

Answer ALL the questions.

Write your answers in the spaces provided.

You must show all of your working.

- 1 The mass of a snowflake is 2.5 mg.
1 000 000 mg = 1 kg.

Convert the mass of the snowflake into kg.
Give your answer in standard form.

$$2.5 \div 1\,000\,000 \quad \textcircled{1}$$

$$0.0000025$$

$$2.5 \times 10^{-6} \quad \textcircled{1} \quad \text{kg}$$

[Total 2 marks]

- 2 (a) Simplify $\frac{12xy}{2xy^4}$

$$\frac{6x}{y^3}$$

$$6xy^{-4} \quad \textcircled{1} \quad \textcircled{1}$$

[2]

- (b) Solve $3(x-5) = 5x + 11$

$$3x - 15 = 5x + 11 \quad \textcircled{1}$$

$$\begin{array}{r} -3x \quad \quad -3x \\ -15 = 2x + 11 \end{array}$$

$$\begin{array}{r} -15 = 2x + 11 \\ -11 \quad \quad -11 \\ -26 = 2x + 2 \end{array}$$

$$\textcircled{1} \quad x = -13$$

[2]

$$\begin{array}{r} -26 = 2x + 2 \\ \div 2 \end{array}$$

[Total 4 marks]

Leave blank

- 3 Alison, Boris and Che shared a lottery win in the ratio 7 : 3 : 2.
If Boris' share was £11 367, how much more did Alison get than Che?

A □□□□□□□
B □□□□ = 11,367
C □□

$$11367 \div 3 = 3789$$

$$\text{Alison} = 7 \times 3789 = 26523 \quad \textcircled{1}$$

$$\text{Che} = 2 \times 3789 = 7578 \quad \textcircled{1}$$

$$\text{£ } 18\,945 \quad \textcircled{1}$$

[Total 3 marks]

- 4 (a) Solve $2 - 4x \leq 12$

$$+4x \quad +4x$$

$$2 \leq 12 + 4x$$

$$\begin{array}{r} -12 \quad -12 \end{array}$$

$$-10 \leq 4x \quad \textcircled{1}$$

$$\begin{array}{r} \div 4 \quad \quad \div 4 \end{array}$$

$$-2.5 \leq x$$

$$-2.5 \leq x \quad \textcircled{1}$$

[2]

- (b) n is an integer.

What is the smallest value of n that satisfies $2 - 4n \leq 12$?

$$n = -2 \quad \textcircled{1}$$

[1]

[Total 3 marks]

Leave blank

- 5 (a) Hamed and Javez are waiting together at a bus station. Hamed's bus leaves every 18 minutes and Javez's bus leaves every 15 minutes. The buses left the station at the same time at 2:00 pm. When will the buses next leave the station at the same time?

$$18 \rightarrow 18, 36, 54, 72, 90$$

$$15 \rightarrow 15, 30, 45, 60, 75, 90$$

90 minutes ①

1 hr 30 minutes

3:30pm [2]

- (b) Explain an assumption you made in part (a).

① The buses run exactly on time
 ② There are no delays [1]

[Total 3 marks]

- 6 Express $0.4\bar{1}$ as a fraction in its simplest form.

$$x = 0.411111$$

$$10x = 4.1111 \quad \text{①}$$

$$100x = 41.111$$

$$100x - 10x = 41.111 - 4.111$$

$$90x = 37$$

$$x = \frac{37}{90} \quad \text{①}$$

[Total 2 marks]

Leave blank

- 7 Declan keeps chickens and weighs all the eggs they lay. The table shows the weights of eggs he collected last month.

| Mass (m) in grams | Frequency | Mid points | Mid \times freq. |
|-----------------------|-----------|------------|--------------------|
| $40 \leq m < 50$ | 27 | 45 | 27×45 |
| $50 \leq m < 60$ | 30 | 55 | 30×55 |
| $60 \leq m < 70$ | 16 | 65 | 16×65 |
| $70 \leq m < 80$ | 7 | 75 | 7×75 |
| Totals | 80 | | 4430 |

- (a) Calculate an estimate of the mean mass of Declan's eggs.

$$4430 \div 80 \quad \text{①}$$

$$55.375 \text{ g} \quad \text{①}$$

[3]

- (b) Eggs are classified as small if they weigh 53 g or less.

