OCR
Oxford Cambridge and RSA

H

Thursday 4 June 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 **20** pages. Any blank pages are indicated.

> You are permitted to use a calculator for this paper

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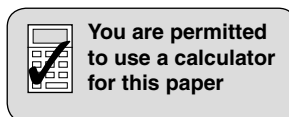
Formulae Sheet: Higher Tier

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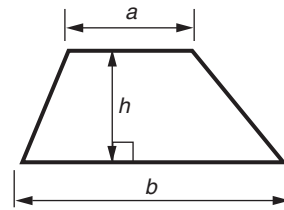
Volume of prism = (area of cross-section) × length
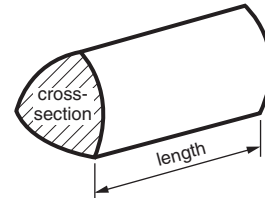
In any triangle *ABC*

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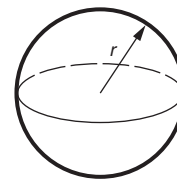
Volume of cone $= \frac{1}{3}\pi r^2 h$

Curved surface area of cone $= \pi rl$

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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Answer **all** the questions.

1 *Gulliver's Travels* by Jonathan Swift is a book about a man, Gulliver, who visits a land of very small people. These very small people are called Lilliputians.
The Lilliputians used ratio to measure Gulliver to make new clothes for him.

In the book Gulliver says:

'They measured my right thumb to use a mathematical computation that **twice round the thumb is once round the wrist**.'
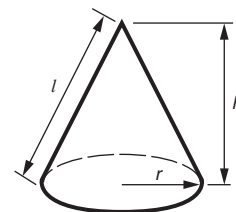
(a) (i) Write a hypothesis about thumb and wrist measurement based on the statement in bold.

....

....

.... **[1]**

Cara decided to carry out a survey to check the statement.
This is the start of Cara's data collection sheet.

Sample size *n* =	
Data	

(ii) Suggest a suitable sample size and write headings for the data columns.
Remember to include the units in your headings. **[4]**

(iii) Describe how the data can be collected. Give one way to avoid bias.

....

....

....

....

