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

Wednesday 8 November 2017 – Morning
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. 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*.
- You must **show all your working**.
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- **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.

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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Hints

Pearson

Please note that these worked solutions have neither been provided nor approved by Pearson Education and may not necessarily constitute the only possible solutions. Please refer to the original mark schemes for full guidance.

Any writing in blue indicates what must be written in order to answer the questions and get the marks. The worked solutions have been designed to show the smallest amount of work which needs to be done to answer the question.

Anything written in green in a cloud doesn't have to be written in the exam.

Anything written in orange in a rectangle doesn't have to be written in the exam and is there to show what should be put into a calculator or measured using a ruler or protractor.

If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

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1 The table shows information about the heights of 80 children.

Height (h cm)	Frequency
$130 < h \leqslant 140$	4
$140 < h \leqslant 150$	11
$150 < h \leqslant 160$	24
$160 < h \leqslant 170$	22
$170 < h \leqslant 180$	19

(a) Find the class interval that contains the median.

Using the formula (n + 1)/2 works out which data point is the median. Then create a cumulative frequency column. As soon as it goes above the number of the data point, that class interval contains the median

....

(1)

(b) Draw a frequency polygon for the information in the table.
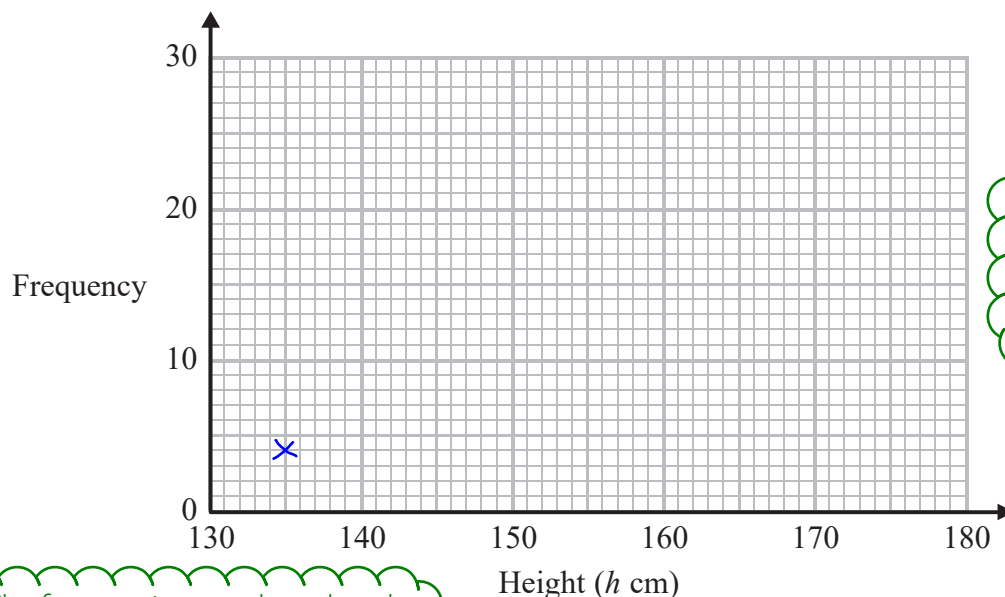
Once all the points are plotted, connect them all up with a series of straight lines

The frequencies are plotted at the midpoint of each class interval

(2)

(Total for Question 1 is 3 marks)

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2 In London, 1 litre of petrol costs 108.9p
In New York, 1 US gallon of petrol costs $2.83

   1 US gallon = 3.785 litres
   £1 = $1.46

In which city is petrol better value for money, London or New York?
You must show your working.

> Convert the dollars per gallon for the petrol in New York into pence per litre so it can be compared to the price in London

(Total for Question 2 is 3 marks)

3 A gold bar has a mass of 12.5 kg.

The density of gold is 19.3 g/cm³

Work out the volume of the gold bar.
Give your answer correct to 3 significant figures.

$d \overset{m}{\wedge} v$

> The mass needs to be converted into grams. This needs to be done as the unit of density is in terms of grams, not kilograms

.... cm³

(Total for Question 3 is 3 marks)

4 There are only blue pens, green pens and red pens in a box.

The ratio of the number of blue pens to the number of green pens is 2 : 5
The ratio of the number of green pens to the number of red pens is 4 : 1

There are less than 100 pens in the box.

What is the greatest possible number of red pens in the box?

