Write your name here

Surname	Other Names

Mathematics

2018 Practice Paper
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.

1 There are only red counters, blue counters, yellow counters and black counters in a bag.

The table shows the probabilities of picking at random a red counter and picking at random a black counter.

Colour	red	blue	yellow	black
Probability	0.22	$2x$	x	0.34

The probability of picking a blue counter is **twice** the probability of picking a yellow counter.

Find the probability of picking a blue counter.

$1 - 0.22 - 0.34 = 0.44$

$3x = 0.44$

$x = \frac{11}{75}$

$2x = \frac{22}{75}$

$\frac{22}{75}$

(Total for question 1 is 2 marks)

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2 A number y is rounded to 1 decimal place.

The result is 5.8

Write down the error interval for y.

$5.75 \leq y < 5.85$

(Total for question 2 is 2 marks)

3 It takes 5 machines 6 hours to produce 1000 DVDs

Work out how long it would take 4 machines to produce 1000 DVDs.

$5 \times 6 = 30$ (30 hours needed)

$\frac{30}{4} = 7.5$ hours

7.5 hours

(Total for question 3 is 2 marks)

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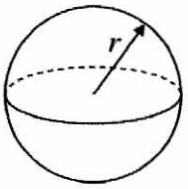
4 A sphere is carved from a block of wood.
The sphere has a radius of 5cm.

The density of the wood is 0.85 g/cm^3

Find the mass of the sphere.
Give your answer to 3 significant figures.

Volume of sphere $= \frac{4}{3}\pi r^3$

Surface area of sphere $= 4\pi r^2$



mass = density x volume

volume $= \frac{4}{3}\pi (5)^3$

$= \frac{500}{3}\pi$

mass $= 0.85 \times$ ans

$= 445$ g (3sf)

