Probability Basics

1   Amy has a bag containing strawberry and banana sweets in the ratio $2:5$. She picks a sweet at random from the bag.

   a) What is the probability that she picks a strawberry sweet from the bag?

   ....
   [1]

   b) Amy says, "I am exactly twice as likely to pick a banana sweet as a strawberry sweet".
   Is Amy correct? Explain your answer.

   ....

   ....
   [2]

   [Total 3 marks]

2   There are p counters in a bag. n of the counters are blue and the rest are red. One counter is picked out at random.

   Work out the probability that the counter picked is red.
   Give your answer as a fraction in terms of p and n.

   ....
   [Total 2 marks]

3   Arthur has stripy, spotty and plain socks in his drawer.
   He picks a sock from the drawer at random.

   The probability of picking a plain sock is 0.4, and of picking a spotty sock is y.
   He is twice as likely to pick a stripy sock as a spotty sock.
   Find the value of y. Give your answer as a decimal.

   P(stripy sock) = ... y

   .... $+ y +$ .... $= 1$

   .... $= 0.6$

   $y =$ ....

   $y =$ ....
   [Total 3 marks]

   Score:

   8

Counting Outcomes

1 Alvar has a fair six sided dice and a set of five cards numbered 2, 4, 6, 8 and 10.
He rolls the dice and chooses a card at random.
Alvar adds the number on the dice to the number on the card to calculate his total score.

Find the probability that Alvar will score more than 4.

....

[Total 3 marks]

2 A shop sells three different meal deals. The possible meal deal options are:
• sandwich and drink   • sandwich and snack   • sandwich, snack and drink

There are 5 different sandwiches, 8 different drinks and 4 different snacks.
How many possible meal deal combinations are there?

....

[Total 3 marks]

3 Trish spins 5 fair spinners, each numbered 1-4. She writes down, in order,
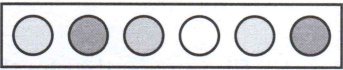the number that each spinner lands on to generate a 5 digit number.

a) How many different possibilities are there for the 5 digit number she generates?

....

[1]

b) What is the probability of Trish generating a 5 digit number not containing a 1?

....

[2]

[Total 3 marks]

4 A row of six disco lights all flash at the same time.
Each light randomly flashes either red, blue, green or yellow.

a) How many possible colour combinations of the six lights are there?

....

[1]

b) What is the probability that, in one flash, all the lights are either red or blue?

....

[2]

[Total 3 marks]

Score: ....

12

Section Seven — Probability and Statistics

Probability Experiments

1 Suda has a six-sided dice. The sides are numbered 1 to 6. **(GRADE 4)**

Suda rolls the dice 50 times. Her results are shown in the table below.

Number	1	2	3	4	5	6
Relative Frequency	0.32	0.12	0.24	0.14	0.06	0.12

a) How many times did she roll a 6?

....

[2]

b) Is Suda's dice fair? Explain your answer.

....

....

[2]

c) She rolls the dice another 50 times. Should she expect the same results? Explain your answer.

....

....

[1]

[Total 5 marks]

2 Eimear has a bag containing a large number of counters. **(GRADE 4)**
Each counter is numbered either 1, 2, 3, 4 or 5.

She selects one counter from the bag, makes a note of its number, and then puts it back in the bag.
Eimear does this 100 times. Her results are shown in the table below.

Number on counter	1	2	3	4	5
Frequency	23	25	22	21	9
Relative Frequency					

a) Complete the table, giving the relative frequencies of each counter being selected.

[2]

b) Elvin says that he thinks that the bag contains the same number of counters with each number.
Do you agree? Give a reason for your answer.

....

[1]

c) Using Eimear's results, estimate the probability of selecting an odd number
when one counter is picked from the bag.

....

[2]

[Total 5 marks]

Section Seven — Probability and Statistics

3 Danielle thinks she can predict if a fair coin will land showing heads or tails. **(GRADE 5)**

a) She makes a prediction and flips the coin. She repeats this 8 times.
The results are shown in the table below.

Prediction	H	H	T	H	T	H	H	H
Outcome	H	T	H	H	T	H	H	T

i) How many predictions would you expect to be correct if she was just guessing?

....

[1]

ii) Do you think Danielle can predict the flip of a coin? Explain your answer.

....

....

[1]

Danielle flipped the coin another 100 times and predicted the outcome of each flip.
She predicted it would land showing heads 39 times. It landed on tails 53 times.
Of the times it landed on tails, 3 more of her predictions were correct than were wrong.

b) i) Complete the frequency tree below to show these results.