Both ratios have green in common. Combine the ratios together into one ratio by making both have the same number of parts for green. Simplify the combined ratio if possible. The number of parts in the combined ratio (in its simplest form) is the least number of total pens. Work out how many lots of this least amount would give the greatest number less than 100. Multiply the number of red pens in the combined ratio by the same amount to work out the greatest number of red pens

....

(Total for Question 4 is 3 marks)

5 (a) Find the value of the reciprocal of 1.6
Give your answer as a decimal.

Reciprocal means 1 over the number

....

(1)

Jess rounds a number, *x*, to one decimal place.
The result is 9.8

(b) Write down the error interval for *x*.

The resolution of one decimal place is 0.1. Dividing this by 2 then adding and subtracting this from 9.8 gives the upper and lower bounds for x
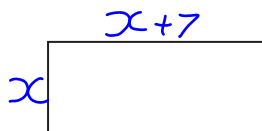
.... $\leq x <$ ....

(2)

(Total for Question 5 is 3 marks)

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6 Here is a rectangle.

$x + 7$

x

The length of the rectangle is 7 cm longer than the width of the rectangle.

4 of these rectangles are used to make this 8-sided shape.
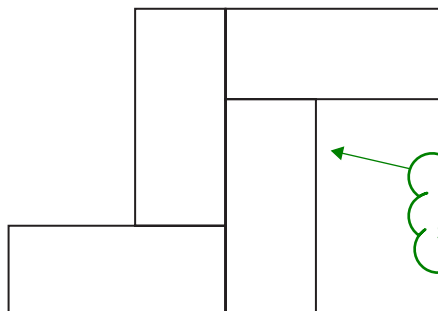
The perimeter of the 8-sided shape is 70 cm.

Work out the area of the 8-sided shape.

.... cm^2

(Total for Question 6 is 5 marks)

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7 Work out $(13.8 \times 10^7) \times (5.4 \times 10^{-12})$

Give your answer as an ordinary number.

Type it into the calculator

The calculator should give the result in standard form, not as an ordinary number

....

(Total for Question 7 is 2 marks)

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8 When a drawing pin is dropped it can land point down or point up.

Lucy, Mel and Tom each dropped the drawing pin a number of times.

The table shows the number of times the drawing pin landed point down and the number of times the drawing pin landed point up for each person.

	Lucy	Mel	Tom
point down	31	53	16
point up	14	27	9

Rachael is going to drop the drawing pin once.

(a) Whose results will give the best estimate for the probability that the drawing pin will land point up?
Give a reason for your answer.

.... *The more times it is dropped,* ....
.... *the more accurate the estimate* ....

(1)

Stuart is going to drop the drawing pin twice.

(b) Use all the results in the table to work out an estimate for the probability that the drawing pin will land point up the first time and point down the second time.

Point up AND point down, so the probabilities of each event should be multiplied together. To work out an estimate for the probability of point up, work out the fraction of the total drops which were point up

....

(2)

(Total for Question 8 is 3 marks)

9 Jack bought a new boat for £12 500

The value, £V, of Jack's boat at the end of n years is given by the formula

$$V = 12\,500 \times (0.85)^n$$

(a) At the end of how many years was the value of Jack's boat first less than 50% of the value of the boat when it was new?

Keep increasing n by 1 until 0.85ⁿ is less than 0.5. If the multiplier is less than 0.5, the value of the boat will be less than 50% of the original

....

(2)

A savings account pays interest at a rate of R% per year.
Jack invests £5500 in the account for one year.

At the end of the year, Jack pays tax on the interest at a rate of 40%.
After paying tax, he gets £79.20

(b) Work out the value of R.

Work out the percentage of the interest he receives after tax. Then use reverse percentages to work out the full amount of interest. Express the full amount of interest as a fraction of the amount invested then convert the fraction into a percentage, R

....

(3)

(Total for Question 9 is 5 marks)

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10 There are only blue counters, yellow counters, green counters and red counters in a bag.
A counter is taken at random from the bag.

The table shows the probabilities of getting a blue counter or a yellow counter or a green counter.

Colour	blue	yellow	green	red
Probability	0.2	0.35	0.4	

(a) Work out the probability of getting a red counter.

It is certain that one of the colours will be chosen so the probabilities must add up to 1

...

(1)

(b) What is the least possible number of counters in the bag?
You must give a reason for your answer.

Express the probabilities, which are equal to the relative frequencies, as a ratio then simplify the ratio. The total number of parts in the simplified ratio is the smallest number of counters

....

....