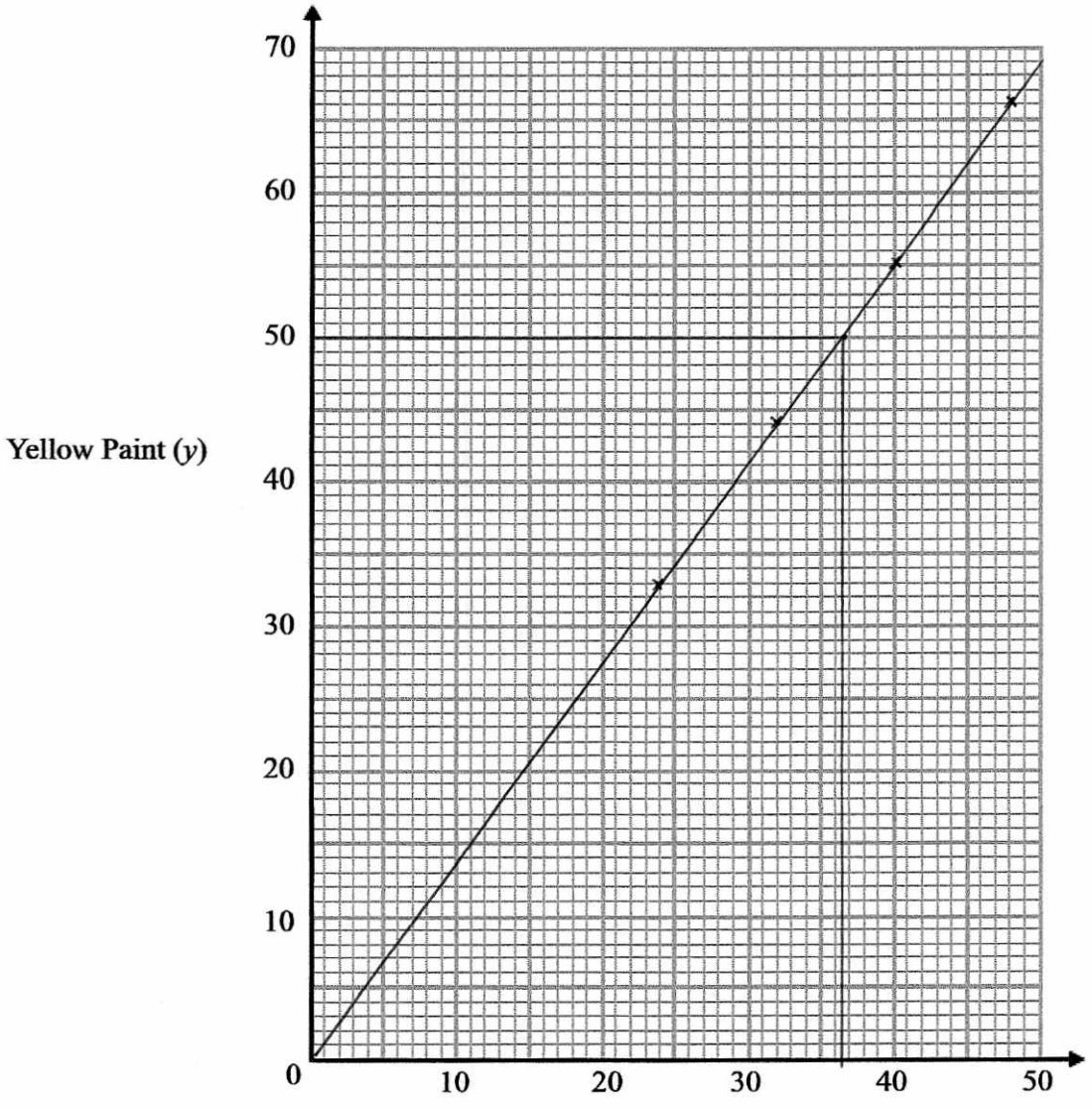
445 g

(Total for question 4 is 3 marks)

5 An artist is making orange paint by mixing red paint (x ml) and yellow paint (y ml) in the ratio 8:11

(a) Use this information to draw a graph showing the relationship between the amount of red paint and the amount of yellow paint used.

x	8	16	24	32	40	48
y	11	22	33	44	55	66



(2)

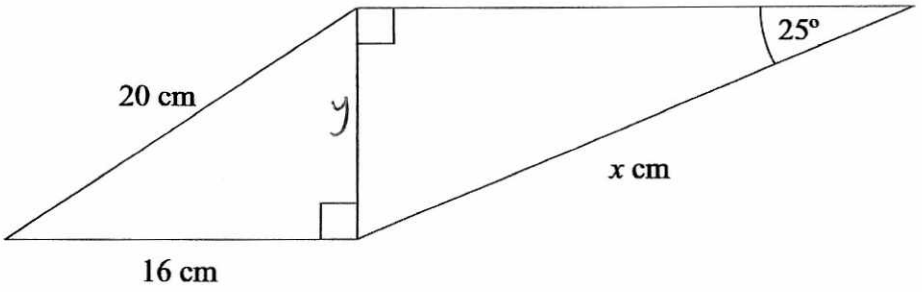
(b) The artist decides to use 50ml of yellow paint. Use your graph to work out how much red paint he should use.

36.5 ml

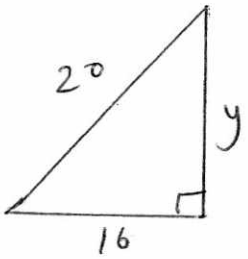
36 to 37 (2)

(Total for question 5 is 4 marks)

6



Work out the value of x.
Give your answer to 1 decimal place.

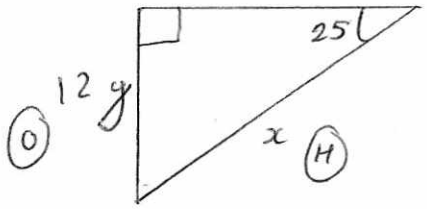


$y^2 + 16^2 = 20^2$

$y^2 = 20^2 - 16^2$

$y^2 = 144$

$y = 12$



$\sin(25) = \frac{12}{x}$

$x = \frac{12}{\sin(25)}$

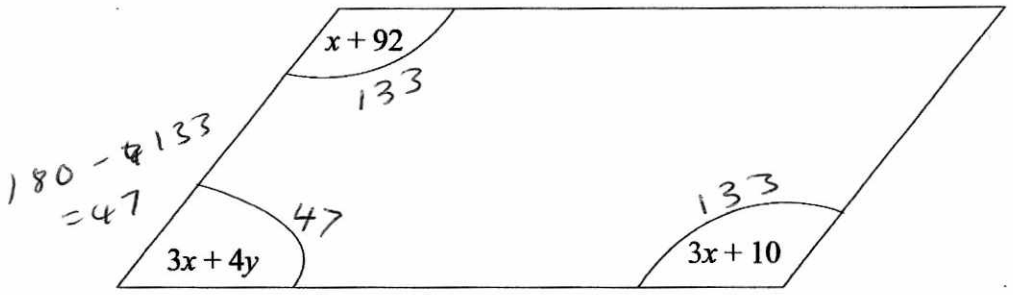
$= 28.4$

28.4

(Total for question 6 is 4 marks)

7

$41 + 92 = 133$



The diagram shows a parallelogram

All of the angles are in degrees.