Estimate the percentage of his eggs that would be classified as small. Clearly describe any assumptions you make.

27 eggs definitely weigh less than 53g

Assuming even distribution

$$\frac{53 - 50}{60 - 50} = \frac{3}{10} \text{ of eggs in } 50 \leq m < 60 \text{ are } < 53\text{g} \quad \text{①}$$

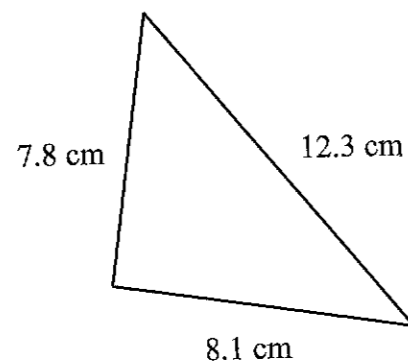
$$27 + \left(\frac{3}{10} \times 30\right) = 27 + 9 = 36 \quad \text{①}$$

$$\frac{36}{80} \times 100 = 45\% \text{ are less than } 53\text{g} \quad \text{①}$$

[Total 6 marks]

Leave blank

- 8 Decide whether the triangle shown below is right-angled, making your reasoning clear.



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

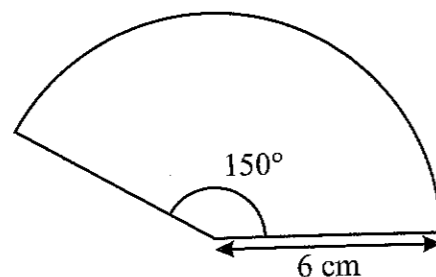
$$7.8^2 + 8.1^2 = 126.45 \quad (1) \quad 126.45 \neq 151.29$$

$$12.3^2 = 151.29 \quad (1) \quad \text{So not a right-angled } \Delta$$

[Total 3 marks]

Leave blank

- 9 Find the arc length of the sector shown below. Give your answer in terms of π .



$$\pi \cdot D \times \frac{150}{360} \quad (1)$$

$$D = 6 \times 2$$

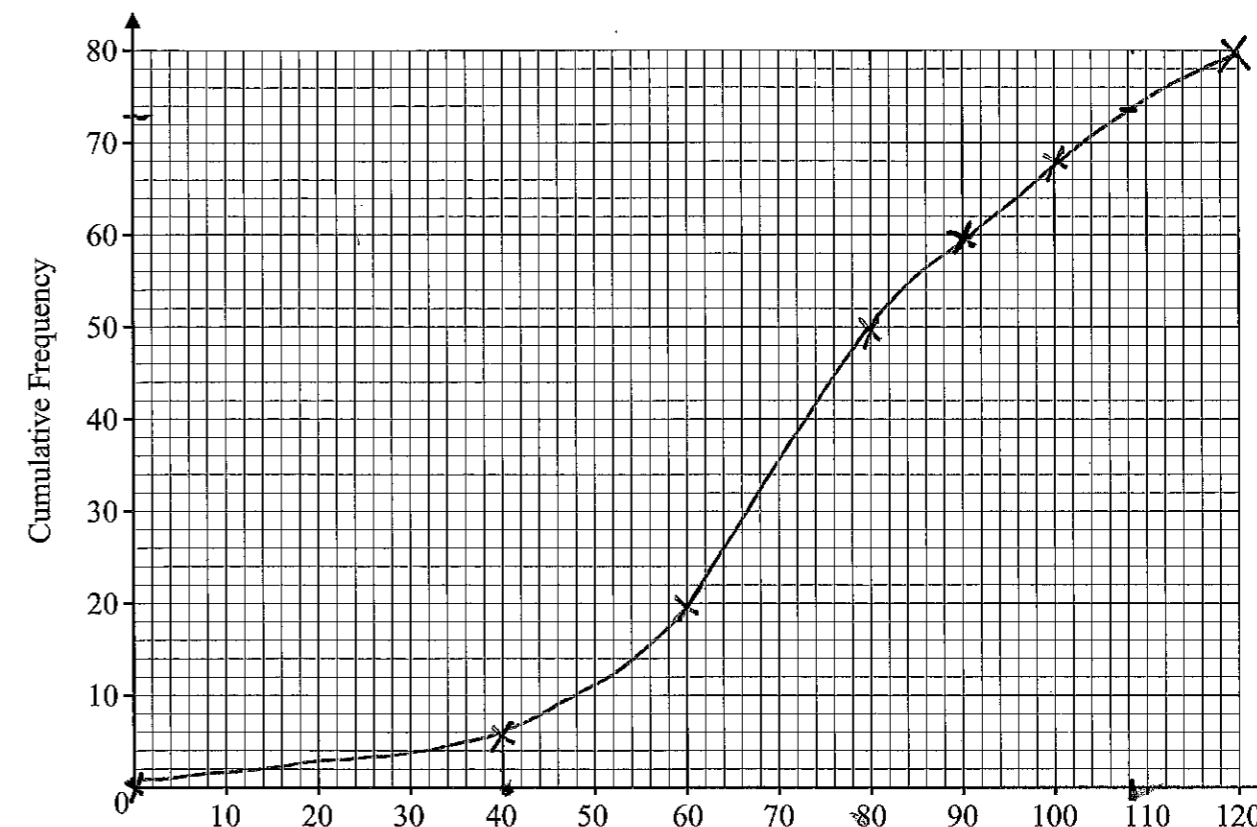
$$\Rightarrow \pi \times 12 \times \frac{5}{360} = 5\pi \quad (1)$$

