Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9 - 1)

Centre Number	Candidate Number

Mathematics

Paper 3 (Calculator)

Higher Tier

Specimen Papers Set 2
Time: 1 hour 30 minutes

Paper Reference
1MA1/3H

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator.

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.**
- If your calculator does not have a π button, take the value of π to be 3.142 unless the question instructs otherwise.
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- You must **show all your working out.**

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.

Turn over ▶

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S 5 0 1 6 0 A 0 1 2 4

PEARSON

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 The ratio of the number of boys to the number of girls in a school is 4 : 5
There are 95 girls in the school.

Work out the total number of students in the school.

boys : girls

$\times 19$ 4 : 5 $\times 19$

76 : 95

$95 \div 5 = 19$

$19 \times 4 = 76$

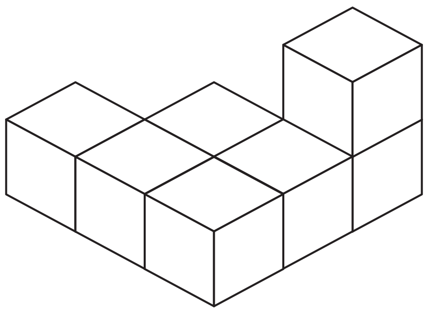
total number of students :

$76 + 95 = 171$

171

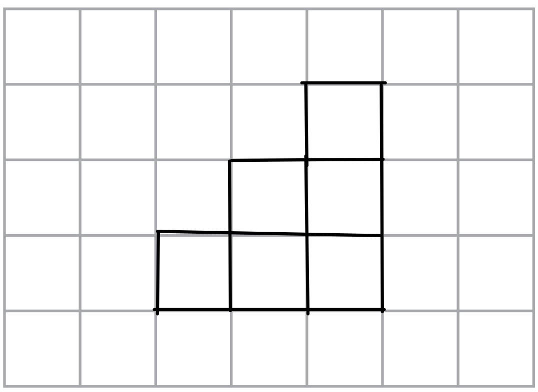
(Total for Question 1 is 3 marks)

2 The diagram represents a solid made from seven centimetre cubes.



plan: view from directly above

On the centimetre grid below, draw a plan of the solid.



(Total for Question 2 is 2 marks)

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3 Make t the subject of the formula $y = \frac{t}{3} - 2a$

$y = \frac{t}{3} - 2a$

+2a

+2a

$y + 2a = \frac{t}{3}$

x3

x3

$3(y+2a) = t$

collect terms containing t on one side

multiply out bracket

$t = 3y + 6a$

(Total for Question 3 is 2 marks)

4 Jim rounds a number, x, to one decimal place.
The result is 7.2

Write down the error interval for x.

