OCR
Oxford Cambridge and RSA

H

Friday 6 November 2015 – Morning

GCSE APPLICATIONS OF MATHEMATICS

A382/02   Applications of Mathematics 2 (Higher Tier)

Duration: 2 hours

Candidate forename		Candidate surname	

Centre number					Candidate number				

INSTRUCTIONS TO CANDIDATES

* Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
* Use black ink. HB pencil may be used for graphs and diagrams only.
* Answer **all** the questions.
* Read each question carefully. Make sure you know what you have to do before starting your answer.
* Your answers should be supported with appropriate working. Marks may be given for a correct method even if the answer is incorrect.
* Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
* Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

* The number of marks is given in brackets **[ ]** at the end of each question or part question.
* Your quality of written communication is assessed in questions marked with an asterisk (*).
* The total number of marks for this paper is **90**.
* This document consists of **24** pages. Any blank pages are indicated.

You are permitted
to use a calculator
for this paper

OCR is an exempt Charity

Turn over
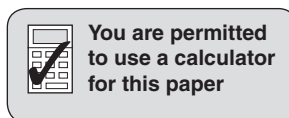
Formulae Sheet: Higher Tier

Area of trapezium $= \frac{1}{2}(a + b)h$
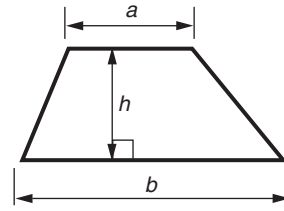
Volume of prism = (area of cross-section) × length
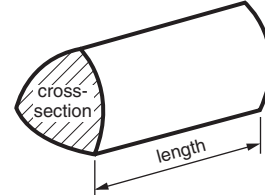
In any triangle _ABC_

Sine rule $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

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

Area of triangle $= \frac{1}{2}ab \sin C$
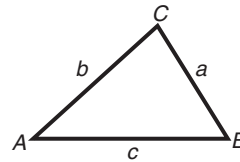
Volume of sphere $= \frac{4}{3}\pi r^3$

Surface area of sphere $= 4\pi r^2$
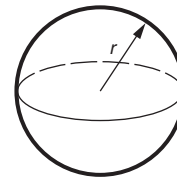
Volume of cone $= \frac{1}{3}\pi r^2 h$

Curved surface area of cone $= \pi r l$
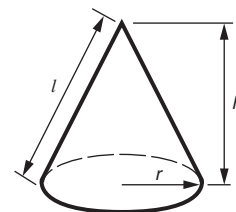
The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$,
where $a \neq 0$, are given by

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

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1 Andy and Beth are cycling at constant speeds along a straight road in opposite directions.

T
Andy

Beth
P

5m   95m
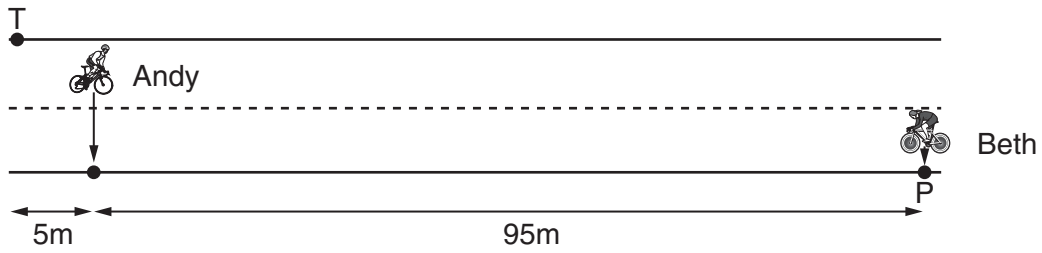
Andy is 5 m past the tree, T, and cycling at 15 m/s.
Beth is at the postbox, P, and cycling at 10 m/s.