Prediction   Outcome
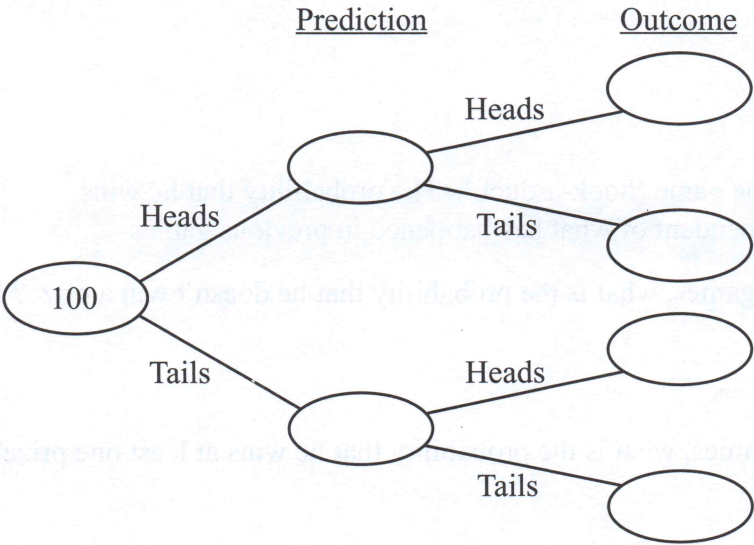
[3]

ii) Work out the relative frequency of Danielle predicting the outcome correctly.

....

[2]

c) Are the results from the experiment in part a) or part b) more reliable? Explain your answer.

....

....

[1]

[Total 8 marks]

Score: ☐

18

The AND / OR Rules

1 A biased 5-sided spinner is numbered 1-5.

The probability that the spinner will land on each of the numbers 1 to 5 is given in this table.

Number	1	2	3	4	5
Probability	0.3	0.15	0.2	0.25	0.1

a) What is the probability of the spinner landing on a prime number or a multiple of 2? **(6)**

....

[2]

b) The spinner is spun until it lands on a 2.
   i) What is the probability that the spinner is spun exactly twice? **(7)**

....

[2]

   ii) Work out the probability that the spinner is spun more than twice. **(7)**

....

[2]

[Total 6 marks]

2 Shaun is playing the game 'hook-a-duck'. The probability that he wins a prize is 0.3, independent of what has happened in previous games.

a) If he plays three games, what is the probability that he doesn't win a prize? **(6)**

....

[1]

b) If he plays two games, what is the probability that he wins at least one prize? **(7)**

....

[2]

c) Shaun says, "if I play three games I have more than a 50% chance of winning exactly one prize". Is he correct? Explain your answer. **(8)**

....

....

[3]

[Total 6 marks]

Exam Practice Tip

You can't just use the AND / OR rules mindlessly, you need to do a bit of thinking about the events before you start any questions. If you're using the OR rule you need to check if the events can happen at the same time or not. If you're using the AND rule you'll have to check that the events are independent.

Score

12

Section Seven — Probability and Statistics

# Tree Diagrams

1 Jo and Heather are meeting for coffee.

The probability that Jo will wear burgundy trousers is $\frac{2}{5}$.

There is a one in four chance that Heather will wear burgundy trousers.

The two events are independent.

GRADE **5**

a) Complete the tree diagram below.

<u>**Jo**</u>   <u>**Heather**</u>

Burgundy trousers
.... Burgundy trousers
Burgundy trousers
.... Not burgundy trousers
....
.... Burgundy trousers
....
Not burgundy trousers
.... Not burgundy trousers

[2]
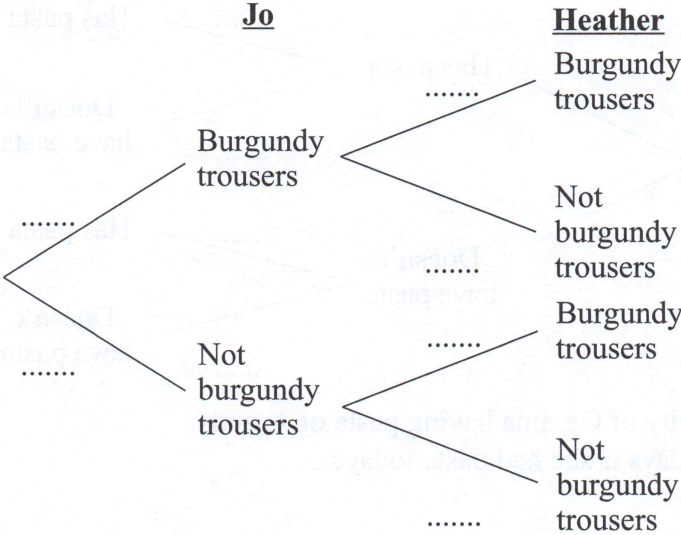
b) What is the probability that neither of them wear burgundy trousers?

....

[2]

[Total 4 marks]

2 Paul and Jen play a game where they roll a fair dice. If it lands on a factor of 6 then Paul gets a point, otherwise Jen gets a point. The winner is the person who gets the most points.