.... **[2]**
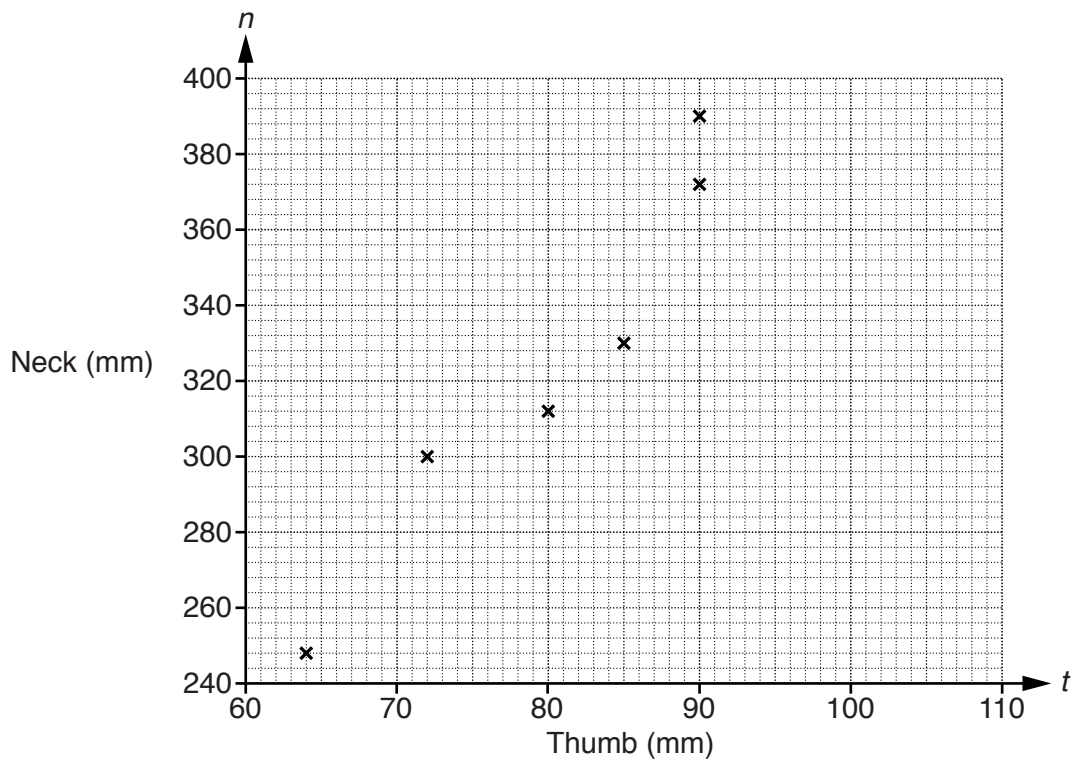
Turn over

(b) Gulliver also said:

'The measurement round the neck is four times the measurement round the thumb.'

Seth decides to investigate whether this is true.
Here are the measurements Seth collected.

Thumb, *t* mm	90	72	64	90	85	80	98	95	90	92
Neck, *n* mm	372	300	248	390	330	312	390	380	360	352

The first six measurements have been plotted on the scatter diagram.

 (i) Complete the scatter diagram. **[2]**

 (ii) Draw a line of best fit for the data on your diagram. **[1]**

 (iii) Explain why your line of best fit should not be used for a thumb measurement of 105 mm.

 ....

 .... **[1]**

 (iv) Assuming Gulliver's statement is **true**, write down an equation connecting *n* and *t*.

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

(c) (i) Shirt sizes for men are given in inches to the nearest half inch.

To find a man's shirt size:
- use the distance around his neck in **inches**
- add half an inch
- **round up** to the next inch or half inch.

Complete the flow diagram to find shirt size, s, for a neck size measurement of n mm.
Use 1 inch = 25.4 mm.

$n \rightarrow$ [ ] $\rightarrow$ [ ] $\rightarrow$ [ ] $\rightarrow s$

[3]

(ii) The distance round Joe's **thumb** is 106 mm.

Work out Joe's shirt size.
Assume the statement in part **(b)** is true.

(c)(ii) .... **[3]**

2 The Sun is 4.57 billion years old.
One billion = one thousand million.

(a) An astronomer needs the age of the Sun in seconds for a calculation.

Work out 4.57 billion years in seconds.
Give your answer in standard form to a sensible degree of accuracy.

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

(b) Give one reason why it is **not** sensible to give an exact answer for the age of the Sun in seconds.

....

.... **[1]**
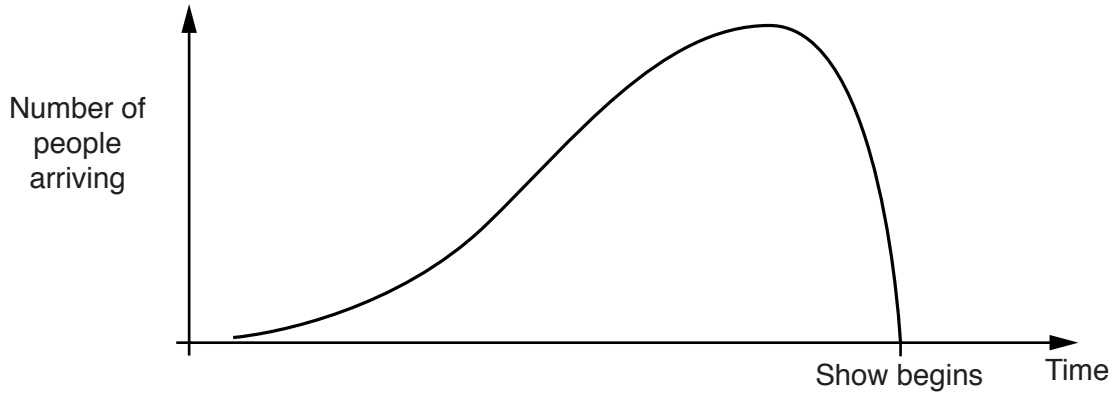
3 To plan for crowd control the arrival rates (number of people arriving) at events are modelled.