(a) Draw a distance-time graph to show their distances **from the tree** as they cycle along the road.
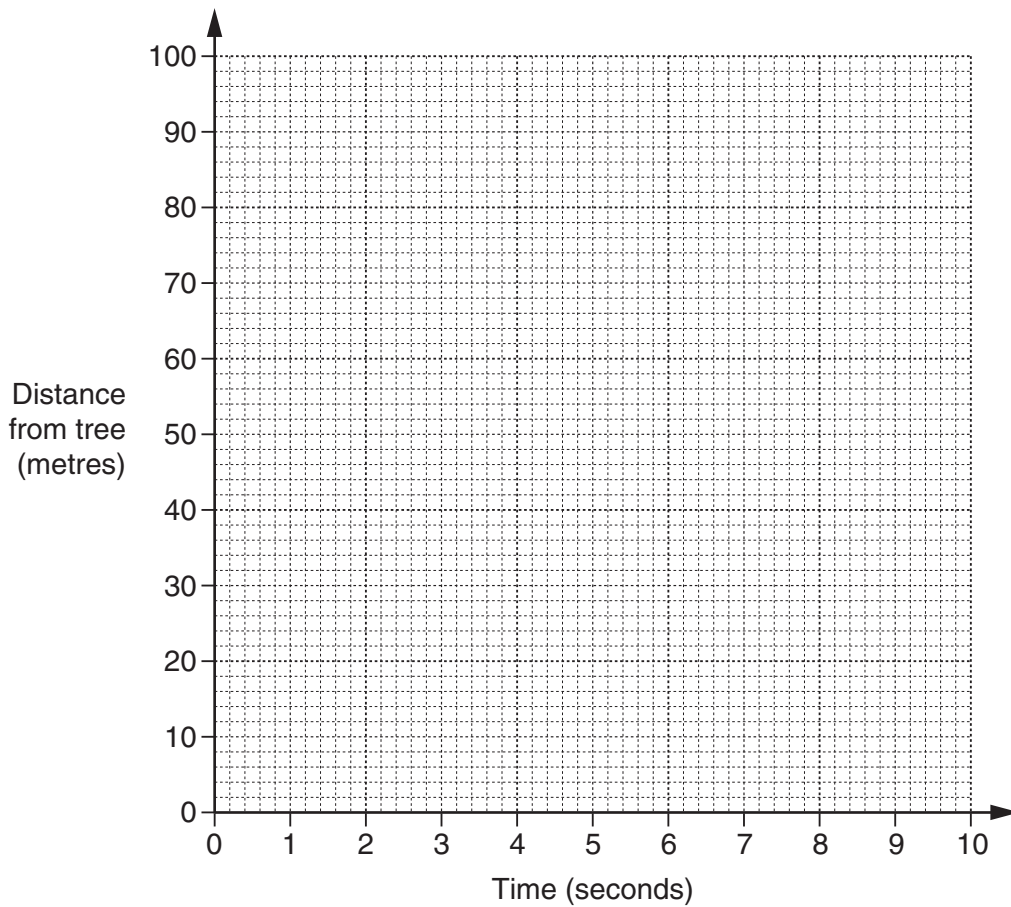
[4]

(b) (i) After how many seconds do Andy and Beth pass each other?

(b)(i) .... seconds **[1]**

(ii) How far from the tree is Beth when she passes Andy?

(ii) .... m **[1]**

2 This is a map of St Helena.

6 km
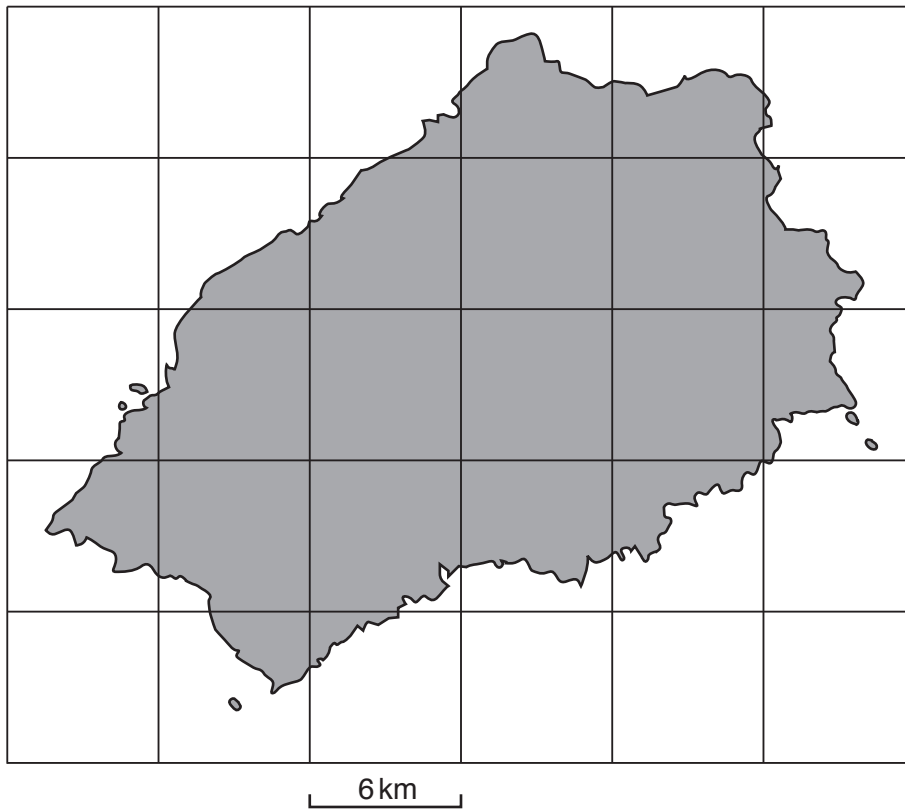
(a) Work out an estimate of the area in km² of St Helena.
Show how you worked out your answer.

(a) .... km² **[3]**

(b) A population census of St Helena is carried out every 10 years.
In the 1998 census the population was 5157. In the 2008 census the population was 4255.

If the population continues to decrease by the same **proportion**, in which census year will the population first be less than 2000?

(b) .... **[4]**

(c) St Helena is divided into 8 districts, shown on the map below.

The table shows the population density for each district recorded from the 2008 census.