Find the value x and the value of y.

$$x + 92 = 3x + 10$$
$$92 = 2x + 10$$
$$82 = 2x$$
$$x = 41$$

$$3x + 4y = 47$$
$$3(41) + 4y = 47$$
$$4y = -76$$
$$y = -19$$

$x =$ 41

$y =$ −19

(Total for question 7 is 3 marks)

8 Solve the simultaneous equations

$2x - 3y = 4$ $\times 2$

$4x - y = 13$ $\times 1$

$4x - y = 13$

$4x - 6y = 8$

$5y = 5$

$y = 1$

$4x - 1 = 13$

$4x = 14$

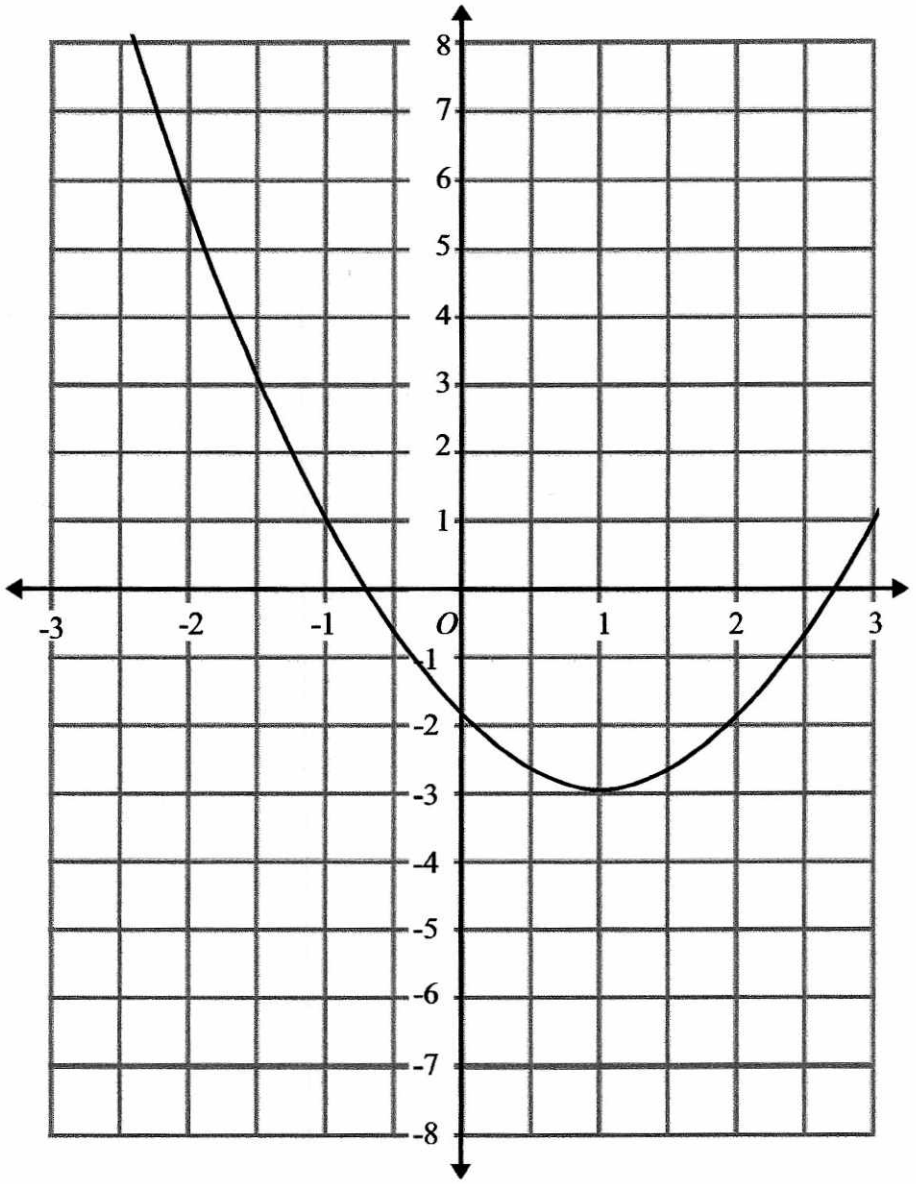
$x = 3.5$

$x =$ 3.5

$y =$ 1

(Total for question 8 is 3 marks)

9 Here is the graph of $y = x^2 - 2x - 2$



(a) Write down estimates for the roots of $x^2 - 2x - 2 = 0$

-0.75 and 2.75

(2)

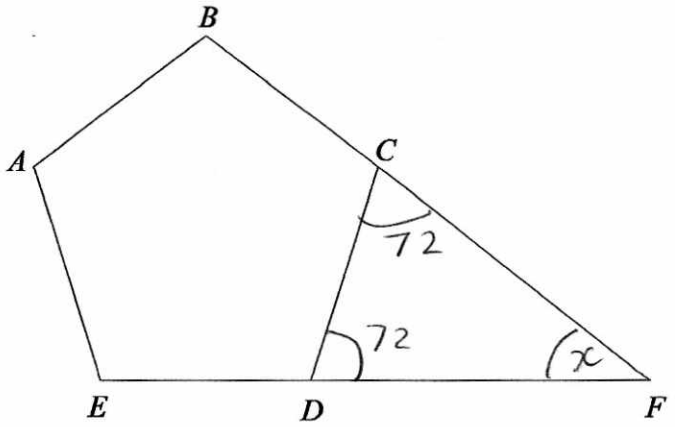
(b) Write down the coordinates of the turning point of $y = x^2 - 2x - 2$

(1, -3)

(1)

(Total for question 9 is 3 marks)

10



ABCDE is a regular pentagon.
BCF and EDF are straight lines.