This graph models the arrival rate for a theatre show.
This is an event where tickets are bought in advance and everyone with a ticket has a numbered seat.
Entry is refused to people who arrive once the show has begun.

 (a) For the following two events:

* Sketch graphs to model each arrival rate.
* Indicate on your graph when the event begins.

 (i) Event 1. A music concert, where the audience stand.
 Many people arrive early to get as close to the stage as possible.
 Entry is refused to people who arrive once the concert has begun.

[2]

 (ii) Event 2. A firework display.
 Many people arrive as late as possible so they can be the first to leave.
 Entry is allowed to people who arrive after the display has begun.

[2]

(b) A large department store had a sale.
People continued to join the queue for the sale after the doors opened.
The graph shows the number of people in the queue.
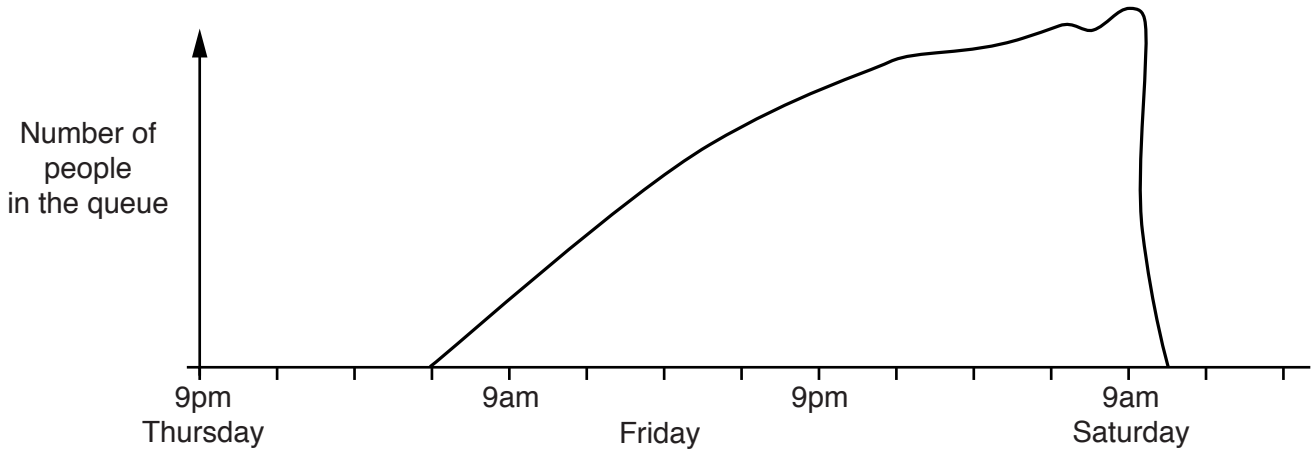
(i) What day and time did people start to queue?

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

(ii) What day and time did the doors open?

(ii) Day .... Time .... **[1]**

(c) This graph shows the number of people in the queues for rides at a theme park.
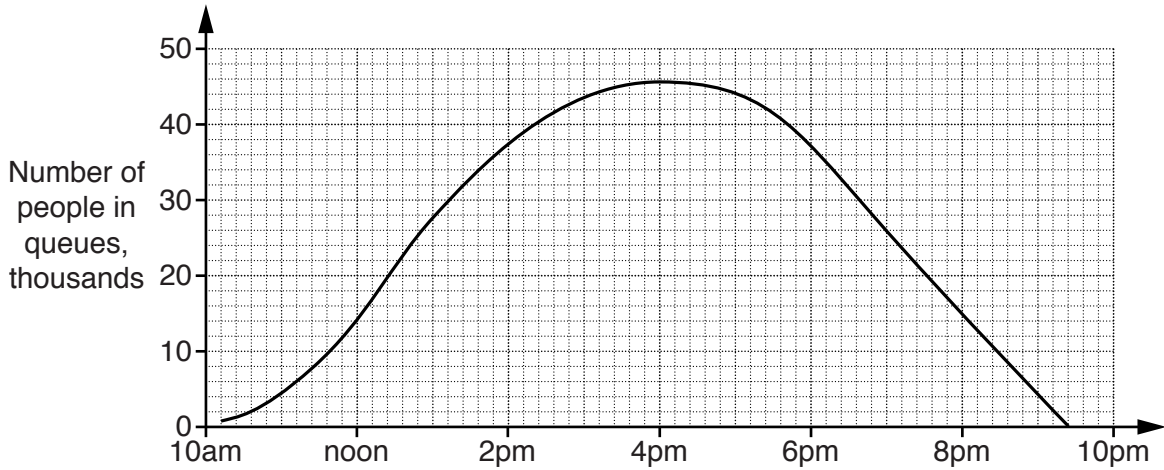
Work out the rate of increase in the number of people in the queues at 2pm.
Include the units in your answer.