District	Alarm Forest	Blue Hill	Half Tree Hollow	Jamestown	Levelwood	Longwood	Sandy Bay	St Paul's
Population / km²	46.8	4.2	563.1	198.3	22.6	21.4	13.4	69.7

(c) The populations of Jamestown and Longwood are about the same.

How many times larger is the **area** of Longwood compared to Jamestown?

(c) .... **[2]**

(d) Decide if the following statements are true or false for St Helena in 2008.

Justify your decisions.

(i) More people live in Levelwood than Longwood.

.... because ....

.... **[1]**

(ii) There were about three times as many people living in St Paul's than in Levelwood.

.... because ....

....

.... **[2]**

3 Signs at bridges give information about the maximum height of vehicles that can safely drive underneath the bridge.

Here are signs for two different bridges.
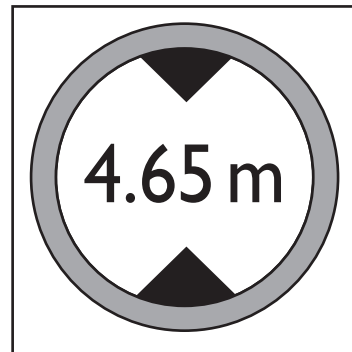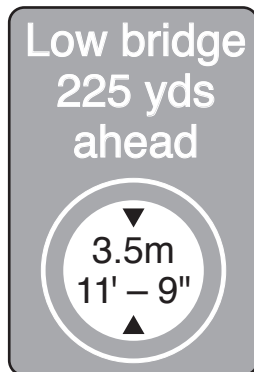
11' – 9" means 11 feet and 9 inches.
There are 12 inches in one foot.

The low bridge sign gives the maximum height in metres and in feet and inches.
The other sign gives the maximum height in metres.

Use the information given to work out the maximum height in feet and inches of a vehicle that can safely drive under a bridge with maximum height of 4.65 m.

.... **[4]**

Turn over

4 An electrical store offers the following 'instant replacement' insurance cover for some products. The table shows the cost of this insurance.

Product cost	SatNav	eReader	Camera	Radio
£20 to £40.99		£10	£10	
£41 to £60.99		£17	£15	£15
£61 to £80.99	£25	£25	£20	£20
£81 to £100.99	£30	£34	£25	£26
£101 to £120.99	£35	£39	£30	£33
£121 to £150.99	£40	£44	£35	£39

Instant replacement insurance means the store will replace a product that fails within 3 years.

(a) (i) Which product does the store believe is **least** likely to fail within 3 years?
Give a reason for your answer.

....

.... [1]

(ii) All the eReaders sold at this store have a manufacturers' warranty of 2 years.
This means that if an eReader fails within 2 years the manufacturer will replace the eReader.

Juno buys an eReader from the store.
Juno is very likely to buy a new eReader within 2 years.

Should Juno buy instant replacement insurance?
Give a reason for your answer.

....

.... [1]

(b) Theo buys a SatNav for £125.
He finds these probabilities of failure for this particular SatNav.

Age of SatNav	Within 1 year	1 to 2 years	Between 2 and 10 years
Probability of failure	0.01	0.1	0.0009

(i) How does this information show that the SatNav is most likely to fail when it is 1 to 2 years old?

.... [1]

(ii) Theo's SatNav is still working after 3 years.

Explain whether Theo should be worried that it may break within the next year.

....

.... [1]

5 Gareth designs printed circuit boards (PCBs).
This spreadsheet shows the costs of making different quantities of two PCB designs, R and S.

	A	B	C	D	E	F	G
1	PCB design	Set-up cost	Cost per unit	Total for 100 units	Price per PCB	Total for 200 units	Price per PCB
2	R	£60.00	£0.20	£80.00	£0.80	£100.00	£0.50
3	S	£60.00	£0.36	£96.00	£0.96	£132.00	£0.66

The set-up cost is the cost of preparing to manufacture PCBs.
The cost per unit is the cost of making one PCB.

(a) The formula used for cell B2 is =B2+(100*C2).
The formula used for cell E2 is =D2/100

Complete the formula used for cell F3 to find the total cost of **200** of PCB design **S**.

(a) = ……………+ (………………*…………….) **[2]**

(b) Explain why the price per PCB is cheaper when 200 PCBs are made.

....

.... **[1]**

Turn over

In this question you may leave your answers to part (a) and part (b) in terms of π.

6 Body shape of young children can be modelled using geometrical solids.

   (a) Work out the volume and the total surface area of this cylinder.

   0.5 cm

   Not to scale

   18 cm
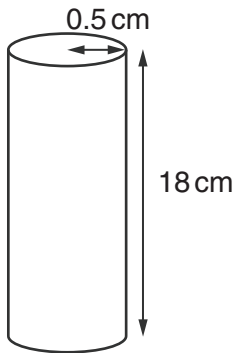
   (a) Volume .... cm³

   Total surface area .... cm²
   [4]

   (b) Work out the volume and the surface area of this sphere.