[Total 2 marks]

- 10 The table shows the distribution of marks in a School Maths challenge.

| Mark (m) | $m \leq 40$ | $m \leq 60$ | $m \leq 80$ | $m \leq 100$ | $m \leq 120$ |
|----------------------|-------------|-------------|-------------|--------------|--------------|
| Cumulative Frequency | 6 | 20 | 50 | 68 | 80 |

- (a) Draw a cumulative frequency graph to show these results.



(1) \Rightarrow points (1) joining up [2]

- (b) Students with 90 or more marks are awarded either a platinum or a gold certificate. Platinum and gold certificates are awarded in the ratio 1:1.5. Students with the highest marks are awarded a platinum certificate.

Estimate the minimum mark needed to be awarded a platinum certificate. Show how you get your answer.

20 students platinum or gold (1)

$$1 + 1.5 = 2.5$$

$$20 \div 2.5 = 8$$

73rd person \Rightarrow 108 mark (1)

$$\text{Gold} \Rightarrow 1.5 \times 8 = 12$$

$$\text{Platinum} \Rightarrow 1 \times 8 = 8 \quad (1)$$

[Total 5 marks]

Leave blank

- 11 Prove that the sum of the squares of any two consecutive odd numbers is 2 more than a multiple of 8.

$$\text{odd number} = 2n+1$$

$$2n+1 \quad \textcircled{1}$$

$$2n+3 \quad \textcircled{1}$$

$$(2n+1)^2 + (2n+3)^2$$

$$4n^2 + 4n + 1 + 4n^2 + 12n + 9 \quad \textcircled{1}$$

$$8n^2 + 16n + 10 \quad \textcircled{1}$$

$$8(n^2 + 2n + 1) + 2 \quad \textcircled{1}$$

[Total 4 marks]

Leave blank

- 12 Tanya and Stuart are taking part in a charity bike race. They have 9 hours to complete the 190 km course. They rode 141 km in the first $6\frac{3}{4}$ hours.