(c) .... **[3]**

4 (a) Some crops depend on insects to pollinate them.
This table shows value of crops, in billions of dollars ($), in the United States in 2006 and how each crop is pollinated.

Item removed due to third party copyright restrictions.

Besides insects, other means of pollination include birds, wind and rainwater.

(i) Which crop depends totally on **honeybees** for pollination?

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

(ii) Which crop would be most affected if there were no **other insects**?

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

(iii) Work out the value of cotton pollinated by **honeybees** in 2006.

(iii) $ ....billions **[2]**

(b) This graph shows the number of honeybee colonies managed by beekeepers in the United States.
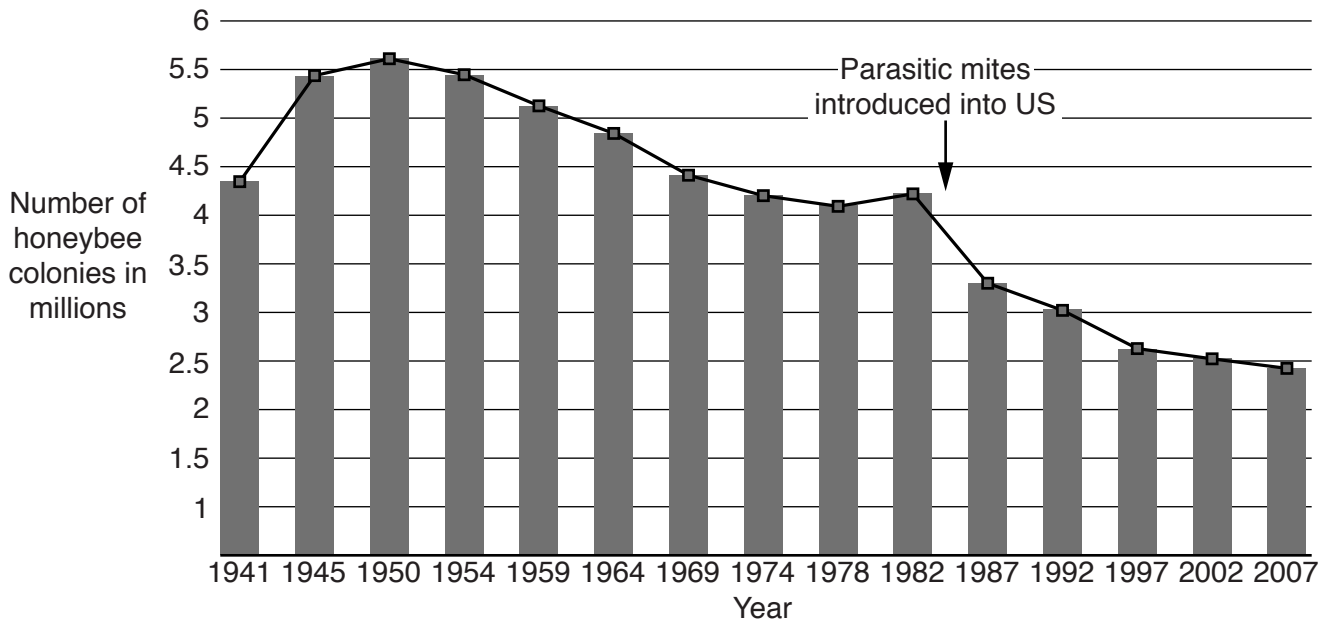
(i) Give a reason why the graph may be misleading.

....