Work out the size of angle CFD.
You must show how you got your answer.

Exterior angle of pentagon $= \frac{360}{5} = 72$

$180 - 72 - 72 = 36°$

36 °

(Total for question 10 is 3 marks)

11 Prove algebraically that the recurring decimal $0.68\dot{1}\dot{1}$ can be written as $\frac{15}{22}$

$0.68\dot{1}\dot{1} = x$

$6.8\dot{1}\dot{1} = 10x$

$681.8\dot{1}\dot{1} = 1000x$

$675 = 990x$

$x = \frac{675}{990}$

$= \frac{15}{22}$

(Total for question 11 is 2 marks)

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12 There are 12 boys and 15 girls in a class.
One boy and one girl will be selected to represent the class on the student council.
Work out the total number of ways of choosing a boy and a girl.

12×15

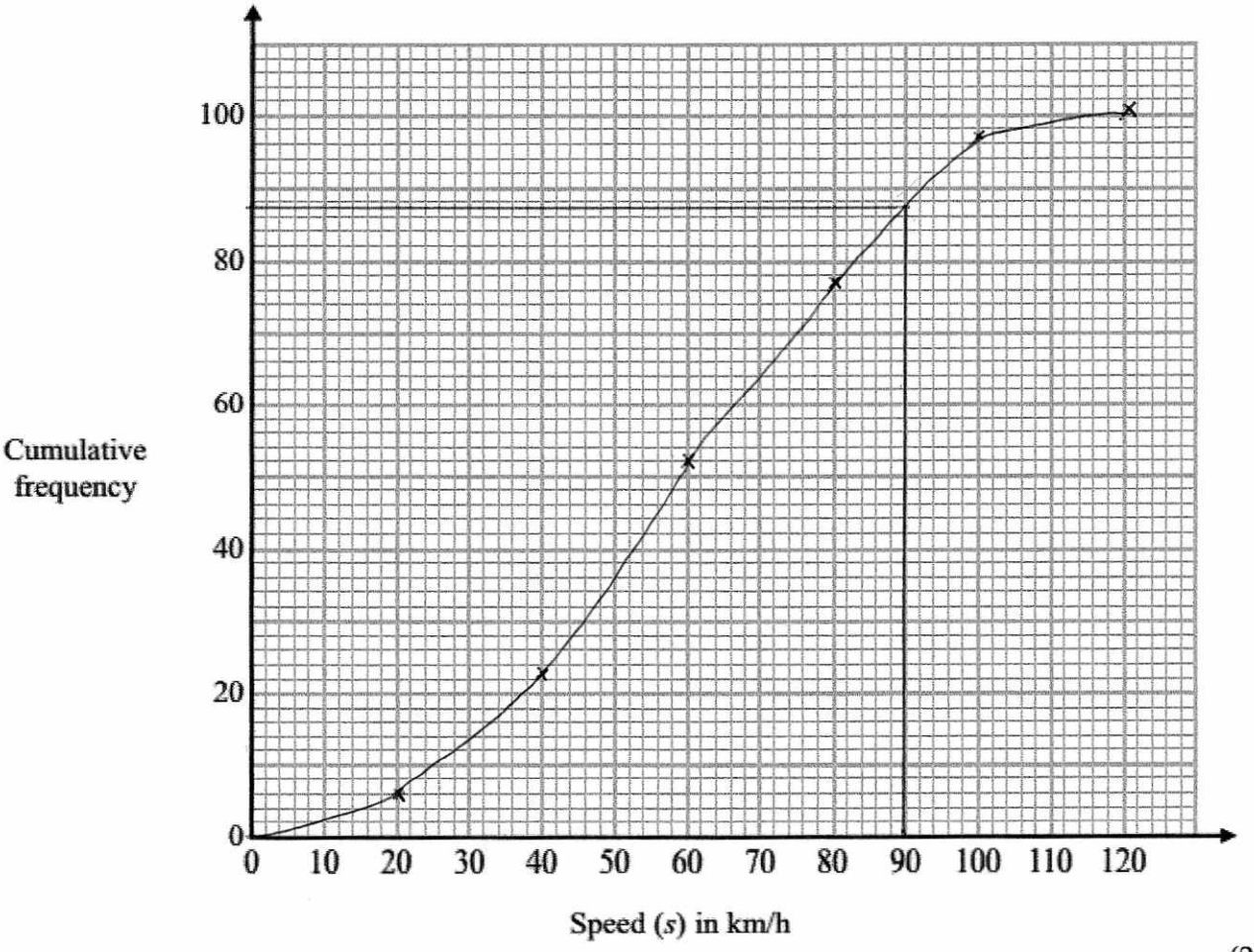
180

(Total for question 12 is 2 marks)