1dp → ± 0.05

$7.2 + 0.05 = 7.25$

$7.2 - 0.05 = 7.15$

greater than or equal to
7.15 rounds to 7.2

$7.15 \leq x < 7.25$

less than
7.25 rounds to 7.2

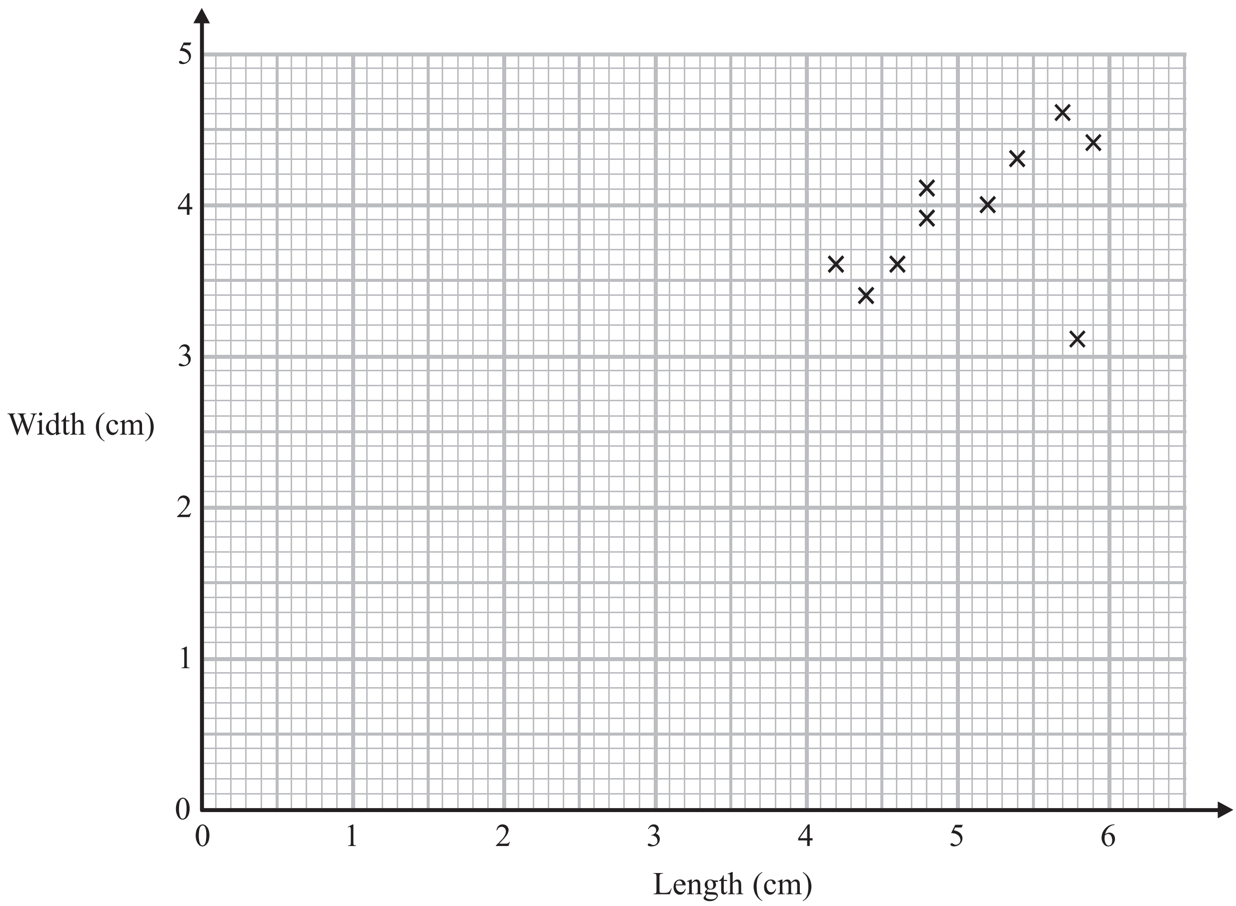
7.2

$7.15 \leq x < 7.25$

(Total for Question 4 is 2 marks)

5 Katie measured the length and the width of each of 10 pine cones from the same tree.

She used her results to draw this scatter graph.



(a) Describe one improvement Katie can make to her scatter graph.

she could change the origin of the graph from (0,0) to (3,3). → no widths or lengths between 0-3cm.

(1)

The point representing the results for one of the pine cones is an outlier.

(b) Explain how the results for this pine cone differ from the results for the other pine cones.

this pine cone is unusually narrow (small width) given its length.

(1)

(Total for Question 5 is 2 marks)

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6 At a depth of x metres, the temperature of the water in an ocean is T°C.
At depths below 900 metres, T is inversely proportional to x.

T is given by

$$T = \frac{4500}{x}$$

(a) Work out the difference in the temperature of the water at a depth of 1200 metres and the temperature of the water at a depth of 2500 metres.

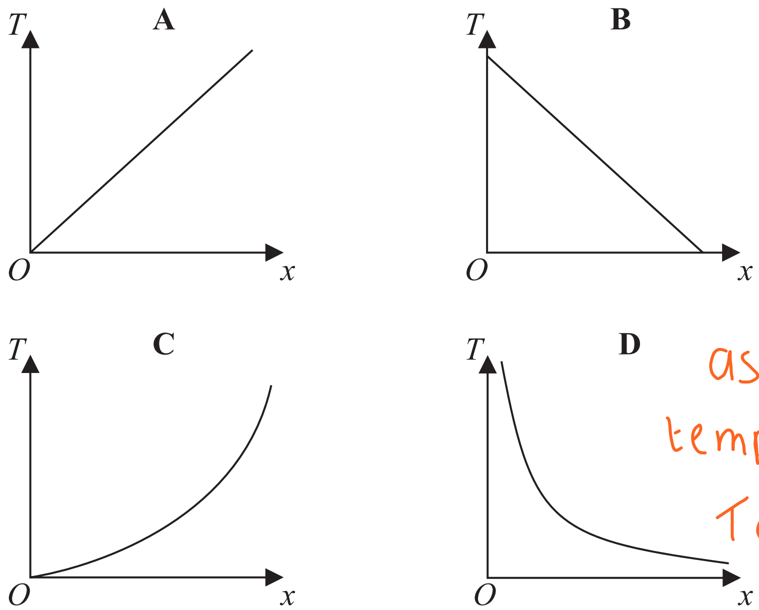
$x = 1200 \quad T = \frac{4500}{1200} = 3.75$°C

$x = 2500 \quad T = \frac{4500}{1200} = 1.8$°C

temperature difference : $3.75 - 1.8 = 1.95$°C

1.95 °C
(3)

Here are four graphs.



as depth, x, increases, temperature, T, decreases

T or x can never be 0

$T = 0$°C $\Rightarrow$ water is frozen

$x = 0$m $\Rightarrow$ T is only inversely proportional for $x > 900$ m

One of the graphs could show that T is inversely proportional to x.

(b) Write down the letter of this graph.

D
(1)

(Total for Question 6 is 4 marks)

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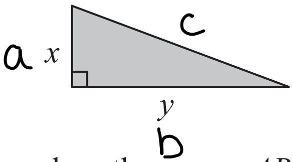
pythagoras : $a^2+b^2=c^2$

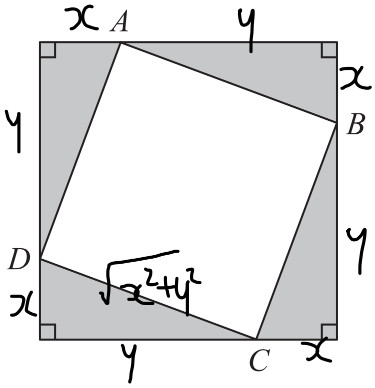
7 Here is a right-angled triangle.