Do you think they will finish the course within the target time? Explain your answer.

$$141 \text{ in } 6.75 \text{ hrs}$$

$$\text{speed} = \frac{141}{6.75} = 20.88 \text{ km/h}$$

$$39 \text{ km in } 2.25 \text{ hrs} \quad \textcircled{1}$$

$$\text{speed} = \frac{39}{2.25} = 21.11 \text{ km/h}$$

current speed no, but if they speed up slightly yes or get faster Total 2 marks $\textcircled{1}$

- 13 Show that $\frac{4}{3+\sqrt{5}} + \sqrt{5} = 3$

$$\times (3+\sqrt{5})$$

$$\frac{4 + \sqrt{5}(3+\sqrt{5})}{3+\sqrt{5}} \quad \textcircled{1}$$

$$4 + 3\sqrt{5} + 5$$

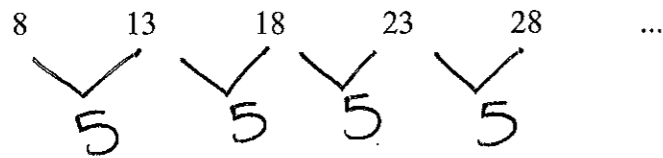
$$\frac{3\sqrt{5} + 9}{3+\sqrt{5}} = \frac{3(\sqrt{5} + 3)}{3+\sqrt{5}} \quad \textcircled{1}$$

$$= 3 \quad \textcircled{1}$$

[Total 3 marks]

Leave blank

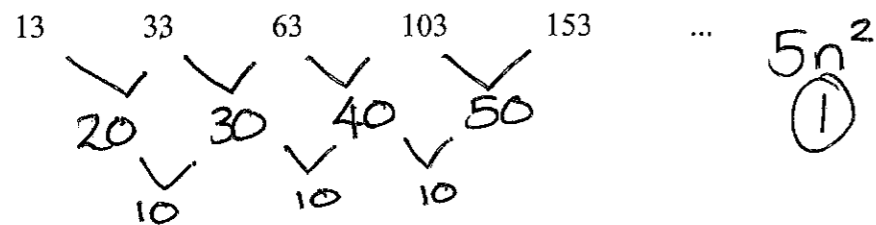
14 (a) Write an expression for the n^{th} term of the following sequence.



$5n + 3$

[2]

(b) Use your answer from part (a) to write an expression for the n^{th} term of the following sequence.



$5n^2$

5, 20, 45, 80

8, 13, 18, 23, ...
 $\Rightarrow 5n + 3$

$5n^2 + 5n + 3$

[3]

(c) Are all the numbers of the second sequence also in the first sequence? Explain your answer.

$5(n^2 + n) + 3$

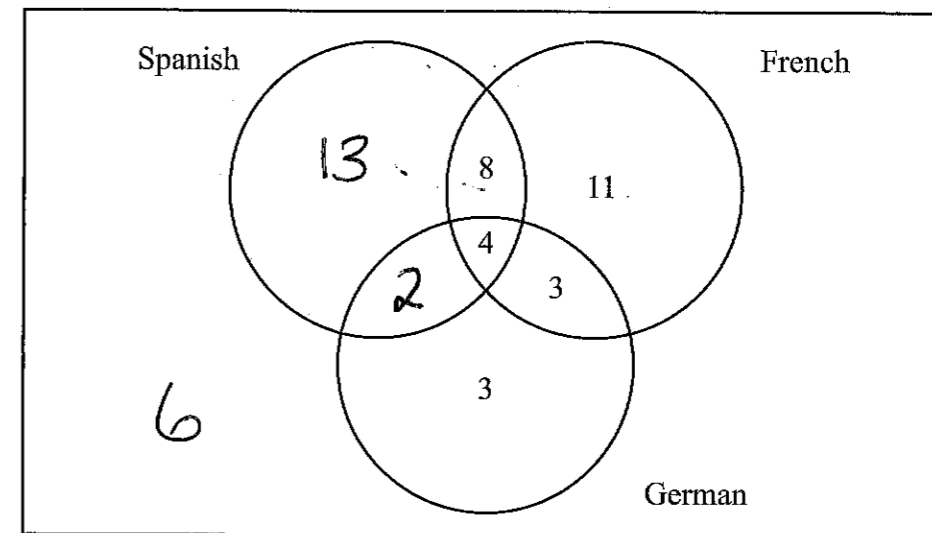
so yes as multiple of 5 add add 3

[1]

[Total 6 marks]

Leave blank

15 The incomplete Venn diagram shows how many Year 11 students study Spanish, French and German. There are 50 Year 11 students in total.