   Not to scale

   1.5 cm
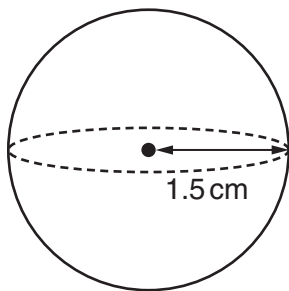
   (b) Volume .... cm³

   Surface area .... cm²
   [4]

(c) The most common method to calculate an estimate of fluid requirements for very young children in hospital is to use **body weight**. Methods to calculate an estimate of the fluid lost by young children use either **body weight** or **body surface area**. Fluid is continuously lost through the skin.

   (i) Using your answers to part **(a)** and part **(b)** give **one** reason why **body surface area** calculations may give a better estimate of fluid lost than **body weight**.

   ....

   ....

   .... **[2]**

   (ii) This is a formula used in hospitals to calculate body surface area (BSA).

   $$\text{BSA} = \frac{1}{60}\sqrt{(h \times w)}$$ where h is height in cm and w is weight in kg

   Give **one practical** reason why **body weight** is easier to use than body surface area to find an estimate of fluid lost.

   ....

   .... **[1]**

7 In a fuel economy competition teams compete to use the least amount of fuel.
These are the competition rules.

- Complete 7 laps of a 1.5 mile circuit.
- Travel at an average speed of at least 15 miles per hour (mph) over the whole 7 laps.

(a)* These are the times, in minutes, for each lap by Team Orange.

$$4.5 \quad 3.0 \quad 6.3 \quad 5.7 \quad 5.1 \quad 4.4 \quad 4.6$$

Show that Team Orange competed within the competition rules.

....

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....

....

....

....

.... **[4]**

(b) At one competition Team Blue had six entries.
Each entry used the same car, but with different drivers.
After each driver had driven the 7 laps, the fuel used was measured.
The results were used to calculate the fuel economy.

The table shows each driver's average speed in mph, correct to the nearest 0.1, and fuel economy in miles per gallon (mpg), correct to the nearest 100, for each attempt.

Driver	Alvita	Barney	Choy	Dilip	Evie	Fatima
Average speed (mph)	18.7	14.5	16.3	21.4	15.6	17.0
Fuel economy (mpg)	4100	5900	5300	4000	5200	4700

   (i) Which driver drove within the competition rules **and** had the best fuel economy?

(b)(i) .... **[1]**

   (ii) What does the table tell you about the relationship between speed and fuel economy?

....

.... **[1]**

8 A UK airport recorded the number of minutes delay from the scheduled take-off time for all its flights for one week in December 2013. These box plots summarise the results.
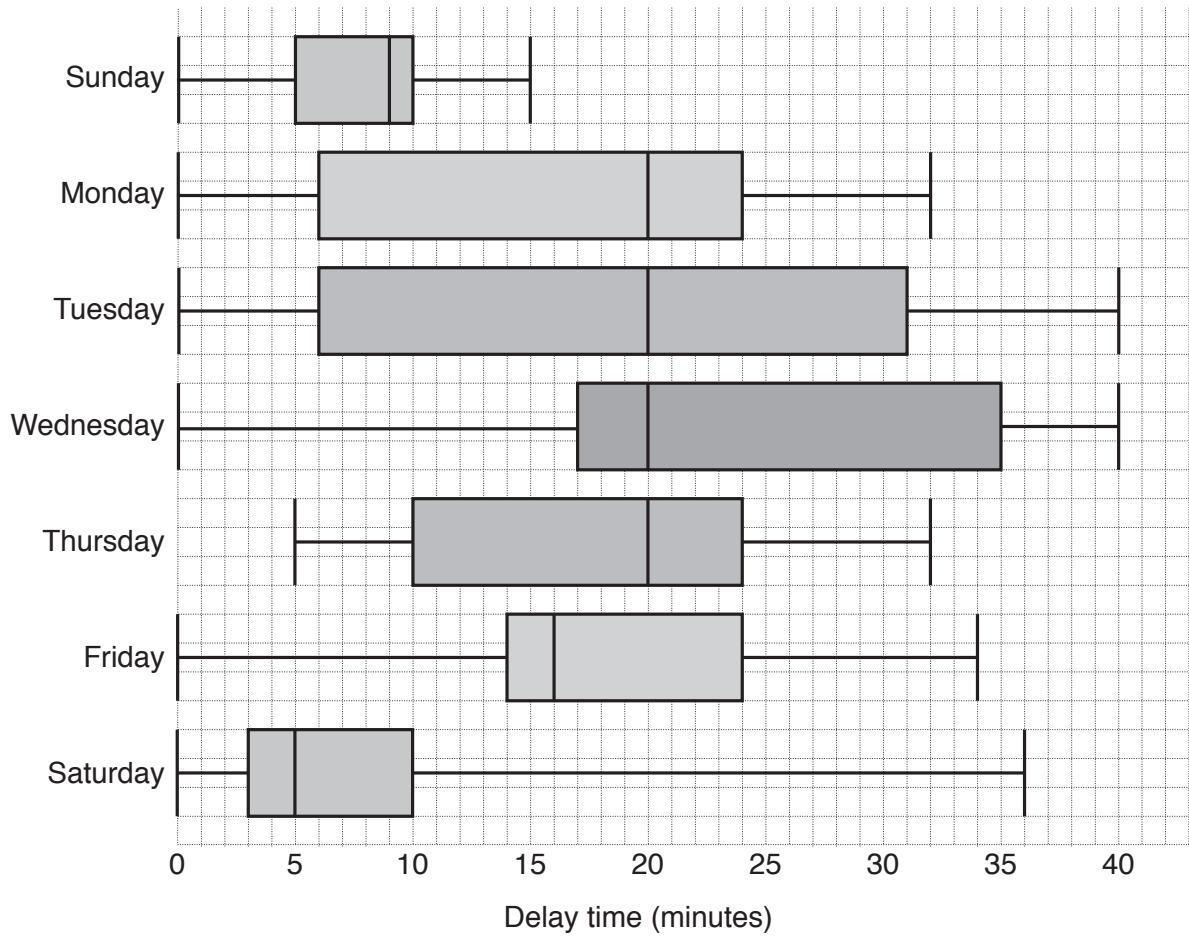
(a) On which day did no flights take off at their scheduled time?