$c^2 = x^2 + y^2$

$c = \sqrt{x^2+y^2}$



Four of these triangles are joined to enclose the square *ABCD* as shown below.



Show that the area of the square *ABCD* is $x^2 + y^2$

area of square ABCD:

length of side of square

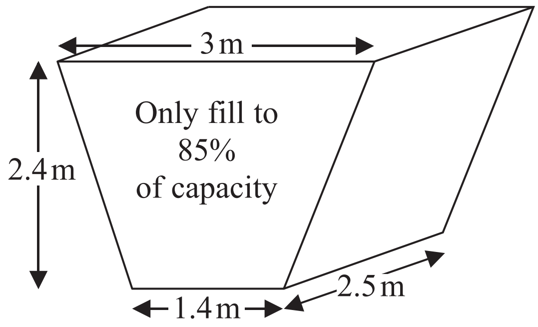
$= \sqrt{x^2+y^2} \times \sqrt{x^2+y^2}$

$= \left(\sqrt{x^2+y^2}\right)^2 = x^2+y^2$

$\boxed{\sqrt{a} \times \sqrt{a} = a}$

(Total for Question 7 is 3 marks)

8 The diagram shows an oil tank in the shape of a prism.
The cross section of the prism is a trapezium.



The tank is empty.

volume = area of cross-section x length

Oil flows into the tank.
After one minute there are 300 litres of oil in the tank.

area of trapezium = ½ x (a+b) x h

Assume that oil continues to flow into the tank at this rate.

a = 3 b = 1.4 h = 2.4

(a) Work out how many **more** minutes it takes for the tank to be 85% full of oil.
($1\text{ m}^3 = 1000$ litres)

area of cross section = ½ x (3+1.4) x 2.4
= 5.28 m²

volume = 5.28 x 2.5 = 13.2 m³

1m³ = 1000L   L ← x1000 m³

13.2 x 1000 = 13200 litres

85% full: 0.85 x 13200 = 11220L → 85% of total capacity

rate of flow: 300L per min

$\frac{11220}{300}$ = 37.4 mins

37.4 − 1 = 36.4

can convert to minutes and seconds, but not needed for answer mark

36.4 minutes

(5)

The assumption about the rate of flow of the oil could be wrong.

(b) Explain how this could affect your answer to part (a).

if the rate of flow is not the same, it will take a different amount of time to fill the tank.

(1)

(Total for Question 8 is 6 marks)

9 Ibrar bought a house for £145 000

The value of the house depreciated by 4% in the first year.
The value of the house depreciated by 2.5% in the second year.

Ibrar says,

"4 + 2.5 = 6.5 so in two years the value of my house depreciated by 6.5%"

(a) Is Ibrar right?
You must give a reason for your answer.

1st year: 4% depreciation = 100% − 4% = 96% = 0.96

2nd year: 2.5% depreciation = 100 − 2.5 = 97.5% = 0.975

No, in the 2nd year, the value of the house after the 1st year depreciates by 2.5%, not the original value of the house.

0.96 × 0.975 = 0.936

1 − 0.936 = 0.064

6.4% depreciation

(2)

The value of Ibrar's house increases by x% in the third year.
At the end of the third year the value of Ibrar's house is £140 000

(b) Work out the value of x.
Give your answer correct to 3 significant figures.

value after 2 years: 0.936 × £145000 = £135720

$$\% \text{ increase} = \frac{\text{final} - \text{original}}{\text{original}} \times 100$$

final = value after 3yrs

original = value after 2yrs

$$x = \% \text{ increase} = \frac{140000 - 135720}{135720} \times 100$$

$$= 3.75\%$$

3.75

(3)

(Total for Question 9 is 5 marks)

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10 The surface gravity of a planet can be worked out using the formula

$$g = \frac{6.67 \times 10^{-11}\, m}{r^2}$$

where

m kilograms is the mass of the planet
r metres is the radius of the planet

For the Earth and Jupiter here are the values of m and r.

Earth	Jupiter
$m = 5.98 \times 10^{24}$	$m = 1.90 \times 10^{27}$
$r = 6.378 \times 10^{6}$	$r = 7.149 \times 10^{7}$

Work out the ratio of the surface gravity of Earth to the surface gravity of Jupiter.
Write your answer in the form $1:n$

Earth: $g = \dfrac{6.67 \times 10^{-11} \times 5.98 \times 10^{24}}{(6.378 \times 10^{6})^2} = 9.80523$

Jupiter: $g = \dfrac{6.67 \times 10^{-11} \times 1.90 \times 10^{27}}{(7.149 \times 10^{7})^2} = 24.7964$

Earth : Jupiter

9.80523 : 24.7964

1 : 2.53

9.80523 ÷ 9.80523

ratio in form 1:n

$1 : 2.53$

(Total for Question 10 is 3 marks)