GRADE **7**

a) If they roll the dice twice, what is the probability that it will be a draw?

....

[3]

b) If they roll the dice three times, what is the probability that Paul wins?
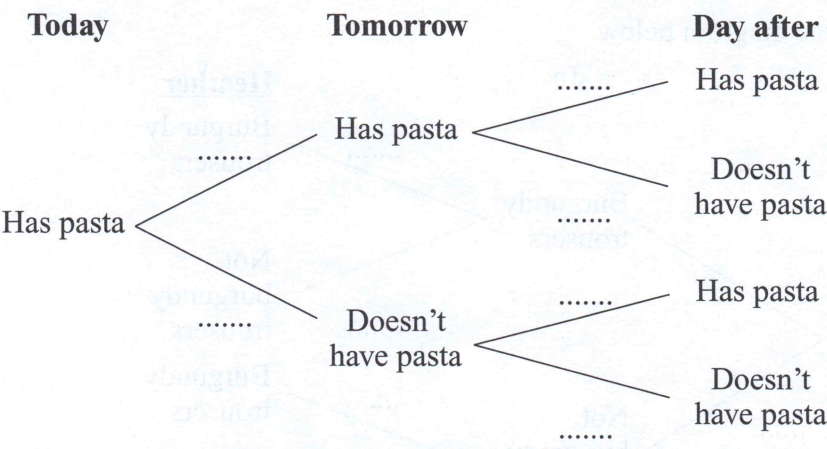
....

[3]

[Total 6 marks]

Score: ☐

10

Conditional Probability

1   The probability that Gemma has pasta for dinner depends on whether she had pasta the previous day. The probability that she will have pasta for dinner is 0.3 if she had it the previous day and 0.8 if she didn't have it the previous day.

(GRADE 8)

a) Given that Gemma had pasta today, complete the tree diagram below.

Today	Tomorrow	Day after

.... Has pasta

.... Has pasta

Doesn't have pasta

Has pasta

.... Doesn't have pasta

.... Has pasta

Doesn't have pasta

.... Doesn't have pasta

[2]

b) What is the probability of Gemma having pasta on exactly one of the next two days if she had pasta today?

....

[2]

[Total 4 marks]

2   A box of chocolates contains 12 chocolates. 7 are milk chocolate and 5 are white chocolate. Two chocolates are chosen at random without replacement.

(GRADE 8)

a) Given that the first chocolate is a milk chocolate, what is the probability that the second chocolate is a milk chocolate?

....

[1]

b) Calculate the probability of at least one milk chocolate being chosen.

....

[2]

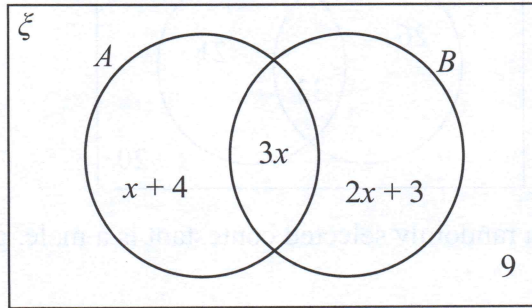c) Calculate the probability that one milk chocolate and one white chocolate are chosen in any order.

....

[2]

[Total 5 marks]

Score:

9

Sets and Venn Diagrams

1 The Venn diagram below shows the number of elements in sets A and B. **(GRADE 6)**

a) Given that n(ξ) = 40, find the value of x.

$x =$ ....
[2]

b) An element is randomly chosen from the universal set, ξ.
Find P(A ∩ B).

....
[2]

[Total 4 marks]

2 At a football match the probability of a randomly selected member of the crowd buying a pie is 0.33, buying a drink is 0.64 and buying both is 0.27.

a) Find the probability that a randomly selected member of the crowd doesn't buy anything. **(GRADE 6)**

....
[2]

b) 4000 people attend a match. Use a Venn diagram to represent the expected **(GRADE 7)** number of people who buy pies, drinks, both or neither at the match.
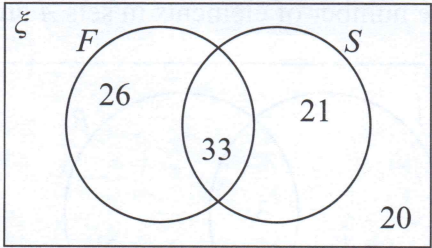
[3]

c) Find the probability that a randomly selected member **(GRADE 8)** of the crowd buys a pie, given that they **don't** buy a drink.

....
[2]

[Total 7 marks]

3   The Venn diagram below shows the percentages of
female contestants (F) and singers (S) in a talent competition.

Find the probability that a randomly selected contestant is a male, given that they're a singer.

....

[Total 2 marks]

4   A cheese stall sells three different cheeses: Cheddar, Wensleydale and Stilton.
One afternoon the stall had 100 customers. Each customer bought at least one cheese.