13 The frequency table shows the speeds of 100 cars.

Speed (km/h)	Frequency	C.F.
$0 < s \leqslant 20$	6	6
$20 < s \leqslant 40$	17	23
$40 < s \leqslant 60$	29	52
$60 < s \leqslant 80$	25	77
$80 < s \leqslant 100$	20	97
$100 < s \leqslant 120$	3	100

(a) On the grid, plot a cumulative frequency graph for this information.



(2)

(b) Find an estimate for the number of cars travelling over 90 km/h.

$100 - 87 = 13$

13

(10 – 14) (1)

(Total for question 13 is 3 marks)

14 Using $x_{n+1} = \dfrac{5}{x_n^2 + 3}$

With $x_0 = 1$

Find the values of x_1, x_2 and x_3.

$x_1 = \dfrac{5}{(1)^2 + 3} = 1.25 \quad \left(\dfrac{5}{4}\right)$

$x_2 = \dfrac{5}{Ans^2 + 3} = 1.095890411 \quad \dfrac{80}{73}$

$x_3 = \dfrac{5}{Ans^2 + 3} = 1.190199669$

$x_1 =$ 1.25

$x_2 =$ 1.09589041

$x_3 =$ 1.190199669

(Total for question 14 is 3 marks)

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15 Charlie invests £2500 for 3 years in a savings account.
She gets 3% per annum compound interest in the first year, then x% for 2 years.

Charlie has £2705.36 at the end of 3 years, work out the value of x .

$2500 \times 1.03 \times y^2 = 2705.36$

$2575\, y^2 = 2705.36$

$y^2 = 1.050625243$

$y = 1.025$

$x = 2.5\%$

2.5

(Total for question 15 is 4 marks)

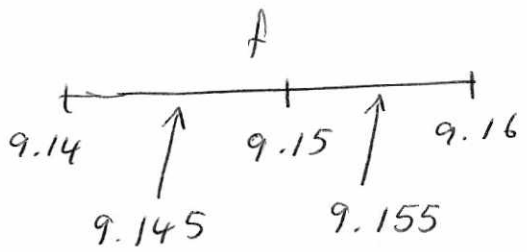
16 $f = \dfrac{\sqrt{g}}{h}$ $f = 9.15$ correct to 3 significant figures
$g = 22.06$ correct to 4 significant figures

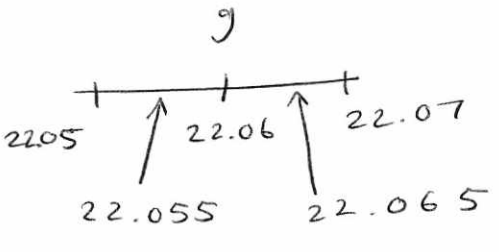
By considering bounds, work out the value of h to a suitable degree of accuracy.
Give a reason for your answer.

upper $f = \dfrac{\sqrt{\text{upper } g}}{\text{lower } h}$ lower $f = \dfrac{\sqrt{\text{lower } g}}{\text{upper } h}$

$h = \dfrac{\sqrt{g}}{f}$

upper $h = \dfrac{\sqrt{\text{upper } g}}{\text{lower } f}$ lower $h = \dfrac{\sqrt{\text{lower } g}}{\text{upper } f}$





upper $h = \dfrac{\sqrt{22.065}}{9.145}$ lower $h = \dfrac{\sqrt{22.055}}{9.155}$

$= 0.513651139\ldots$ $= 0.512973797\ldots$

Both round to 0.51 (2sf)

0.51

(Total for question 16 is 5 marks)

17 For all values of x

$$f(x) = 5x - 2 \quad \text{and} \quad g(x) = x^2 + 2$$

(a) Find f(3)

$5(3) - 2$

13

(1)

(b) Find fg(x)

$5(x^2 + 2) - 2$

$5x^2 + 10 - 2$

$5x^2 + 8$

(2)

(c) Solve fg(x) = gf(x)