(a) .... [1]

(b) On which day were take-off times most consistent?

(b) .... [1]

(c) Work out the interquartile range in delay times on **Saturday**.

(c) ....minutes **[2]**

(d) Write down the name of the statistical measure for **Monday's** delay times that does not have the same value as on any other day.

.... [1]

Turn over

9 This map shows the time differences, in hours, from Greenwich Mean Time (GMT) for states in Australia.
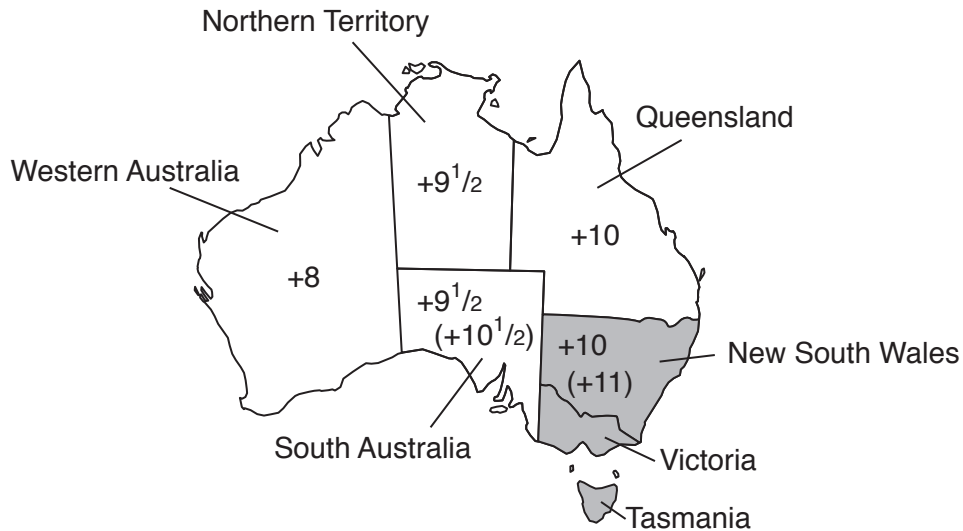
For example, when the time is 10:00 GMT, the local time in Queensland is 20:00.

In the southern states of Australia clocks go forward by 1 hour for Australian summer time.
The southern states are South Australia, New South Wales, Victoria and Tasmania.
Australian summer time runs from the first Sunday in October to the first Sunday in April.
The numbers in brackets show the time differences, in hours, for Australian summer time.

For example, when the time is 10:00 GMT in December, the local time in South Australia is 20:30.

(a) Reanna travels to Western Australia in January.
Her flight leaves London at 20:40 GMT on a Tuesday. The total travelling time is 21 hours.

Which day is it and what is the local time when Reanna arrives in Western Australia?

(a) Day……………………………… Time…………………………..… **[3]**

(b) Reanna travels from Western Australia to South Australia in February.

When she arrives in South Australia, Reanna makes a telephone call to London at 17:00, South Australian local time.

What time is it in **London (GMT)** when Reanna makes the telephone call?

(b) .... **[2]**

(c) Reanna then travels to New South Wales.
She crossed the border from South Australia to New South Wales at the end of April.
Reanna likes her watch to show the correct **local** time.

How did Reanna adjust the time on her watch so that it was correct?

....

.... **[1]**

(d)* In the winter months the UK uses Greenwich Mean Time (GMT).
In British Summer Time (BST) the clocks go forward by 1 hour.

The table summarises the dates when clocks go forward and when clocks go back.