28 customers bought Wensleydale. Of these, 12 customers also bought Stilton.
43 customers bought Cheddar. Of these, 10 also bought Wensleydale and 7 also bought Stilton.
5 customers bought all three cheeses.

a) Draw a Venn diagram to show this information.

[3]

b) Find the probability that a randomly selected customer bought Cheddar or Stilton.

....

[1]

c) Given that a customer bought Wensleydale,
find the probability that this customer also bought Stilton.

....

[2]

[Total 6 marks]

Score: ☐

19

Section Seven — Probability and Statistics   😦 ☐   😐 ☐   🙂 ☐

Sampling and Data Collection

1 Faye is investigating how many chocolate bars teenagers buy each week.
She is going to collect data by asking her teenage friends how many they buy.

a) Design a table that Faye could use to record her data. **(3)**

[2]

b) Comment on whether she can use her results to draw conclusions about teenagers in the UK. **(4)**

....

....

....

[2]

[Total 4 marks]

2 Mario asked 50 people at a football match how they travelled there. He found that 22 of them travelled by car. There were 5000 people at the match altogether. **(4)**

a) Use the information above to estimate the number of people who travelled to the match by car.

....

[3]

b) Daisy was at a different football match on the same day. She uses Mario's sample data to estimate that 374 of the 850 people at her match travelled there by car.
Explain the assumption Daisy has made and comment on the reliability of her estimate.

....

....

....

[2]

[Total 5 marks]

Remember, to get reliable estimates, a sample needs to fairly represent the population.

Score:

9

Section Seven — Probability and Statistics

Mean, Median, Mode and Range

1 A bakery records the number of cookies it sells each day for ten days. **(4)**
The mean number is 17 and the median number is 15.

The next day the bakery sells 18 cookies.

a) Is the mean number sold over all eleven days higher than 17? Explain your answer.

....

[1]

b) Is the median number sold over all eleven days higher than 15? Explain your answer.

....

[1]
[Total 2 marks]

2 Lee has 6 pygmy goats. Their weights, in kg, are listed below.

32   23   31   28   36   26

a) Which three weights, from the list above, would have a range which is half the value of **(3)**
the median of the three weights? Write down the range and median with your answer.

..................., ..., ...

range = ..., median = ...

[2]

b) Two of the goats wander off and don't return. The mean weight of the herd is now 27.25 kg. **(4)**
Find the weights of the two goats who wandered off.

.... kg and .... kg

[3]
[Total 5 marks]

3 Show that the difference between the mean and the **(5)**
median of five consecutive integers is always zero.

Call the five consecutive integers n, n + 1, ..., ... and ....

Median = middle value = ...

Mean = $\dfrac{n + (n + 1) + \text{.................} + \text{.................} + \text{.................}}{\text{.................}}$ = $\dfrac{\text{.................}}{\text{.................}}$ = ...

Difference between mean and median = ...

[Total 3 marks]

Exam Practice Tip

Questions on the mean aren't usually as straightforward as calculating its value from a list of numbers.
No, I'm afraid that won't cut the mustard. You have to figure out how to use the information you're given
— e.g. if you know the mean and the number of values, you can easily find the total of all the values.

Score

10

Grouped Frequency Tables

1   During a science experiment 10 seeds were planted and their growth measured
to the nearest cm after 12 days. The results were recorded in the table below.   (4)

Growth in cm	Number of plants
$0 \leq x \leq 2$	2
$3 \leq x \leq 5$	4
$6 \leq x \leq 8$	3
$9 \leq x \leq 11$	1

Use the table to find:

a) the modal class,

....

[1]

b) the class which contains the median,

....

[1]

c) an estimate of the mean growth.

You can add columns to
the table to help you.

.... cm

[4]

[Total 6 marks]

2   The table shows the times it took 32 pupils at a school to run a 200 m sprint.   (5)

Time (t seconds)	Frequency
$22 < t \leq 26$	4
$26 < t \leq 30$	8
$30 < t \leq 34$	13
$34 < t \leq 38$	6
$38 < t \leq 42$	1

a) Calculate an estimate for the mean time.

.... seconds

[4]

b) What percentage of pupils got a time of more than 30 seconds?

.........................%

[2]

c) Explain whether you could use the results in the table above to draw conclusions about how
long it takes 16-year-old boys at the school to run 200 m.
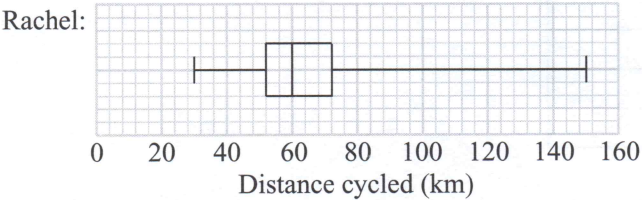
....