11 Solve the simultaneous equations

$$2x - 4y = 19 \quad (1)$$
$$3x + 5y = 1 \quad (2)$$

multiply to eliminate x

$(1) \times 3 = 6x - 12y = 57$

$(2) \times 2 = 6x + 10y = 2$ $-$

subtract $(1) - (2)$

$-22y = 55$

$y = \frac{55}{-22}$

$y = -2.5$

sub $y = -2.5$ into (2)

$3x + 5(-2.5) = 1$

$3x - 12.5 = 1$ $\quad +12.5$

$3x = 13.5$ $\quad \div 3$

$x = 4.5$

$x =$ 4.5

$y =$ -2.5

(Total for Question 11 is 4 marks)

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12 Zahra mixes 150 g of metal A and 150 g of metal B to make 300 g of an alloy.

Metal A has a density of 19.3 g/cm³.
Metal B has a density of 8.9 g/cm³.

Work out the density of the alloy.

mass, density

A : 150g , 19.3g/cm³

B : 150g , 8.9g/cm³

$$\text{density} = \frac{\text{mass}}{\text{volume}} \quad \therefore \text{volume} = \frac{\text{mass}}{\text{density}}$$

$$\text{volume of A} = \frac{150}{19.3} = 7.772...\text{cm}^3$$

$$\text{volume of B} = \frac{150}{8.9} = 16.854...\text{cm}^3$$

$$\text{density of alloy} = \frac{\text{mass A} + \text{mass B}}{\text{volume A} + \text{volume B}}$$

$$\text{density of alloy} = \frac{150 + 150}{7.772 + 16.854} = 12.2\text{g/cm}^3 \text{ to 1dp}$$

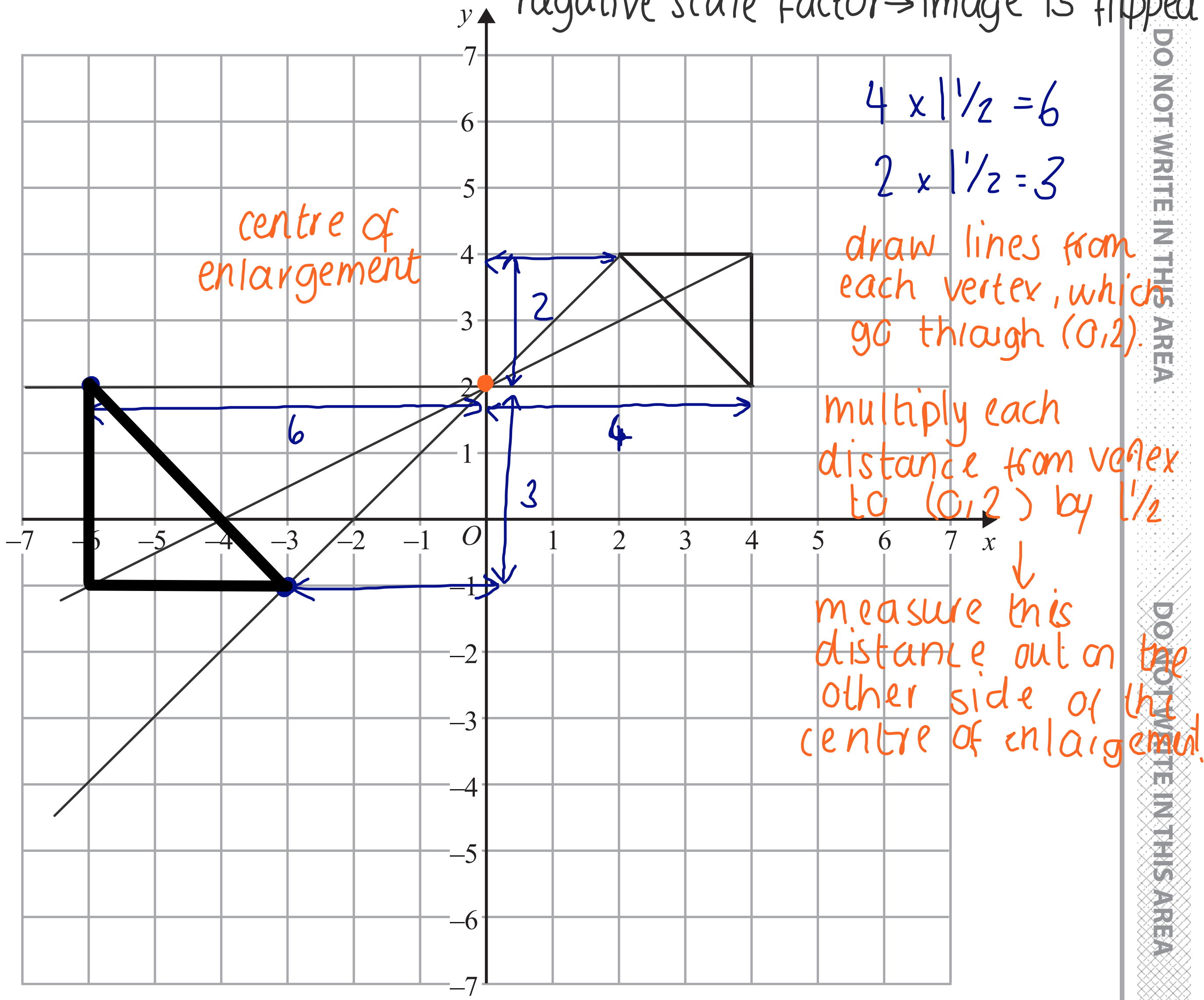
12.2 g/cm³

(Total for Question 12 is 4 marks)