$gf(x) = (5x-2)^2 + 2$

$= (5x-2)(5x-2) + 2$

$= 25x^2 - 10x - 10x + 4 + 2$

$= 25x^2 - 20x + 6$

$5x^2 + 8 = 25x^2 - 20x + 6$

$0 = 20x^2 - 20x - 2$

$0 = 10x^2 - 10x - 1$

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

$$= \frac{-(-10) \pm \sqrt{(10)^2 - 4(10)(-1)}}{2(10)}$$

$x = 1.09$

$x = -0.09$

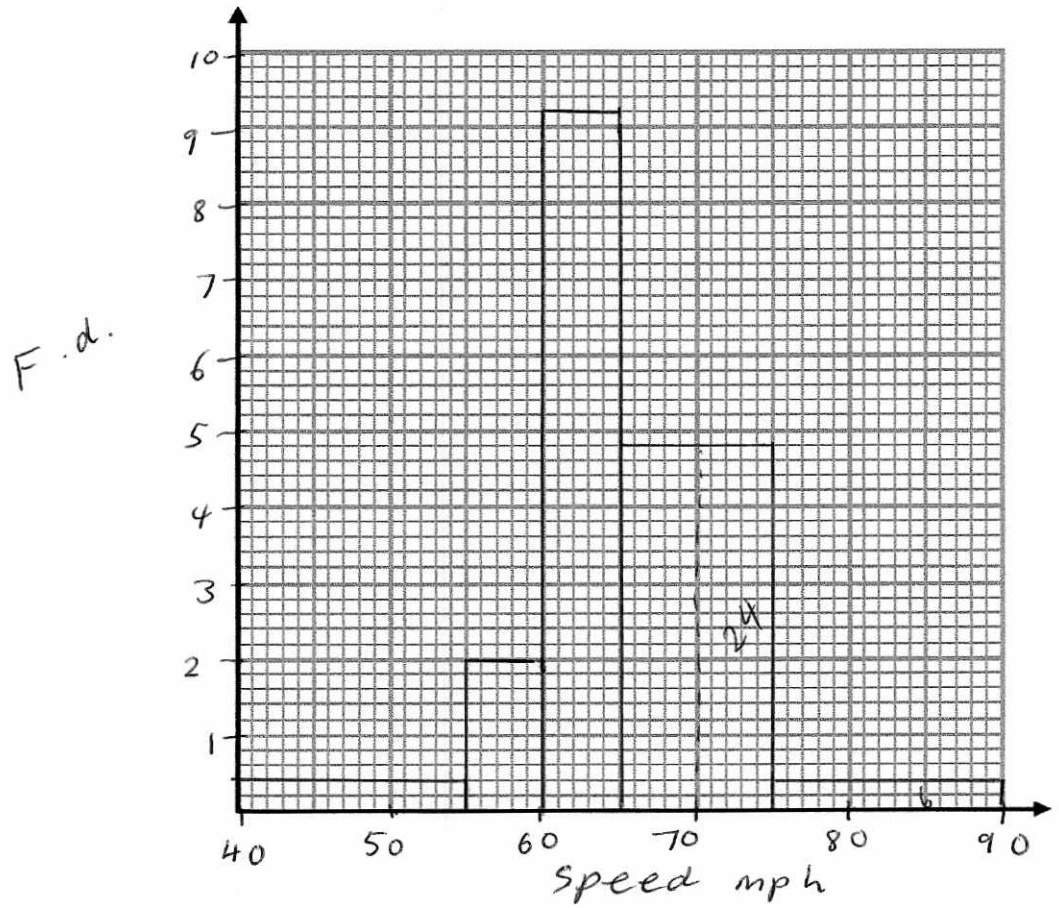
(4)

(Total for question 17 is 7 marks)

18 The table shows information about the speed, in mph, of 120 cars.

Speed (mph)	Frequency	F.d
$40 < s \leqslant 55$	6	0.4
$55 < s \leqslant 60$	10	2
$60 < s \leqslant 65$	46	9.2
$65 < s \leqslant 75$	48	4.8
$75 < s \leqslant 90$	6	0.4

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



(3)

(b) Work out an estimate for the number of cars over 70mph.

24 + 6

30

(1)

(Total for question 18 is 4 marks)

19 Here are the first 5 terms of a quadratic sequence.

$an^2 + bn + c$

4	8	15	25	38

Find an expression, in terms of *n*, for the *n*th term of this sequence.