Leave blank

(a) 27 students study Spanish. 6 students study Spanish and German. Use this information to complete the Venn diagram.

$6 - 4 = 2$ $8 + 4 + 2 + x = 27$
 $x = 27 - 14 = 13$

one or two correct answers [2]

(b) If a student is chosen at random, what is the probability that they study exactly one language?

$13 + 11 + 3 = 27$ one language

$\frac{27}{50}$ (or 0.54)

[2]

(c) If a student studying French is chosen at random, what is the probability that they study exactly one other language?

French students = $8 + 11 + 4 + 3 = 26$

$8 + 3 = 11$

$\frac{11}{26}$

[2]

[Total 6 marks]

- 16 y is inversely proportional to the square root of x .
When $y = 12$, $x = 0.09$

Find the value of x when $y = 9$

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

$$y = \frac{k}{\sqrt{x}} \quad 12 = \frac{k}{\sqrt{0.09}} \quad 12 = \frac{k}{0.3}$$

$$k = 12 \times 0.3 = 3.6$$

$$y = \frac{3.6}{\sqrt{x}} \quad y = 9 \quad 9 = \frac{3.6}{\sqrt{x}}$$

$$\sqrt{x} = \frac{3.6}{9} = 0.4$$

$$x = 0.4^2 = 0.16$$

[Total 3 marks]

Leave blank

- 17 The volumes of two spheres are in the ratio 1 : 8.
The surface area of the larger sphere is 28 cm^2 .

What is the radius, r , of the smaller sphere?
Give your answer to 2 decimal places.

$$\text{Surface area of a sphere} = 4\pi r^2$$

Volume 1:8
 \therefore sides in ratio 1:2

$$4\pi r^2 = 28$$

$$r^2 = \frac{28}{4\pi}$$

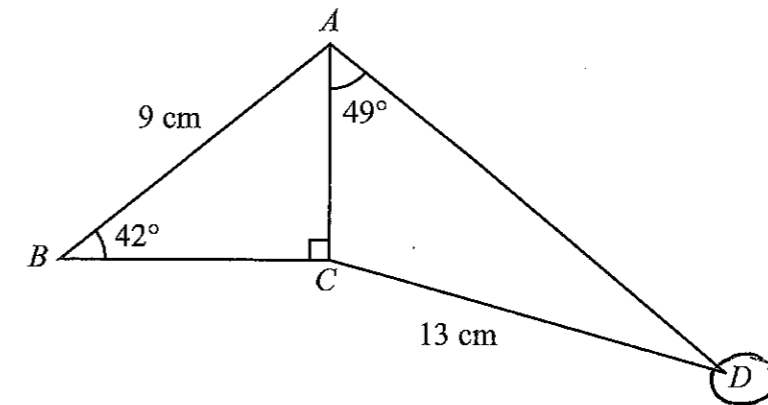
$$r = \sqrt{\frac{28}{4\pi}} = 1.4927 \text{ cm}$$

small $r = 1.4927 \dots \div 2$
 $0.7463 \dots$

$$r = 0.75 \text{ cm}$$

[Total 4 marks]

- 18 The diagram below shows two triangles, ACB and ACD .



Find the size of angle ADC .

$$\sin 42 = \frac{AC}{9}$$

$$AC = \sin 42 \times 9$$

$$= 6.0221 \text{ cm}$$

$$\frac{\sin ADC}{6.0221} = \frac{\sin 49}{13}$$

$$\sin ADC = \frac{6.0221 \times \sin 49}{13} = 0.3496$$

$$ADC = \sin^{-1}(0.3496)$$

$$= 20.4637$$

angle $ADC = 20.5^\circ$

[Total 4 marks]

Leave blank

19 The functions f and g are defined as follows.

$$f(x) = 2x + 3$$

$$g(x) = f^{-1}(x)$$

(a) Solve the equation $f(x)^2 = 5$. Give your answers to 3 significant figures.