13

scale factor : $-1\frac{1}{2}$

negative scale factor → image is flipped



On the grid, enlarge the triangle by scale factor $-1\frac{1}{2}$, centre (0, 2)

(Total for Question 13 is 2 marks)

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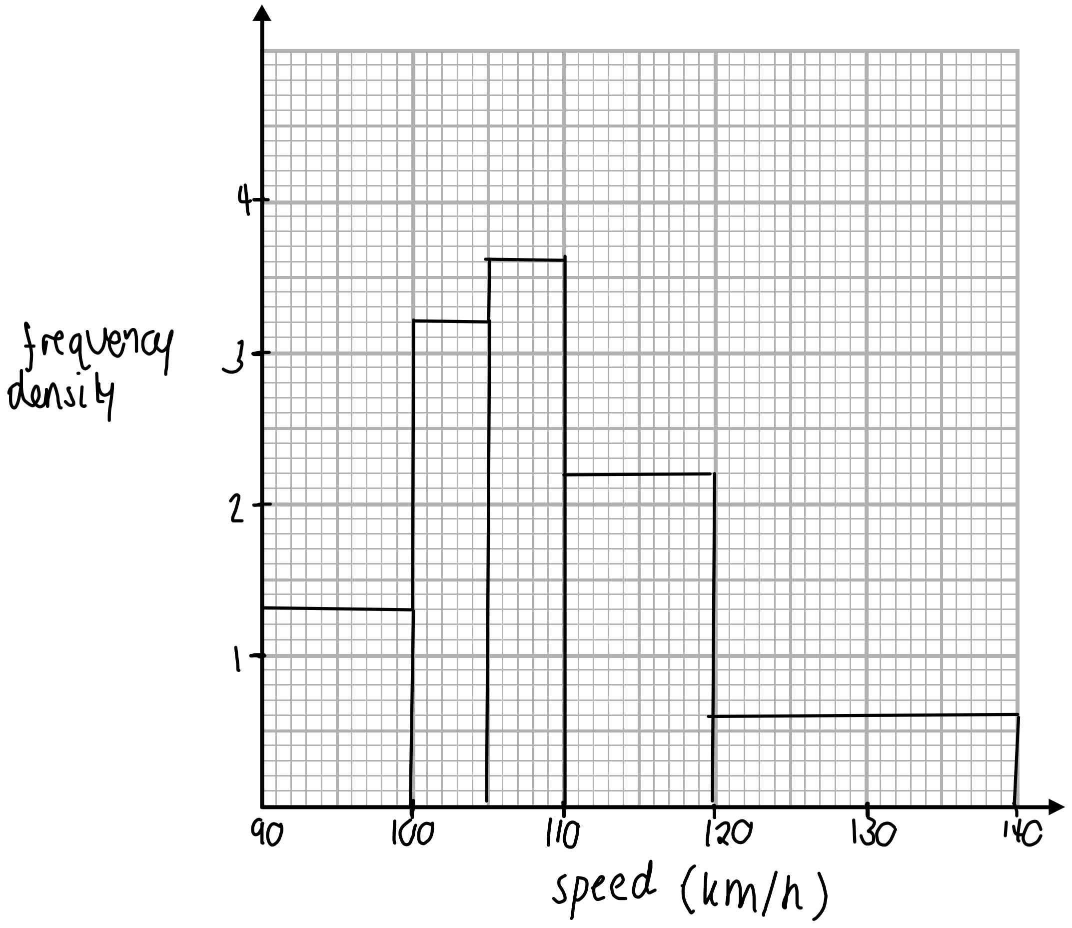
14 The table gives information about the speeds, in km/h, of 81 cars.

Speed (s km/h)	**Frequency**	class width	freq. density	
$90 < s \leqslant 100$	13	10	$13 \div 10 =$	1.3
$100 < s \leqslant 105$	16	5	$16 \div 5 =$	3.2
$105 < s \leqslant 110$	18	5	$18 \div 5 =$	3.6
$110 < s \leqslant 120$	22	10	$22 \div 10 =$	2.2
$120 < s \leqslant 140$	12	20	$12 \div 20 =$	0.6

$\text{freq.density} = \dfrac{\text{freq}}{\text{c.w}}$

(a) On the grid, draw a histogram for the information in the table.