[1]

[Total 7 marks]

Score:

13

Section Seven — Probability and Statistics

Box Plots

1   Rachel and Harry record the distance they cycle each week for 26 weeks.
The box plot below shows information about Rachel's cycling.
The table on the right gives information about Harry's cycling.

Rachel:

Harry's data	Distance cycled (km)
Shortest distance	0
Lower quartile	32
Median	50
Upper quartile	80
Furthest distance	128

a) Work out the interquartile range of the distances Rachel cycled.

.... km

[2]

b) Explain why the interquartile range might be a better measure
of the spread of Rachel's distances than the range.

....

....

[1]

c) Use the grid opposite to draw a
box plot showing Harry's data.

Harry:

[2]
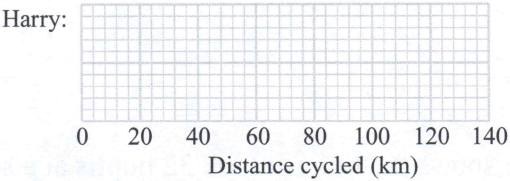
d) Rachel says that the distances she cycled were more consistent than the distances Harry cycled.
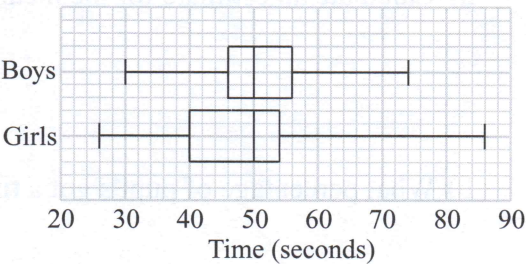Do you agree with her? Explain your answer.

....

....

[2]

[Total 7 marks]

2   Tom gives a puzzle to a sample of boys and girls.
These box plots show information about the
time it took the children to finish the puzzle.

Compare the distributions of the times taken
by the boys and the times taken by the girls.

....

....

....

[Total 2 marks]

Exam Practice Tip

Even in maths, you sometimes have to answer questions in sentences — but don't forget to show values or
calculations to support your answer. Use the number of marks as a guide as to how much detail to go into.
E.g. if there are two marks available for comparing data sets, you need to make two comparisons.

Score

9

Section Seven — Probability and Statistics

Cumulative Frequency

1 120 pupils in a year group sit an examination at the end of the year.
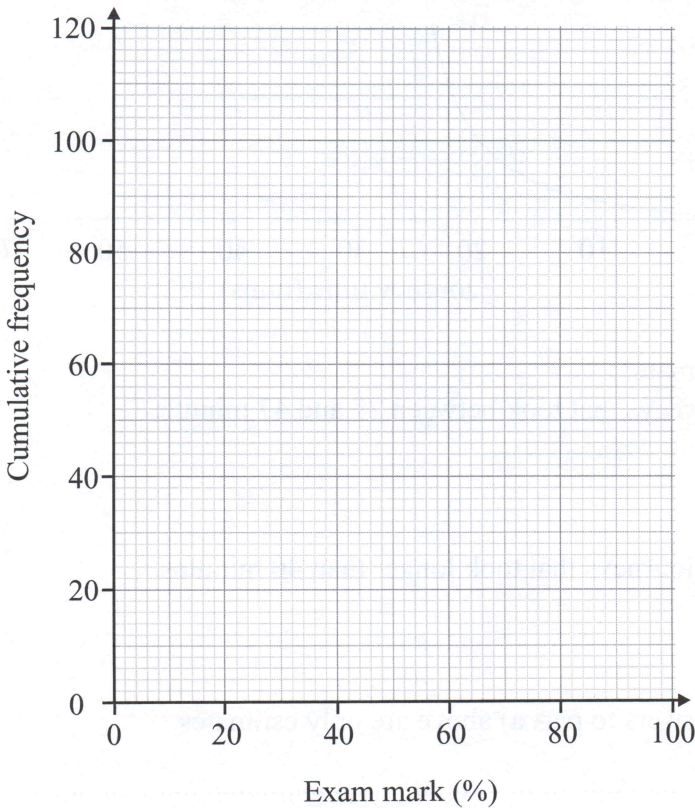Their results are given in the table below.

Exam mark (%)	$0 < x \leq 20$	$20 < x \leq 30$	$30 < x \leq 40$	$40 < x \leq 50$	$50 < x \leq 60$	$60 < x \leq 70$	$70 < x \leq 80$	$80 < x \leq 100$
Frequency	3	10	12	24	42	16	9	4

a) Complete the cumulative frequency table below.

Exam mark (%)	≤ 20	≤ 30	≤ 40	≤ 50	≤ 60	≤ 70	≤ 80	≤ 100
Cumulative Frequency								

[1]

b) Use your table to draw a cumulative frequency graph on the graph paper.

[3]

c) Use your graph to find an estimate for the median.