$$\begin{aligned} (2x+3)^2 &= 5 \\ 4x^2 + 12x + 9 &= 5 \\ 4x^2 + 12x + 4 &= 0 \quad (1) \quad a=4 \quad b=12 \quad c=4 \\ x &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \Rightarrow \frac{-12 \pm \sqrt{12^2 - 4 \times 4 \times 4}}{2 \times 4} \quad (1) \\ &= \frac{-12 \pm \sqrt{80}}{8} \quad x = \frac{-12 + \sqrt{80}}{8} \quad x = \frac{-12 - \sqrt{80}}{8} \\ x &= \dots 2.62 \quad (1) \quad -0.38 \end{aligned}$$

(b) Work out the value of $gg(x)$ when $f(x) = 27$

$$\begin{aligned} 2x + 3 &= 27 \\ -3 & \quad -3 \\ 2x &= 24 \\ \div 2 & \quad \div 2 \\ x &= 12 \quad (1) \end{aligned}$$

$$\begin{aligned} f^{-1}(x) \quad x &= 2y + 3 \\ y &= \frac{x-3}{2} = g(x) \quad (1) \end{aligned}$$

$$g(12) = \frac{12-3}{2} = 4.5$$

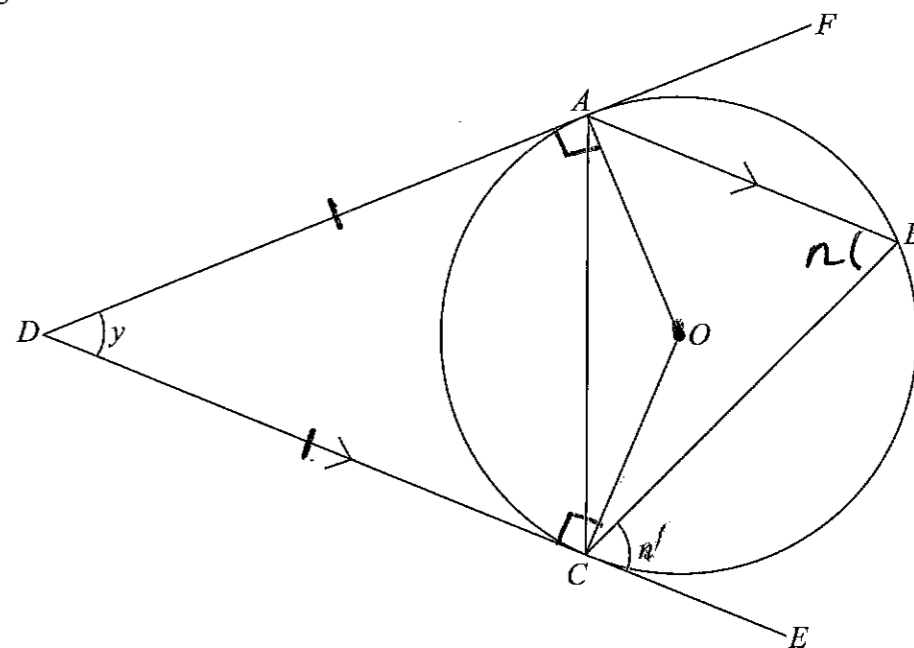
$$g(4.5) = \frac{4.5-3}{2} = 0.75 \quad (1)$$

[3]

[Total 6 marks]

Leave blank

20 The points A, B and C lie on a circle. Point O lies at the centre of the circle. Lines DF and DE are tangents to the circle at points A and C respectively. Lines AB and DE are parallel. Angle $BCE = n$



Show that $y = 180^\circ - 2n$. You must give a reason for each stage of your working.

$ABC = n$ as alternate angle with BCE (1)
 angle $AOC = 2n$ as angle in centre is twice angle at circumference in the same segment (1)