(2)

(Total for Question 10 is 3 marks)

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11 The cumulative frequency graph shows information about the weights of 60 potatoes.
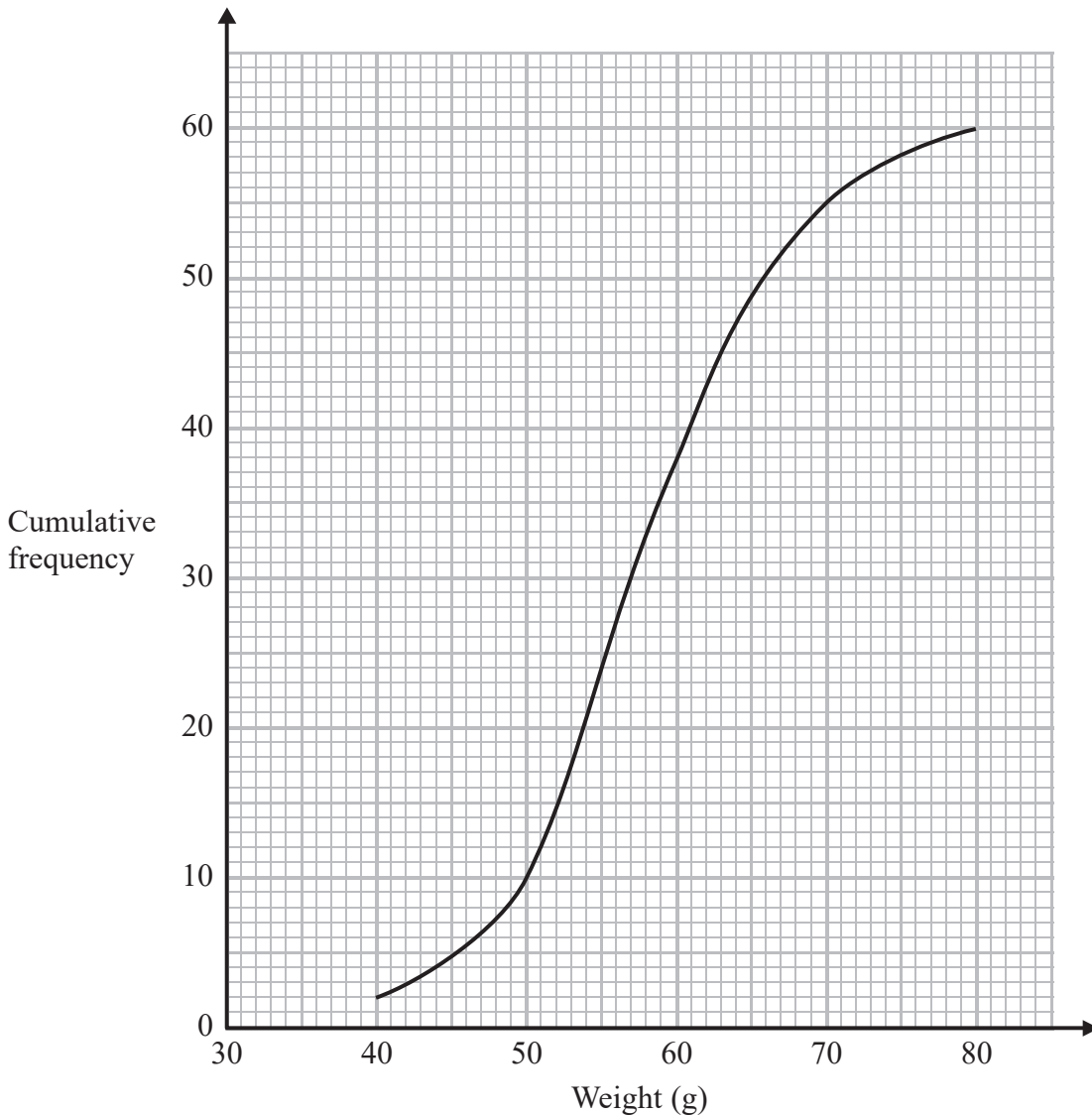
(a) Use the graph to find an estimate for the median weight.

The total frequency is 60 and the median is roughly halfway through the data

.... g

(1)

Jamil says,

"80 − 40 = 40 so the range of the weights is 40 g."

(b) Is Jamil correct?
You must give a reason for your answer.

The range is the highest value subtract the lowest value, but could the lowest value be less than 40g?

....

....

(1)

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(c) Show that less than 25% of the potatoes have a weight greater than 65 g.