.... **[1]**

(ii) Describe the effect on honeybee colonies when parasitic mites were introduced into the United States.

....

.... **[1]**

(c) Beekeepers in Michigan reported that the amount of honey produced in 2012 was 8.5% less than the amount produced in 2011.

Assume that the honey produced continues to drop at the same rate so the amount produced in 2013 is 8.5% less than the amount produced in 2012 and so on.

In which year will the amount of honey produced in Michigan first be less than half the 2011 amount?

(c) .... **[4]**

Turn over

5 In the UK the height of a horse is traditionally measured in hands.
1 hand = 4 inches.
A height of 12.2 hands means 12 hands and 2 inches.
So, 12.2 hands is the same as 12 × 4 + 2 = 50 inches.

(a) (i) To be classed as a miniature, a fully grown horse must have a height that is 34 inches or less.

Write 34 inches in hands.

(a)(i) .... hands **[2]**

In most of Europe, the height of a horse is measured in centimetres.
This graph shows the conversion between hands and centimetres.
For example, a height of 130 cm is the same as 12.3 hands.
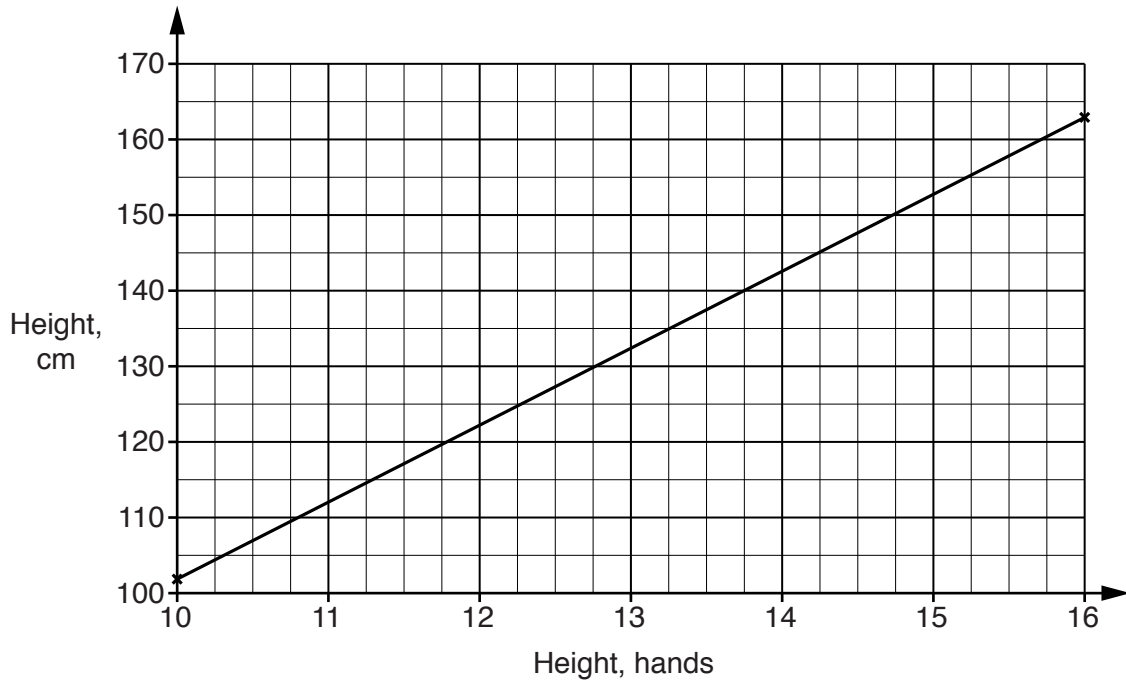
(ii) How high in hands is a horse measuring 150 cm?

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

(iii) The tallest horse ever recorded was 20.2 hands.

How high was this horse in centimetres?
Show how you reached your answer.

(iii) .... cm **[2]**

(b) This table design is called a horseshoe.

This table seats 15 people.
There are 3 people on each straight part and 9 people on the curved part.
The curved part is in the shape of a semicircle.
Each person has a space 0.8 m wide.

(i) Show that the outer radius of the semicircular part is 2.3 m, correct to 1 decimal place.