(3)

(b) Find an estimate for the median.

median $= \left(\dfrac{81+1}{2}\right)$th value

= 41st value

speed	frequency	running total
$90 \leq s < 100$	13	13
$100 \leq s < 105$	16	29
$105 \leq s < 110$	18	47

+16, +18

41 is between 29 and 47, so median class is $105 \leq s < 110$

$41 - 29 = 12$th value in group

$\dfrac{12}{18} \times 5 = 3.\dot{3}$

$105 + 3.\dot{3} = \underline{108.\dot{3}}$

108.3 km/h

(2)

(Total for Question 14 is 5 marks)

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15 Show that $\frac{a}{b+1} - \frac{a}{(b+1)^2}$ can be written as $\frac{ab}{(b+1)^2}$

$\frac{a}{b+1} - \frac{a}{(b+1)^2}$ *common denominator

multiply top and bottom by $(b+1)$

$= \frac{a(b+1)}{(b+1)(b+1)} - \frac{a}{(b+1)(b+1)} = \frac{a(b+1)-a}{(b+1)(b+1)}$ } combine fractions

$= \frac{ab+a-a}{(b+1)^2}$ simplify $= \frac{ab}{(b+1)^2}$

(Total for Question 15 is 2 marks)

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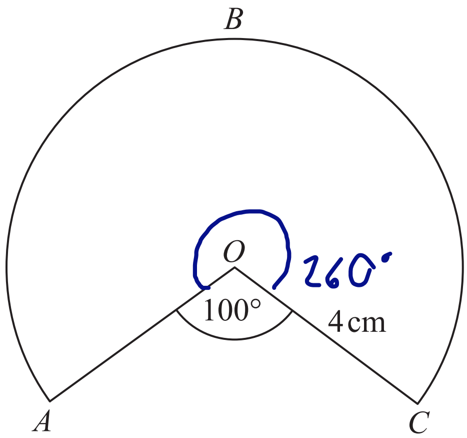
16 The diagram shows a sector of a circle of radius 4 cm.



Work out the length of the arc *ABC*.
Give your answer correct to 3 significant figures.

$360 - 100 = 260$ 360° in a circle

arc ABC $= \frac{260}{360} \times$ circumference

$= \frac{\theta}{360°} \times$ circumference

$C = 2\pi r$

$= \frac{260}{360} \times 2 \times \pi \times 4$

$= 18.2$ cm (3sf)

18.2 cm

(Total for Question 16 is 2 marks)

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17 The product of two consecutive positive integers is added to the larger of the two integers.

Prove that the result is always a square number.

consecutive integers : $n, n+1$

product of the consecutive integers:

$n \times (n+1) = n(n+1) = n^2+n$

adding product to largest of the two integers

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

factorise

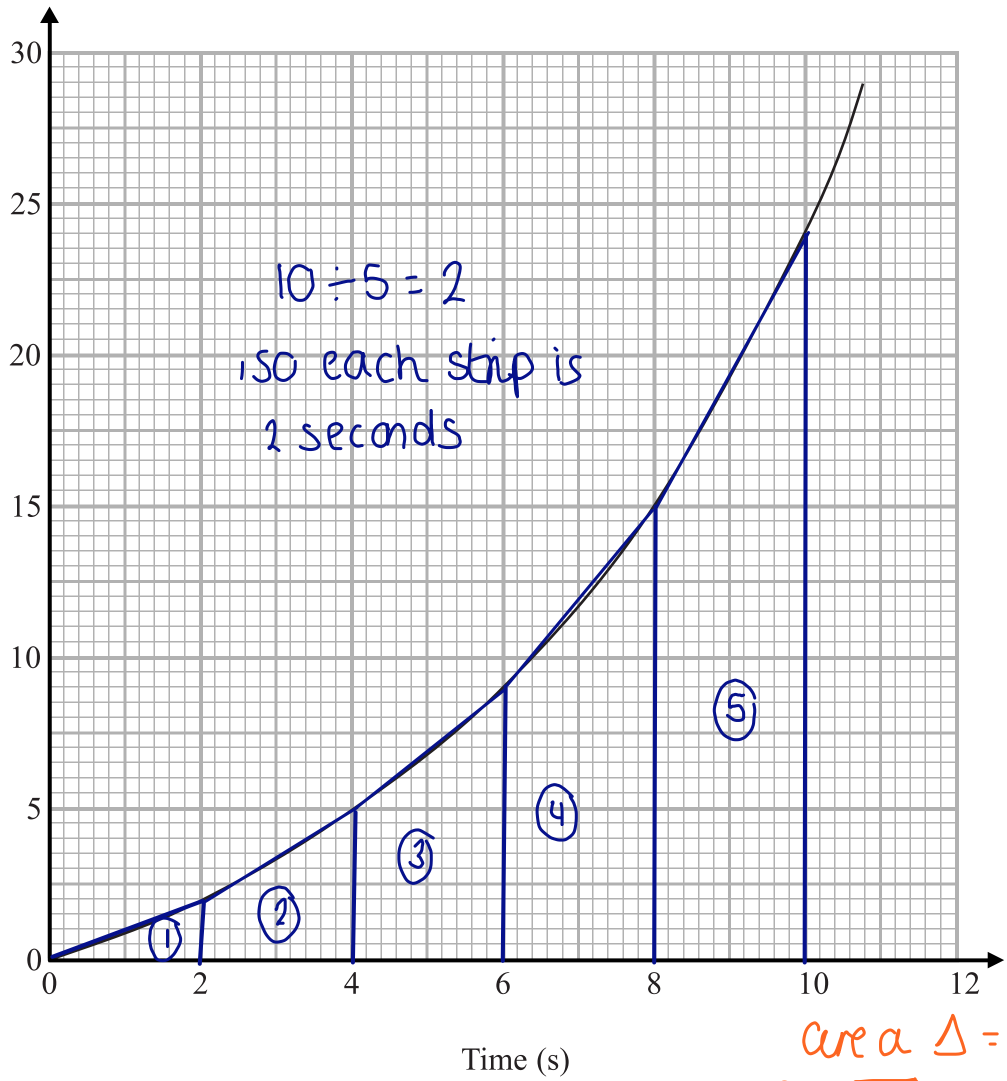
$= (n+1)(n+1)$

$= (n+1)^2$

square number

(Total for Question 17 is 3 marks)

18 Here is a speed-time graph for a car.



area $\Delta = \frac{1}{2}bh$

area ⏢ $= \frac{1}{2}(a+b)h$

(a) Work out an estimate for the distance the car travelled in the first 10 seconds.
Use 5 strips of equal width.

① : area $= \frac{1}{2}bh = \frac{1}{2} \times 2 \times 2 = 2m$

② : area $= \frac{1}{2}(a+b)h = \frac{1}{2} \times (2+5) \times 2 = 7m$

③ : area $= \frac{1}{2}(a+b)h = \frac{1}{2} \times (5+9) \times 2 = 14m$

④ : area $= \frac{1}{2}(a+b)h = \frac{1}{2} \times (9+15) \times 2 = 24m$

⑤ : area $= \frac{1}{2}(a+b)h = \frac{1}{2} \times (15+24) \times 2 = 39m$

total distance =

$2+7+14+24+39 = 86m$

86 m

(3)

(b) Is your answer to (a) an underestimate or an overestimate of the actual distance?
Give a reason for your answer.

overestimate - we have included the area between the trapeziums and the curves.

(1)

(Total for Question 18 is 4 marks)

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19 Prove algebraically that the recurring decimal $0.3\dot{1}\dot{8}$ can be written as $\frac{7}{22}$

$x = 0.3\dot{1}\dot{8}$

$10x = 3.18181818$

$1000x = 318.181818$

$1000x = 318.181818\ldots$

$-\ 10x = 3.181818\ldots$

$990x = 315$

$x = \frac{315}{990} \xrightarrow{\div 15} = \frac{21}{66} \xrightarrow{\div 3} = \frac{7}{22}$

(Total for Question 19 is 2 marks)

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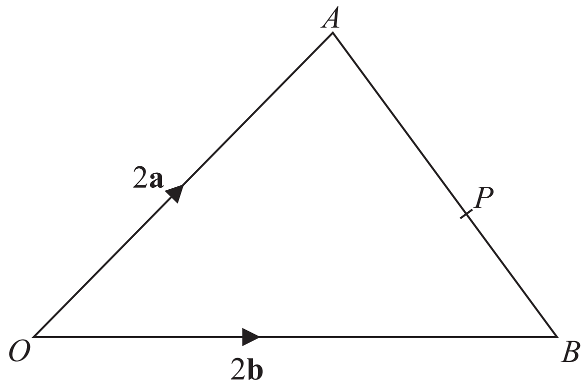
20



OAB is a triangle.
P is the point on *AB* such that $AP : PB = 5 : 3$

$\overrightarrow{OA} = 2\mathbf{a}$

$\overrightarrow{OB} = 2\mathbf{b}$

$\overrightarrow{OP} = k(3\mathbf{a} + 5\mathbf{b})$ where k is a scalar quantity.

Find the value of k.

$\vec{AB} = \vec{AO} + \vec{OB}$

$= -2a + 2b = 2b - 2a$

$5 + 3 = 8$ parts

$\vec{AP} = \frac{5}{8}\vec{AB}$

$= \frac{5}{8}(2b - 2a) = \frac{5}{4}b - \frac{5}{4}a$

$\vec{OP} = \vec{OA} + \vec{AP} = 2a + \frac{5}{4}b - \frac{5}{4}a$

$= \frac{8}{4}a + \frac{5}{4}b - \frac{5}{4}a = \frac{3}{4}a + \frac{5}{4}b$

$= \frac{1}{4}(3a + 5b)$

factorise

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

(Total for Question 20 is 4 marks)

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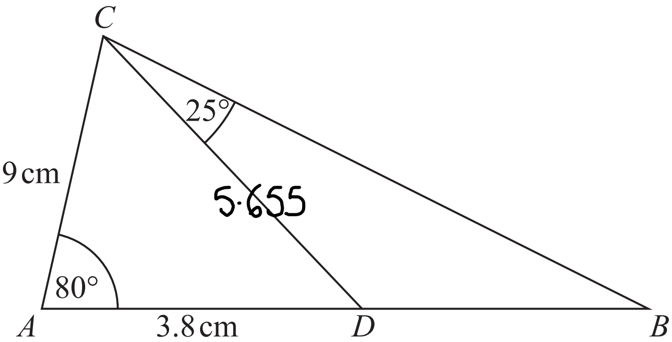
21



ABC is a triangle.
D is a point on *AB*.