Use the graph to work out how many potatoes had mass
equal to or less than 65g. Subtract this from the total number
of potatoes to give the number which are greater than 65g.
Putting this over 60 (the total number of potatoes) gives the
fraction of the potatoes greater than 65g. Then convert the
fraction into a percentage, which should be less than 25%

(2)

(Total for Question 11 is 4 marks)
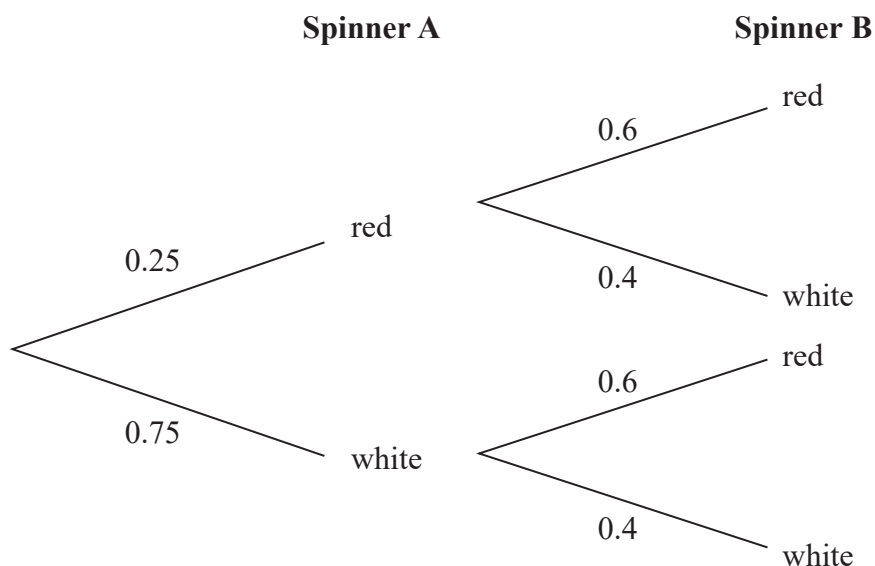
12 Alan has two spinners, spinner **A** and spinner **B**.
Each spinner can land on only red or white.

The probability that spinner **A** will land on red is 0.25
The probability that spinner **B** will land on red is 0.6

The probability tree diagram shows this information.

Spinner A   Spinner B

Alan spins spinner **A** once and he spins spinner **B** once.
He does this a number of times.

The number of times **both** spinners land on red is 24

Work out an estimate for the number of times **both** spinners land on white.

The total number of spins multiplied by the probability for red and red gives the number of times both spinners should land on red. Make an equation out of this, once the probability for red and red is found, and then rearrange to find the total number of spins. The total number of spins multiplied by the probability for white and white gives the number of times both spinners should land on white

....

(Total for Question 12 is 3 marks)

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13 Write $x^2 + 6x - 7$ in the form $(x + a)^2 + b$ where a and b are integers.

....

(Total for Question 13 is 2 marks)

14 Cone **A** and cone **B** are mathematically similar.
The ratio of the volume of cone **A** to the volume of cone **B** is 27 : 8

The surface area of cone **A** is 297 cm²

Show that the surface area of cone **B** is 132 cm²

(Total for Question 14 is 3 marks)

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15 (a) Show that the equation $x^3 + 7x - 5 = 0$ has a solution between $x = 0$ and $x = 1$

First substitute in 0 and 1 into the left side of the equation. One value should be negative and the other should be positive. Consider that the curve is continuous and must go through all the values between these two values so at some point must be zero

(2)

(b) Show that the equation $x^3 + 7x - 5 = 0$ can be arranged to give $x = \dfrac{5}{x^2 + 7}$

Notice that the 5 has been moved to the other side of the equation. Factorising can get the $x^2 + 7$ part out of the $x^3 + 7x$

(2)

(c) Starting with $x_0 = 1$, use the iteration formula $x_{n+1} = \dfrac{5}{x_n^2 + 7}$ three times to find an estimate for the solution of $x^3 + 7x - 5 = 0$

$$x_1 = \frac{5}{(1)^2 + 7}$$

....

(3)

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(d) By substituting your answer to part (c) into $x^3 + 7x - 5$,
comment on the accuracy of your estimate for the solution to $x^3 + 7x - 5 = 0$

If the result is close to 0, it should be considered to be accurate

....

....