.... %

[1]

d) Use your graph to find an estimate for the inter-quartile range.

.... %

[2]

e) Each pupil was awarded a grade based on their mark. 4 times as many pupils achieved grade 5
or higher as those who got a lower grade. Estimate the lowest mark needed to get grade 5.

....

....

[3]

[Total 10 marks]

Section Seven — Probability and Statistics

2 The cumulative frequency graph below gives information about the length of time it takes to travel between Udderston and Trundle on the main road each morning. The graph has been drawn using the data from a grouped frequency table.
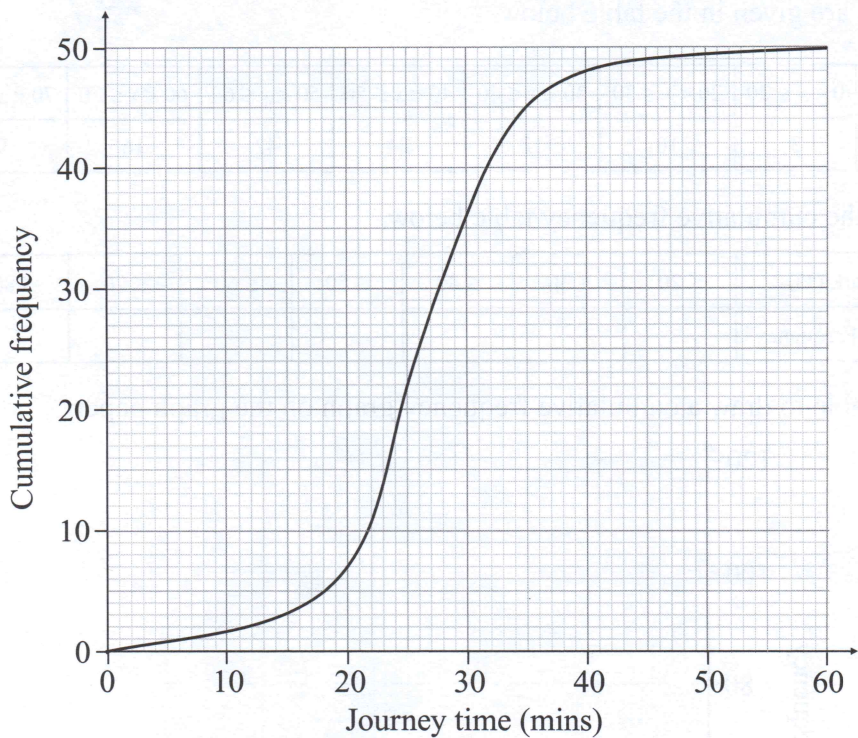
a) Use the graph to estimate:
   i) the number of journeys that took between 27 and 47 minutes.

.... *journeys*
[2]

   ii) the percentage of journeys that took longer than 40 minutes.

.... %
[2]

b) Explain why your answers to part a) above are only estimates.

....

....
[1]

The minimum journey time was 12 minutes and the maximum journey time was 52 minutes.

c) Using this information and the graph above, draw a box plot on the grid below
   to show the morning journey times between Udderston and Trundle.

Journey Time (mins)

[3]
[Total 8 marks]
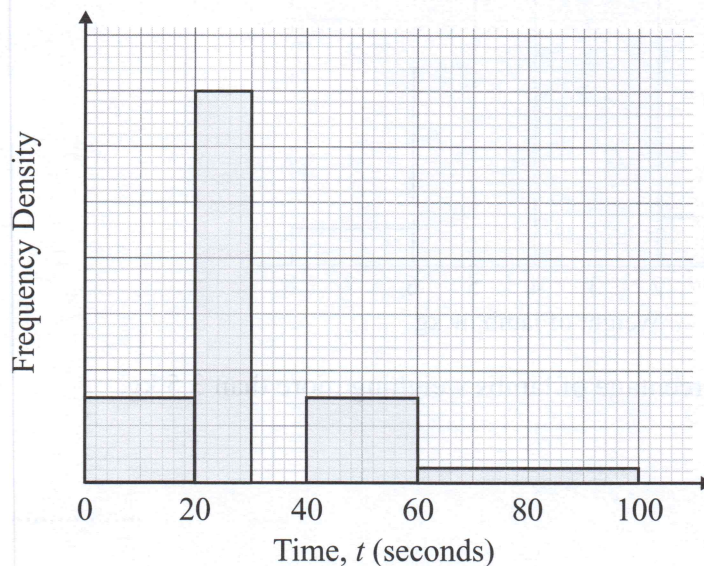
Score:

18

Section Seven — Probability and Statistics

Histograms and Frequency Density

1 A group of pupils were each given a potato. The table below gives some information about how long it took the pupils to peel their potato.