Work out the area of triangle *BCD*.
Give your answer correct to 3 significant figures.

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

$CD^2 = 4.9^2 + 3.8^2 - (2 \times 4.9 \times 3.8 \times \cos 80)$

$= 31.98\text{cm}\ldots$

$CD = \sqrt{31.98\ldots} = 5.655\text{cm}\ldots$

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

$\frac{3.8}{\sin \angle ACD} = \frac{5.655\ldots}{\sin 80}$

$3.8 \sin 80 = 5.655 \sin \angle ACD$

$\frac{3.8 \sin 80}{5.655} = \sin \angle ACD$

$\sin^{-1}\left(\frac{3.8 \sin 80}{5.655}\right) = \angle ACD$

$\angle ACD = 41.4°$

$\angle ABC = 180 - 80 - 25 - 41.4$
$= 33.6$

$\angle BDC = 180 - 33.6 - 25 = 121.4°$

$\frac{BD}{\sin 25} = \frac{5.655}{\sin 33.6}$

$BD = \frac{5.655}{\sin 33.6} \times \sin 25$

$= 4.32\text{cm}$

10.4 cm²

area = ½ absinC

(Total for Question 21 is 5 marks)

area $\Delta BCD = \frac{1}{2} \times 5.655 \times 4.32 \times \sin 121.4$

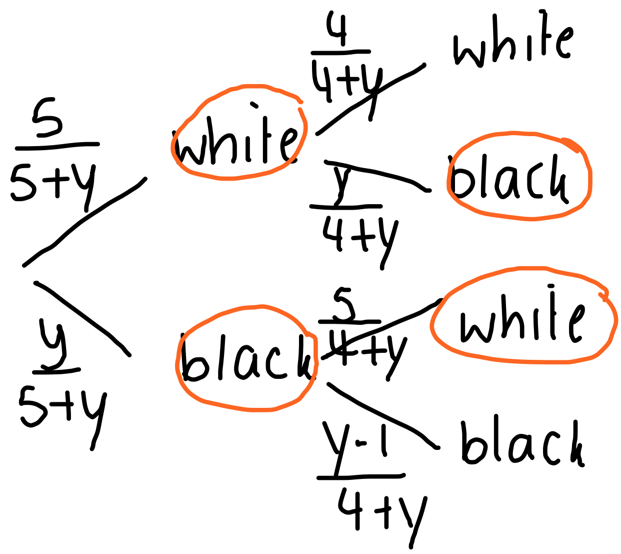
$= 10.4\text{cm}^2$ [to 3sf]

22 There are y black socks and 5 white socks in a drawer.

Joshua takes at random two socks from the drawer.

The probability that Joshua takes one white sock and one black sock is $\frac{6}{11}$

(a) Show that $3y^2 - 28y + 60 = 0$



P(white, black)

$$= \frac{5}{5+y} \times \frac{y}{4+y}$$

$$= \frac{5y}{(5+y)(4+y)}$$

P(black, white)

$$= \frac{y}{5+y} \times \frac{5}{4+y} = \frac{5y}{(5+y)(4+y)}$$

(continue at end of qs)

(4)

(b) Find the probability that Joshua takes two black socks.

$3y^2 - 28y + 60 = 0$

$(3y-10)(y-6)=0$

$3y-10=0$ $\quad$ $y-6=0$

$3y=10$ $\quad$ $y=6$

$y=\frac{10}{3}$

y must be an integer

P(black, black)

$$= \frac{y}{5+y} \times \frac{y-1}{4+y} =$$

$$= \frac{6}{11} \times \frac{5}{10} = \frac{30}{110}$$

$$= \frac{3}{11}$$

$\frac{3}{11}$

(3)

(Total for Question 22 is 7 marks)

23 (a) Write $2x^2 + 16x + 35$ in the form $a(x + b)^2 + c$ where a, b, and c are integers.

$= 2(x^2 + 8x) + 35$

$= 2[(x+4)^2 - 4^2] + 35$

$= 2[(x+4)^2 - 16] + 35$

$= 2(x+4)^2 - 32 + 35$

$= 2(x+4)^2 + 3$

ax^2+bx+c $a=2$ $b=16$ $c=35$

take out a factor of 2 from x & x^2

$a(x^2 + \frac{b}{a}x) + c$

half coefficient of x & subtract $(bx)^2$.

in form $2(x+4)^2+3$.

$2(x+4)^2+3$

(3)

(b) Hence, or otherwise, write down the coordinates of the turning point of the graph of $y = 2x^2 + 16x + 35$

$a(x+b)^2 + c$

turning point: $(-b, c)$

$(-4, 3)$

(1)

(Total for Question 23 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS

P(one black sock and one white sock) have to add probabilities

$= \frac{10y}{(5+y)(4+y)} = \frac{6}{11}$ crossmultiply

$110y = 6(20 + 9y + y^2)$ $-55y$

$55y = 3(20 + 9y + y^2)$

$55y = 60 + 27y + 3y^2$

$3y^2 - 28y + 60 = 0$