(2)

(Total for Question 15 is 9 marks)

16 The petrol consumption of a car, in litres per 100 kilometres, is given by the formula

$$\text{Petrol consumption} = \frac{100 \times \text{Number of litres of petrol used}}{\text{Number of kilometres travelled}}$$

Nathan's car travelled 148 kilometres, correct to 3 significant figures.
The car used 11.8 litres of petrol, correct to 3 significant figures.

Nathan says,

"My car used less than 8 litres of petrol per 100 kilometres."

Could Nathan be wrong?
You must show how you get your answer.

There is some uncertainty in the distance travelled and amount of petrol used as they are only correct to 3 significant figures (they have been rounded) so both figures could be slightly higher or lower than 148 and 11.8. By considering the bounds of each of the figures, calculate the upper bound of the petrol consumption. If this is less than 8, Nathan is correct.

To calculate the upper or lower bound for each figure, add or subtract half of the resolution of the place value of the place it was rounded to.

(Total for Question 16 is 3 marks)

17 *ABC* and *ADC* are triangles.
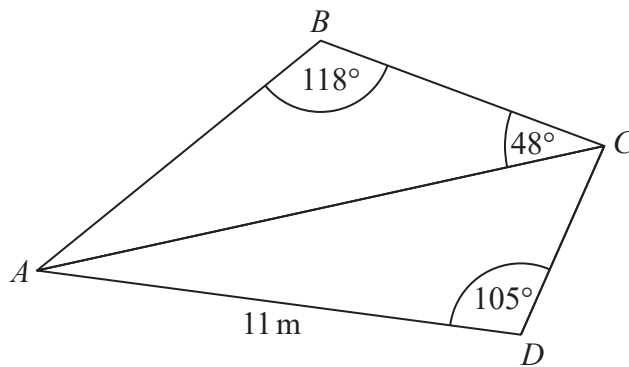
The area of triangle *ADC* is 56 m²

Work out the length of *AB*.
Give your answer correct to 1 decimal place.

Use the formula for the area of a triangle 1/2 ab x sinC to find side CD. Then use the cosine rule $a^2 = b^2 + c^2 - 2bc\cos A$ to find side AC. Then use the sine rule a/sinA = b/sinB to find side AB

.... m

(Total for Question 17 is 5 marks)

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18 Here is a speed-time graph for a train.
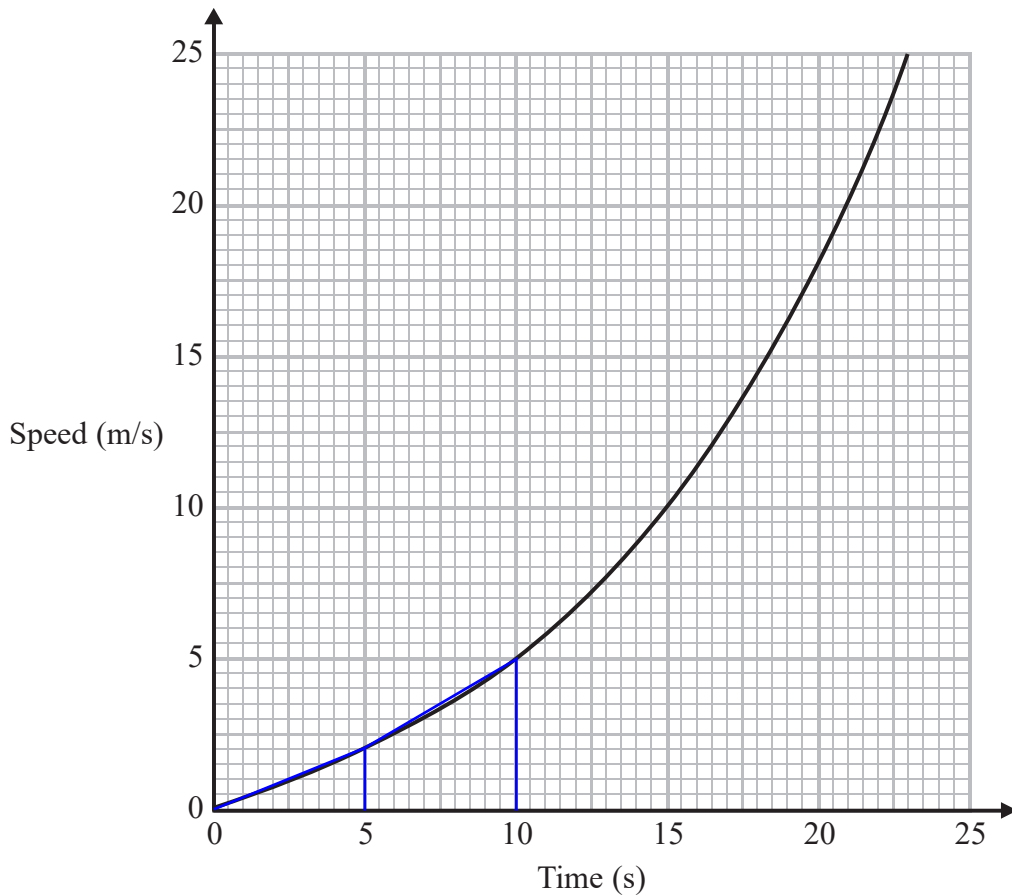
(a) Work out an estimate for the distance the train travelled in the first 20 seconds.
Use 4 strips of equal width.