Time, t (s)	Frequency
$0 < t \leq 20$	15
$20 < t \leq 30$	
$30 < t \leq 40$	30
$40 < t \leq 60$	15
$60 < t \leq 100$	5

Don't forget to fill in the scale on the frequency density axis.

Fill in the missing entry from the table and complete the histogram.

[Total 3 marks]

2 The histogram shows the amount of time (in minutes) that 270 children spent watching television one evening.

A large sample of adults were asked how long they watched television for on the same evening. The mean time for the adults was 102 minutes.

Does the data shown support the hypothesis that, on average, adults watched more television than children on this particular evening?
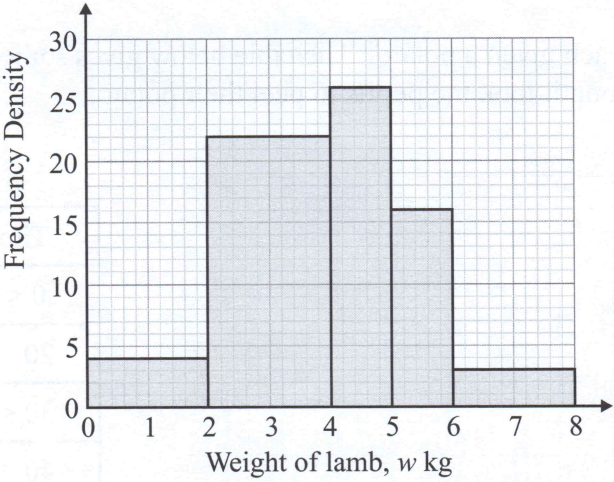
....

....

....
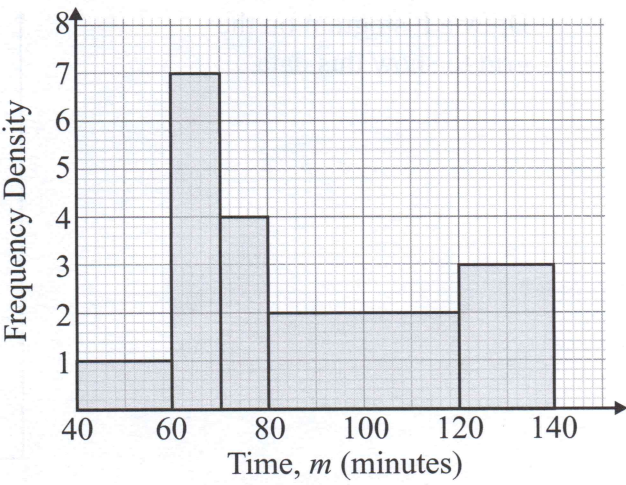
[Total 4 marks]

Make sure you show calculations to support your conclusion.

Section Seven — Probability and Statistics

3   The histogram shows information about the weights, *w* kg, of 100 newborn lambs.   **(7)**

a) Calculate an estimate of the percentage of lambs weighing more than 3.5 kg.

.... %

[3]

b) This table shows information about the weights of the newborn lambs at a different farm.

Weight, *w* kg	$0 < w \leq 2$	$2 < w \leq 4$	$4 < w \leq 5$	$5 < w \leq 6$	$6 < w \leq 8$
Frequency	4	28	30	28	10

Draw a histogram on the grid to show this data.
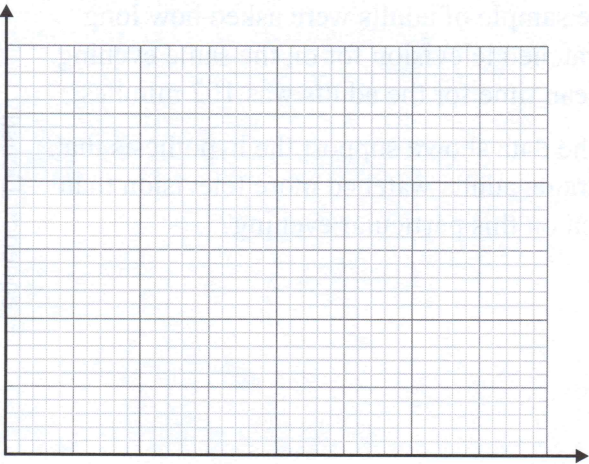
[3]

c) Compare the weights of newborn lambs for the two farms.

....

....

[1]

This question is only worth 1 mark, so you don't need to do any complicated calculations.