	Clocks go forward 1 hour	**Clocks go back 1 hour**
Australia	First Sunday in October	First Sunday in April
United Kingdom	Last Sunday in March	Last Sunday in October

Reanna says 'The greatest number of days that the clocks in **both** Australia and the UK could be 1 hour forward is 35.'
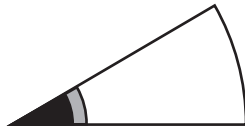
Show that Reanna is correct and work out the other possible number of days for which clocks in both Australia and the UK could both be 1 hour forward.

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.... **[5]**
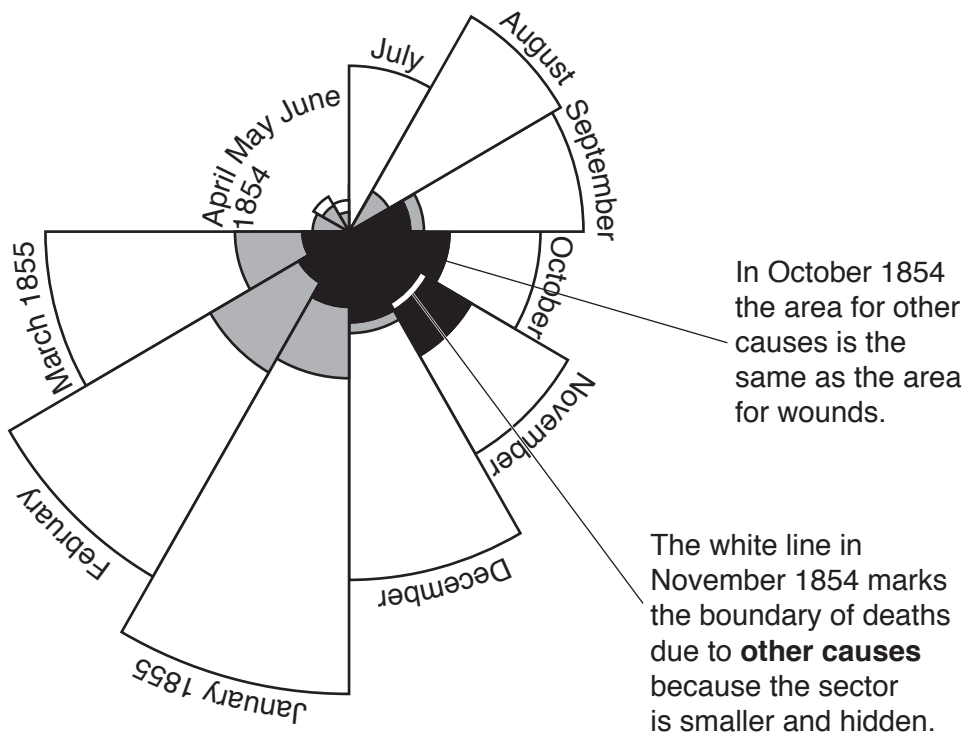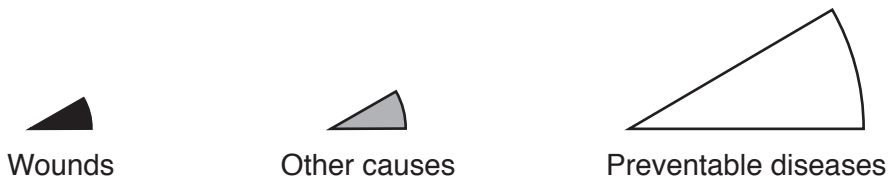
Turn over

10 Florence Nightingale worked as a nurse during the Crimean War.
She used a diagram similar to the one shown below to report to Members of Parliament on the numbers of deaths in the Crimean War and their causes.

The area of each sector represents the number of deaths from the given cause.
The radius of each sector is measured from the centre of the diagram.
Each month is made from up to 3 sectors drawn on top of each other.

This is the information for September.

These are the sectors for September drawn separately.

Wounds   Other causes   Preventable diseases

July
August
April May June
1854
September
March 1855
October
In October 1854 the area for other causes is the same as the area for wounds.
November
February
December
January 1855
The white line in November 1854 marks the boundary of deaths due to **other causes** because the sector is smaller and hidden.

Key:

■ Wounds

▨ Other causes

□ Preventable diseases

(a) Which month had the greatest number of deaths from **preventable diseases**?

(a) .... [1]

(b) Which month had almost the same number of deaths from **wounds** as October?

(b) .... [1]

(c) This diagram has been described as a mix of a pie chart and a histogram.

Describe how this diagram is **similar** to a histogram.

....

.... [1]

(d) Florence Nightingale said the graph shows there was double the mortality from **preventable diseases** in January 1855 than in December 1854.

Use measurement from the graph and calculations to decide if she was correct.

....

....

....

....

