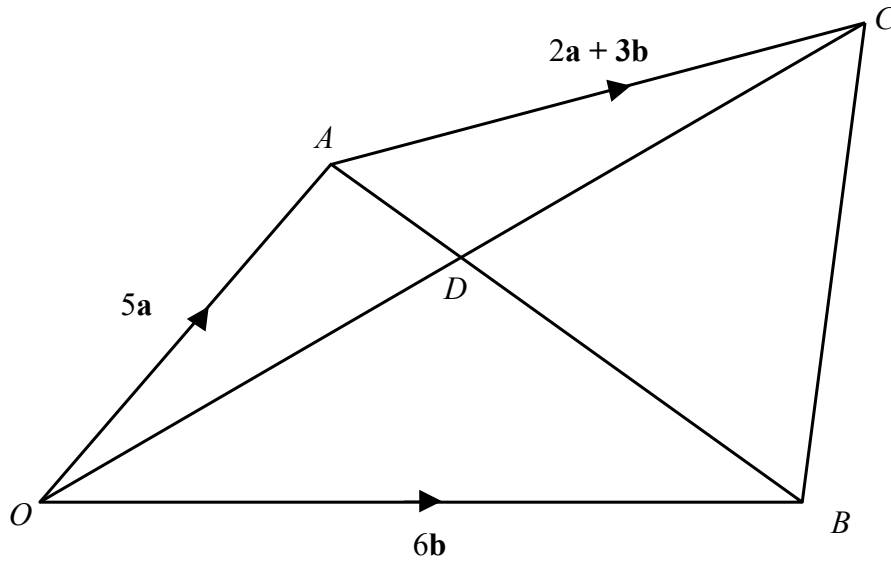
Work out the upper bound for the density of the cube.  
Give your answer in  $\text{g/cm}^3$  correct to 2 decimal places.

.....  $\text{g/cm}^3$

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**(Total for Question 22 is 4 marks)**

23 The diagram shows quadrilateral  $OABC$ .



$ADB$  and  $ODC$  are straight lines.

$$\vec{OA} = 5\mathbf{a} \quad \vec{OB} = 6\mathbf{b} \quad \vec{AC} = 2\mathbf{a} + 3\mathbf{b}$$

Using a vector method, find the ratio  $AD : DB$

.....  
(Total for Question 23 is 5 marks)

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**TOTAL FOR PAPER IS 80 MARKS**