4 8 15 25

$a+b+c$ →

4 7 10

$3a+b$ →

3 3

→

$2a$

$2a = 3$

$a = 1.5$

$3(1.5) + b = 4$

$4.5 + b = 4$

$b = -0.5$

$a + b + c = 4$

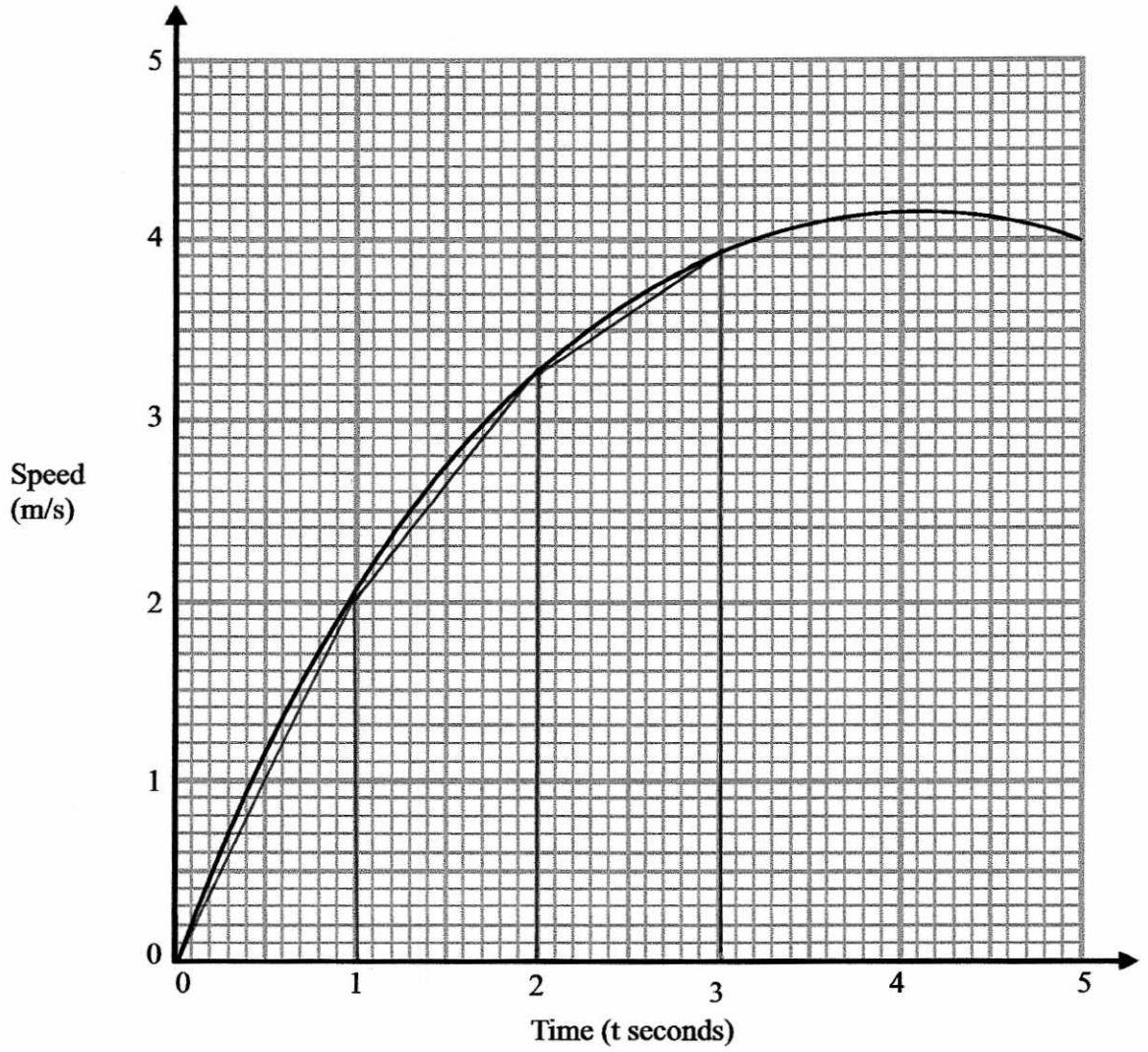
$1.5 - 0.5 + c = 4$

$c = 3$

$1.5n^2 - 0.5n + 3$

(Total for question 19 is 3 marks)

20 Here is a speed-time graph.



(a) Use 3 strips of equal width to find an estimate for the area under the graph for the first 3 seconds.

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

$\frac{1}{2}(2 + 3.3) \times 1 = 2.65$

$\frac{1}{2}(3.3 + 3.9) \times 1 = 3.6$

7.25

7.2 - 7.3 (3)

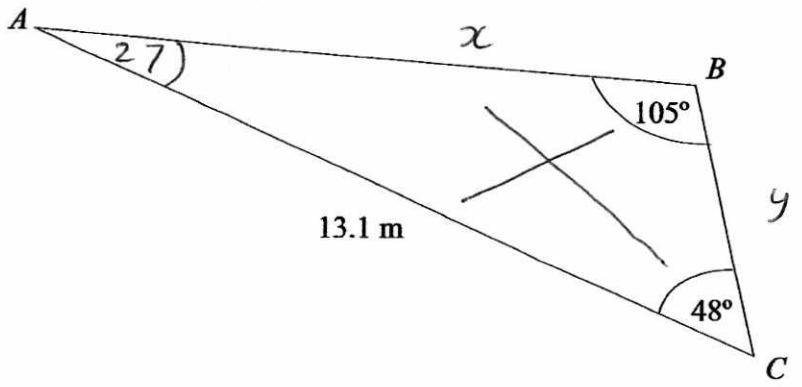
(b) Describe what your answer to part a represents.