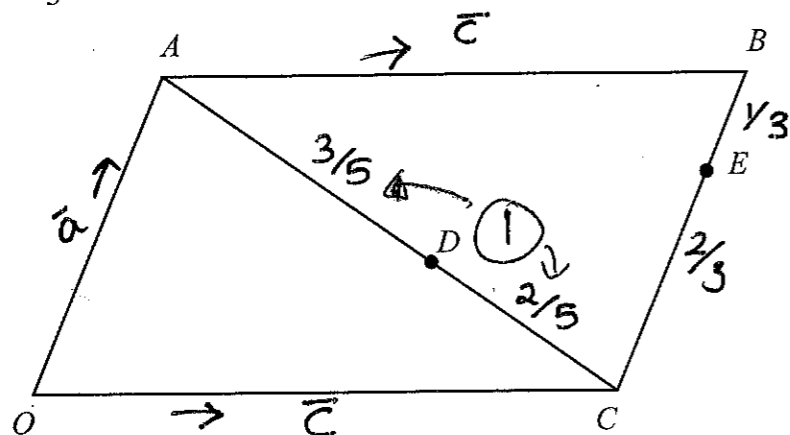
$DAO = DCO = 90^\circ$ as tangent & radius meet = 90° (1)

$$\begin{aligned} \therefore y &= 360 - 90 - 2n - 90 \\ &= 180 - 2n \quad (1) \end{aligned}$$

[Total 4 marks]

Leave blank

- 21 The diagram shows the parallelogram $OABC$.
The point D lies on AC , such that $AD:DC = 3:2$.
The point E lies $\frac{2}{3}$ of the way along line CB .



$\vec{OA} = \mathbf{a}$ and $\vec{OC} = \mathbf{c}$
Show that ODE is a straight line.

$AC = \vec{c} - \vec{a}$

$\vec{AD} = \frac{3}{5}(\vec{c} - \vec{a})$
 $= \frac{3}{5}\vec{c} - \frac{3}{5}\vec{a}$

straight line

$\vec{OE} = k \times \vec{OD}$

$\vec{OD} = \mathbf{a} + \frac{3}{5}\vec{c} - \frac{3}{5}\vec{a}$
 $= \frac{3}{5}\vec{c} + \frac{2}{5}\vec{a}$

$\vec{c} + \frac{2}{3}\vec{a} = k(\frac{3}{5}\vec{c} + \frac{2}{5}\vec{a})$

$1c = \frac{3k}{5}$

$\therefore k = \frac{5}{3}$

$\vec{OC} = \vec{c}$

$\vec{CE} = \frac{2}{3}\vec{a}$

$\frac{5}{3} \times \frac{3}{5}\vec{c} + \frac{5}{3} \times \frac{2}{5}\vec{a}$

$\vec{OE} = \vec{c} + \frac{2}{3}\vec{a}$

$\vec{c} + \frac{2}{3}\vec{a} = \vec{OE}$

$\therefore ODE$ is a straight line

[Total 5 marks]

[TOTAL FOR PAPER = 80 MARKS]

Leave blank

General Certificate of Secondary Education

GCSE
Mathematics (Grade 9-1)
Higher Tier

| | | | | |
|------------------|--|--|--|--|
| Centre name | | | | |
| Centre number | | | | |
| Candidate number | | | | |

Practice Set 1
Paper 2: Calculator

Time allowed: 1 hour 30 minutes

| |
|---------------------|
| Surname |
| Other names |
| Candidate signature |

In addition to this paper you should have:

- A pen, pencil and eraser.
- A ruler.
- A protractor.
- A pair of compasses.
- A calculator.



Instructions to candidates

- Write your name and other details in the spaces provided above.
- Answer all questions in the spaces provided.
- In calculations show clearly how you worked out your answers.
- Diagrams are **not** drawn accurately unless otherwise indicated.
- Calculators may be used — if your calculator doesn't have a π button, take the value of π to be 3.142

Information for candidates

- There are 80 marks available for this paper.
- The marks available are given in brackets at the end of each question.
- You may get marks for method, even if your answer is incorrect.

Advice to candidates

- Work steadily through the paper.
- Don't spend too long on one question.
- If you have time at the end, go back and check your answers.

| For examiner's use | | | |
|--------------------|------|----|------|
| Q | Mark | Q | Mark |
| 1 | | 12 | |
| 2 | | 13 | |
| 3 | | 14 | |
| 4 | | 15 | |
| 5 | | 16 | |
| 6 | | 17 | |
| 7 | | 18 | |
| 8 | | 19 | |
| 9 | | 20 | |
| 10 | | 21 | |
| 11 | | | |
| Total | | | |