....

....

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....

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.... **[3]**

(ii) The width of each part of the table is 0.6 m.

Work out the total area of the table top.

(ii) ....m² **[5]**

Turn over

6 Josh and Reuben are standing near a tree, T.

Josh is 6 m from T.
Reuben is 10 m from T.

(a) Use construction to show all the possible positions for Josh and for Reuben.
Use scale: **1 cm represents 2 m**.

■ T

[2]

(b) Josh and Reuben are 8 m apart.

(i) On your diagram in part **(a)** mark one pair of possible positions for Josh and Reuben using two crosses (X). Label the points J and R. **[1]**

(ii)* Join points J, R and T and use mathematics to fully describe and explain why for any position of Josh there are only two possible positions for Reuben.

....

....

....

....

....

....

.... **[3]**

7 The aspect ratio of a screen describes the relationship between its width and its height.
The table gives some of the commonly used aspect ratios of different screens.

Screen	Aspect ratio width : height
Standard widescreen cinema	12:5
European widescreen cinema	5:3
Computer monitor	4:3
HD flat-screen television	16:9

(a)* Ken looks directly at a point on a wall.
Around this he can see points that are 9 cm apart horizontally and 3.5 cm apart vertically.

Which screen has an aspect ratio closest to what Ken can see?

....

....

....

.... **[3]**

(b) (i) Work out the angle, a, that the diagonal makes with the bottom of the screen on an HD flat-screen television.

Not to scale
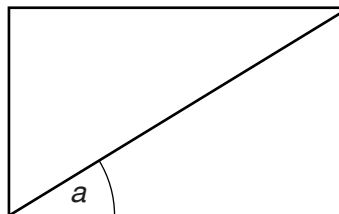
(b)(i) ....° **[3]**

(ii) The size of a television screen is given by the length of its diagonal.

Work out the width of the screen of a 32 inch HD flat-screen television.

(ii) .... inches **[3]**

(c) Maja carried out a survey to find how far people sat from their computer monitor.
She asked 120 people.
The table shows her results.