The distance travelled in the first 3 seconds.

(1)

(Total for question 20 is 4 marks)

21



Work out the perimeter of triangle *ABC*.
Give your answer to 3 significant figures.

$$\frac{x}{\sin 48} = \frac{13.1}{\sin 105}$$

$$x = \frac{13.1}{\sin 105} \times \sin 48$$

$$x = 10.07861779$$

$$180 - 105 - 48 = 27^\circ$$

$$\frac{y}{\sin 27} = \frac{13.1}{\sin 105}$$

$$y = \frac{13.1}{\sin 105} \times \sin 27$$

$$y = 6.157072712$$

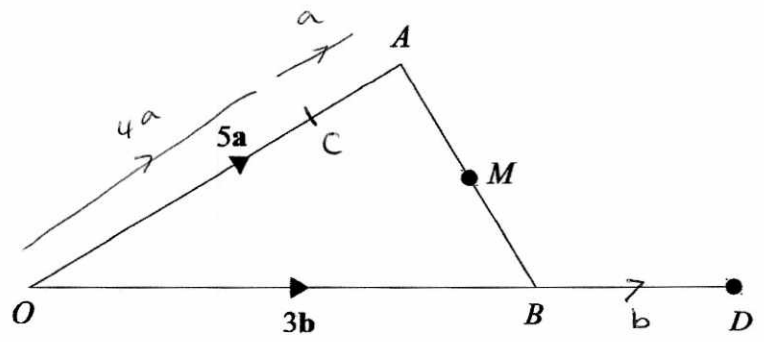
$$\text{perimeter} = x + y + 13.1$$

$$= 29.3 \text{ m} \quad (3 \text{ sf})$$

29.3 m

(Total for question 21 is 4 marks)

22



$\overrightarrow{OA} = 5a$

$\overrightarrow{OB} = 3b$

C is the point on OA such that OC:CA = 4:1
M is the midpoint of AB
D is the point such that OB:OD = 3:4

Show that C, M and D are on the same straight line.

$\overrightarrow{AB} = -5a + 3b$

$\overrightarrow{AM} = \frac{1}{2}(-5a + 3b)$

$\overrightarrow{CM} = a + \frac{1}{2}(-5a + 3b)$

$= a - \frac{5}{2}a + \frac{3}{2}b$

$= -\frac{3}{2}a + \frac{3}{2}b$

$\overrightarrow{CD} = -4a + 4b$

$\overrightarrow{CM} = \frac{3}{2}(-a + b)$ $\quad \overrightarrow{CD} = 4(-a + b)$

In the same direction and path passing through C

∴ same straight line.

(Total for question 22 is 5 marks)

23 There are some red counters and some blue counters in a bag.

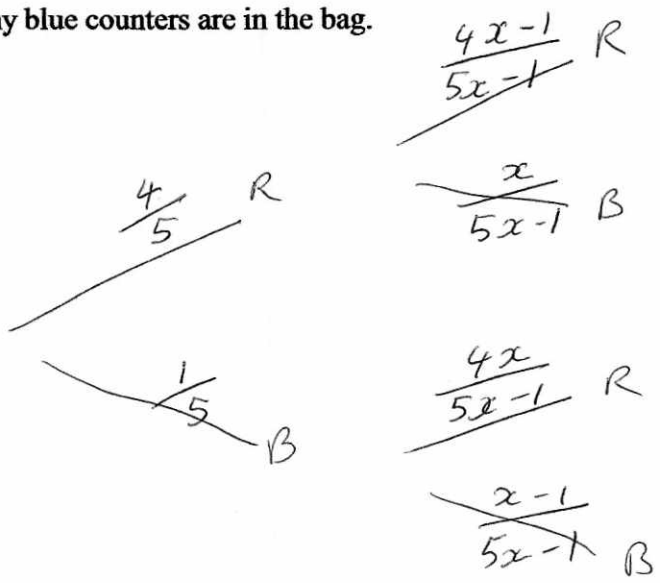
The ratio of red counters to blue counters is 4:1.

$4x : x$ total $5x$

Two counters are removed at random.

The probability that both the counters taken are red is $\frac{22}{35}$

Work how many blue counters are in the bag.



$$\frac{4}{5} \times \frac{4x-1}{5x-1} = \frac{22}{35}$$

$$\frac{4(4x-1)}{5(5x-1)} = \frac{22}{35}$$

$$140(4x-1) = 110(5x-1)$$

$$14(4x-1) = 11(5x-1)$$

$$56x - 14 = 55x - 11$$

$$x - 14 = -11$$

$$x = 3$$

3

(Total for question 23 is 5 marks)