Distance on a speed-time graph is the area under the curve. Split the area into 4 shapes of equal width (with straight sides instead of a curve) to work out an estimate of the area. Area of triangle = 1/2 x base x height. Area of a trapezium = 1/2 (a + b) x h where a and b are the parallel sides and h is the distance between them

.... m

(3)

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

The area of the curve isn't exactly the same as what was calculated in part (a)

(1)

(Total for Question 18 is 4 marks)

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19 Prove algebraically that the straight line with equation $x - 2y = 10$ is a tangent to the circle with equation $x^2 + y^2 = 20$

Tangents intersect a curve at one point only. Solving the simultaneous equations can show the point of intersection and show that there is only one.
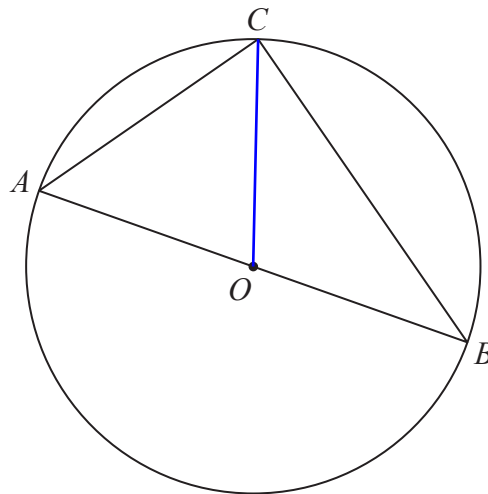
First rearrange the linear equation to make either x or y the subject. Then substitute it into the equation of the circle to eliminate a variable. This will create a quadratic which can be solved with factorisation once in the form $ax^2 + bx + c = 0$

(Total for Question 19 is 5 marks)

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20

A, B and C are points on the circumference of a circle, centre O.
AOB is a diameter of the circle.

Prove that angle ACB is 90°
You must **not** use any circle theorems in your proof.

Let angles ACO = x and OCB = y

> Radii are equal in length. The base angles in isosceles triangles are equal. Angles in a triangle add up to 180. Using these facts, we can show that x + y = 90. x + y gives angle ACB

(Total for Question 20 is 4 marks)

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21
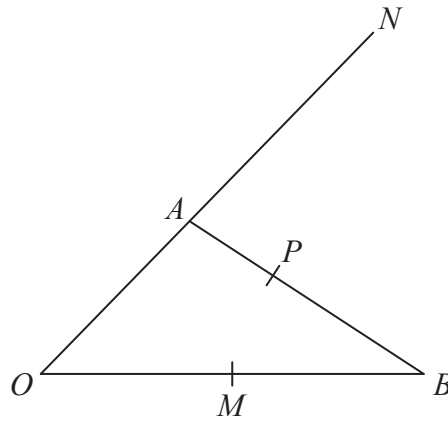
OAN, *OMB* and *APB* are straight lines.
AN = 2*OA*.
M is the midpoint of *OB*.

$\overrightarrow{OA} = \mathbf{a}$ $\qquad \overrightarrow{OB} = \mathbf{b}$

$\overrightarrow{AP} = k\overrightarrow{AB}$ where *k* is a scalar quantity.

Given that *MPN* is a straight line, find the value of *k*.

> MPN is a straight line so $\overrightarrow{MN}$ must be something multiplied by $\overrightarrow{MP}$. Find both of these vectors. There are two ways of expressing $\overrightarrow{MN}$ and both of these expressions must be equal to each other. This makes an equation. Equating the coefficients of vectors a and b in this equation creates two equations which can be solved simultaneously to find k

....

(Total for Question 21 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS

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