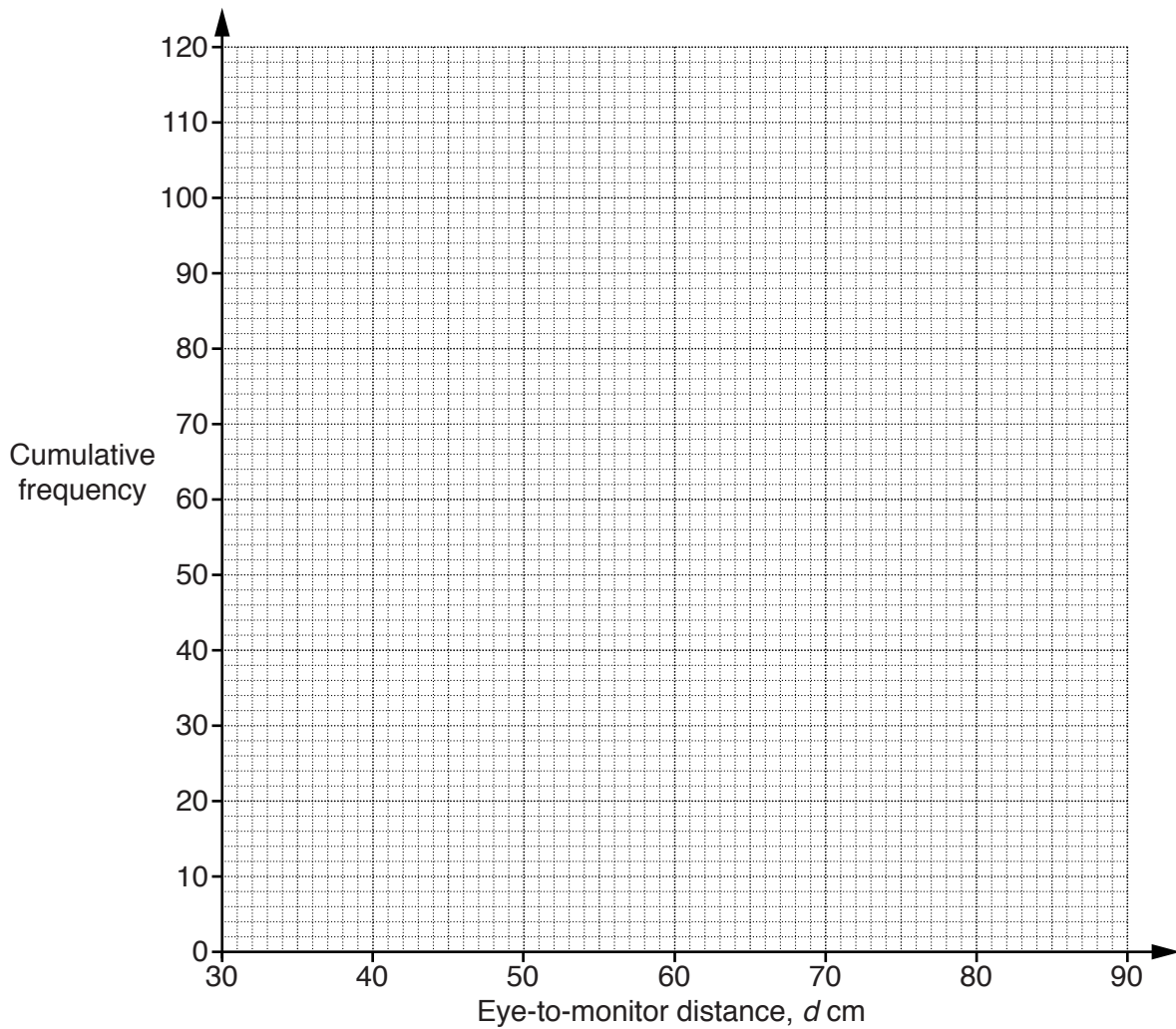| Eye-to-monitor distance, d cm	Frequency
$30 < d \leqslant 40$	6
$40 < d \leqslant 50$	15
$50 < d \leqslant 60$	31
$60 < d \leqslant 70$	40
$70 < d \leqslant 80$	22
$80 < d \leqslant 90$	6

  (i) Calculate an estimate of the mean eye-to-monitor distance.

(c)(i) .... cm **[4]**

  (ii) Complete the cumulative frequency table.

Eye-to-monitor distance, d cm	Cumulative frequency
$30 < d \leqslant 40$	6
$d \leqslant 50$	
$d \leqslant 60$	
$d \leqslant 70$	
$d \leqslant 80$	
$d \leqslant 90$	120

[1]

(iii) Draw a cumulative frequency graph for these data.

[3]

(iv) Use your graph to find the median.

(iv) .... cm **[1]**

(v) It is recommended that the eye-to-monitor distance is such that $54 \leqslant d \leqslant 69$.

Estimate how many people in the survey sat in the recommended range.

(v) .... **[3]**

Turn over

8 The table shows the Consumer Price Index (CPI) and percentage annual change in the CPI for the years 1997 – 2008. All figures have been rounded to 1 decimal place.

Year	1997	1998	1999	2000	2001	2002
CPI	101.8	103.4	104.8	105.6	106.9	108.3
% change	1.8	1.6	1.3	0.8	1.2	1.3

Year	2003	2004	2005	2006	2007	2008
CPI	109.8	111.2	113.5	102.3	104.7	108.5
% change	1.4	1.3	2.0	2.3	2.3	3.6
Notes				Calculations of CPI after 2005 used 2005 as the base year		

(a) The percentage change in CPI from 2000 to 2001 was 1.2.

Write down the **calculation** used to work out this figure and give your answer to more than 1 decimal place.

....

.... **[2]**

In a base year CPI = 100.

(b) What was the base year used for the CPI for 1997?
Justify your answer.

Year .... because ....

....

.... **[2]**

(c) Calculations of CPI after 2005 used 2005 as the base year.

What would the CPI have been in 2006 if the base year had not been changed?

(c) .... **[3]**

 (d) Describe the difference in trend in CPI from 2005 to 2008 compared with 2001 to 2004.

 ....

 .... **[1]**

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