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.... [4]

11 Drivers on a drag strip race to cover a set distance in the shortest time possible.
At the end of the set distance a parachute is opened to help the car slow down.
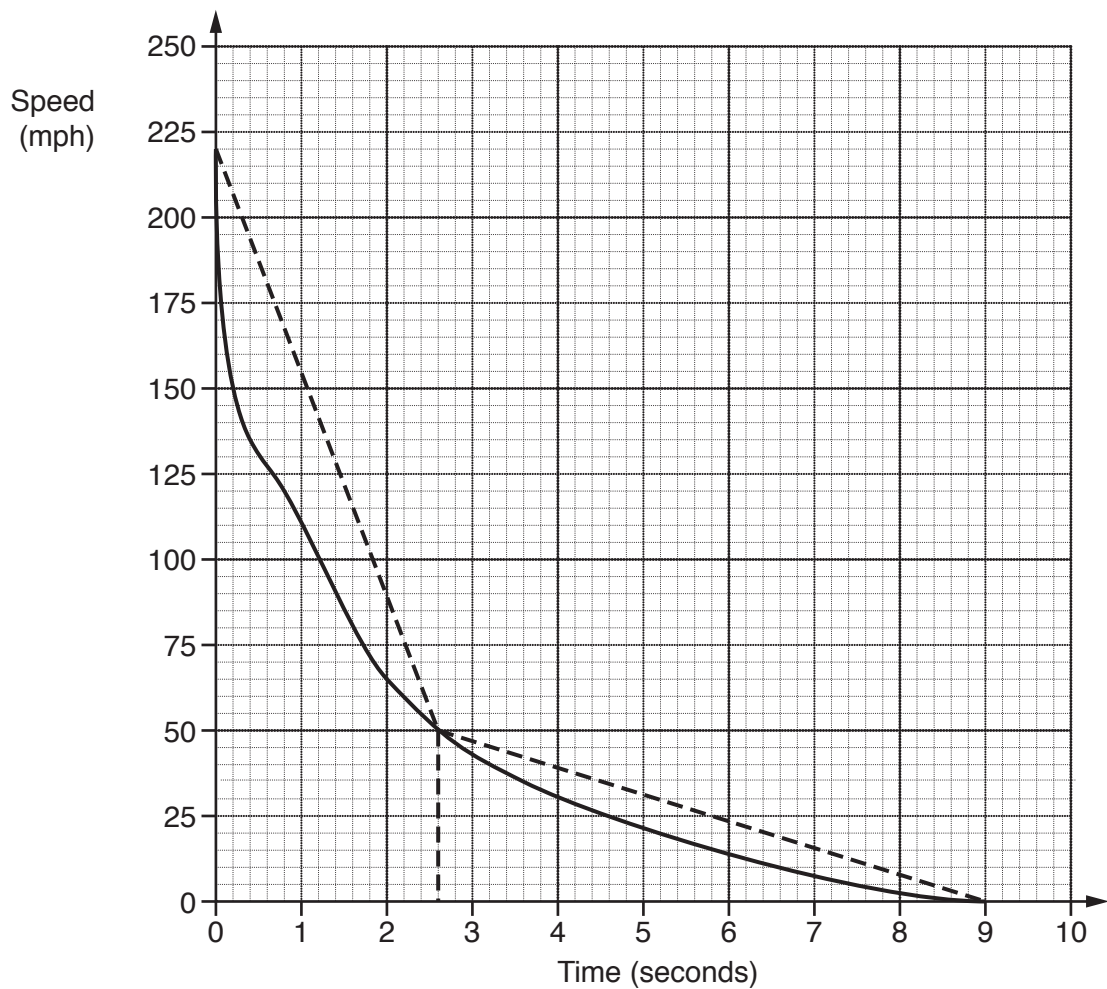
John races his car on a drag strip.
At the end of the set distance his speed is
220 miles per hour (mph).

At this moment John opens the car's parachute.
It takes 9 **seconds** for the car to stop.

On the speed-time graph, the solid curved line
shows the motion of the car from the moment the
parachute is opened.

The dotted lines are drawn to help calculate the area under the graph.

(a) The area under the graph shows the distance the car travelled whilst slowing down.
John estimated this distance by splitting the area into a trapezium and a triangle.
These are shown by the dotted lines.

    (i) Calculate an estimate of this distance using John's method.
        Show clearly the values you use.

(a)(i) .... miles **[4]**

    (ii) Explain how John could make his method for estimating the distance more accurate.

        ....

        .... **[1]**

(b)* Draw a tangent on the graph at **5 seconds** and calculate an estimate of the deceleration of
the car **5 seconds** after the parachute opened.
Show clearly on the graph the information you needed for your calculation.
Give the units of your answer.

(b) .... **[5]**

12 The diagram shows a sketch of the earth.
The equator and the circle of latitude 53° North are shown dotted.

Circle of latitude 53° North

Equator
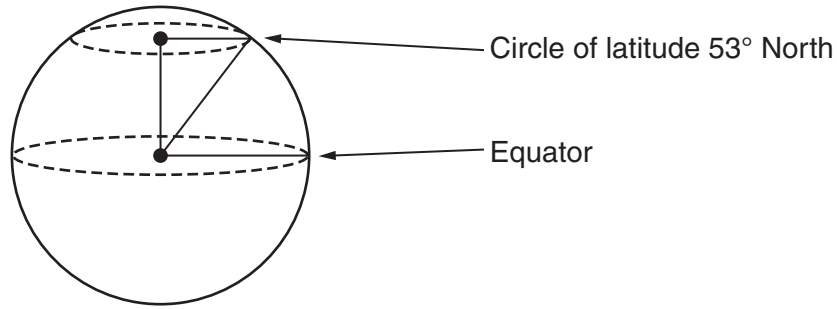
(a) Calculate the radius of the circle of latitude 53° North.
You may assume the earth is a sphere with radius 6370 km.

(a) .... km **[3]**

(b) Leopold is driving from Bremen (B) in Germany to Samara (S) in Russia.
Bremen and Samara lie on the circle of latitude 53° North.

41°

S

B
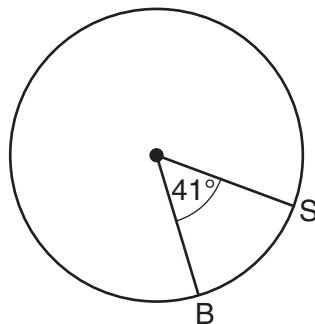
Not to scale

(i) Work out the distance along the circle of latitude between Bremen and Samara.

(b)(i) .... km **[3]**

(ii) An internet map gives a driving distance of 3240 km between Bremen and Samara.
Leopold wants to estimate his fuel costs for the journey.

Should Leopold use the distance calculated in part **(b)(i)** or the distance on the internet
map? Give a reason for your choice.

....

.... **[1]**

13 A scout group is planning a day where scouts assemble electronic kits.
They plan to buy two different types of kit, **X** and **Y**.

(a) The most they have to spend is £25.
Kit **X** costs £1.25 and kit **Y** costs £0.75.

Show that $5x + 3y \leqslant 100$ where x is the number of kit **X** bought
and y is the number of kit **Y** bought.

....

.... **[2]**

(b) The scout group wants to buy at least 5 of kit **X** and at least 4 of kit **Y**.
They need at least 20 kits altogether.

All this information, and the information from part **(a)**, is shown on the graph.
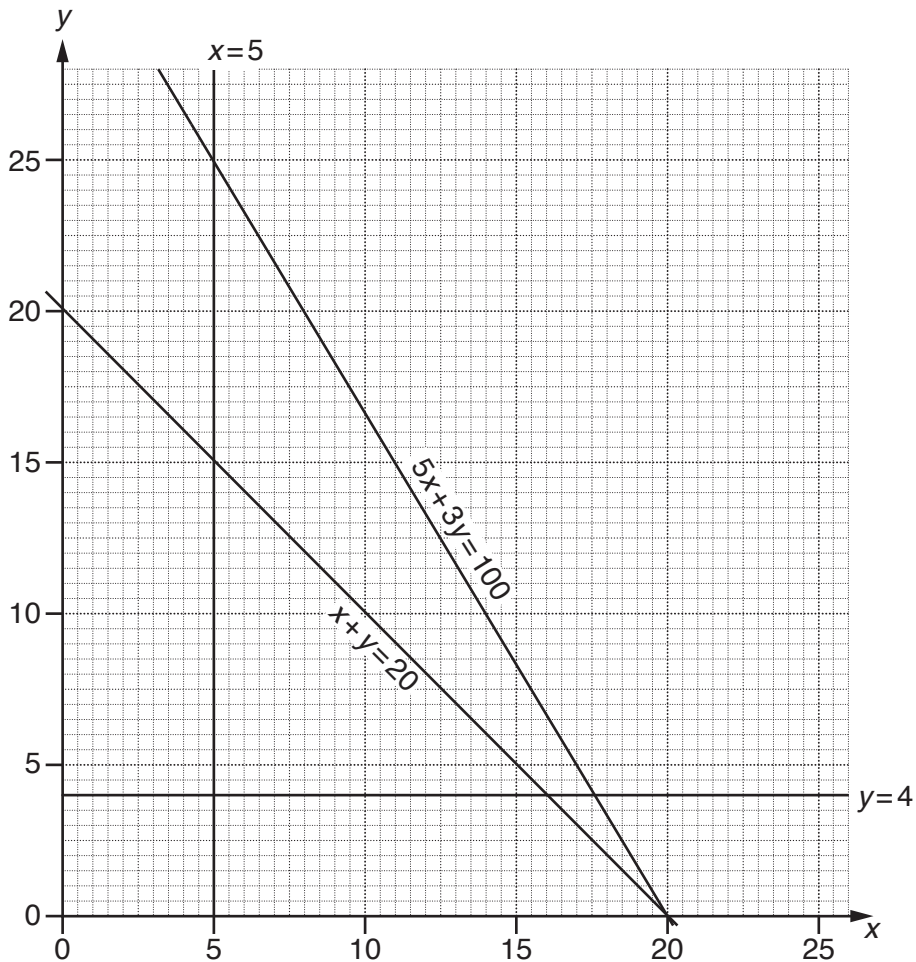
What is the greatest number of kits that can be bought?
How many of kit **X** and how many of kit **Y** is this?

(b) Total number of kits ....

kit **X** .... kit **Y** .... **[2]**

END OF QUESTION PAPER

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