[Total 7 marks]

Score:

14

Section Seven — Probability and Statistics

Other Graphs and Charts

1 The numbers of swallows seen in Eli's garden over three years are shown in the time series graph below. **GRADE 3**

Describe the overall trend in the numbers of swallows seen in Eli's garden over the 3-year period.
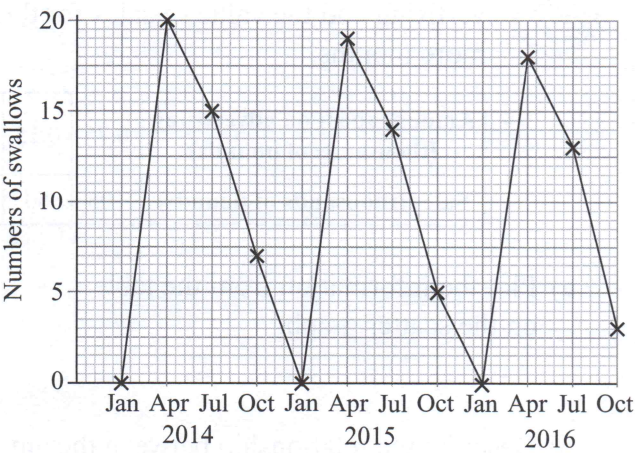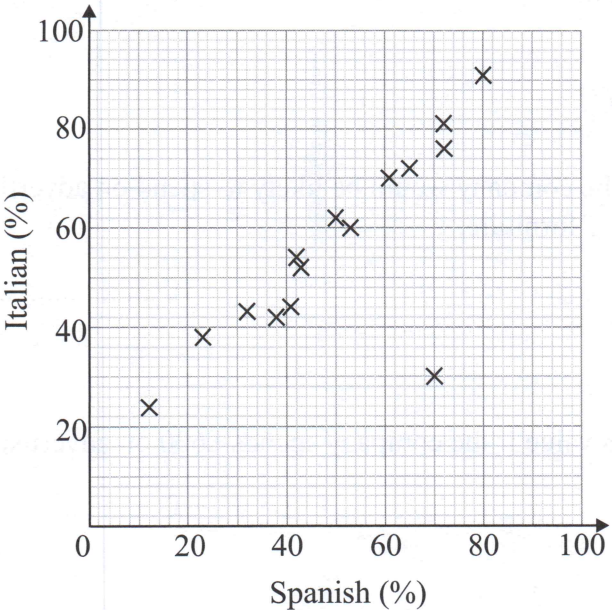
....

....

....

....

[Total 1 mark]

2 15 pupils in a class study both Spanish and Italian. Their end of year exam results are shown on the scatter graph below. **GRADE 3**
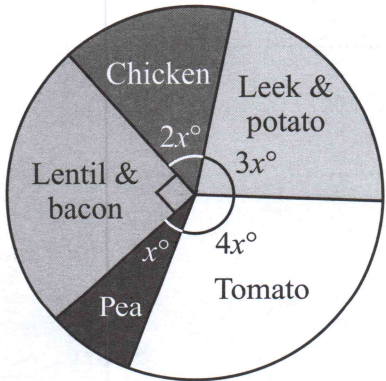

a) Circle the point that doesn't follow the trend.

[1]

b) Describe the strength and type of correlation shown by the points that do follow the trend.

....

....

[1]

c) Draw a line of best fit for the data.

[1]

[Total 3 marks]

3 There are 80 students in Year 11. The pie chart below shows their favourite types of soup. **GRADE 5**


How many students chose leek & potato soup?

....

[Total 4 marks]

Section Seven — Probability and Statistics

4   A furniture company is looking at how effective their advertising is.
They are comparing how much they spent on advertising in random months with
their total sales value for that month. This information is shown on the graph below.

The table shows the amount spent on advertising and the value of sales for three more months.

Amount spent on advertising (thousands of pounds)	0.75	0.15	1.85
Sales (thousands of pounds)	105	60	170
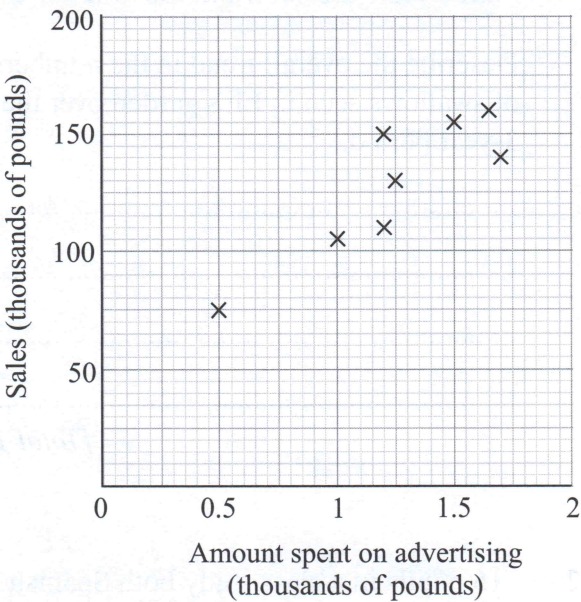
a) Plot the information from the table on the scatter graph.

[1]

b) Describe the relationship between the amount spent on advertising and the value of sales.

....

....

....

[1]

c) Use a line of best fit to estimate how much the company would be likely to spend on advertising in a month where they sold £125 000 worth of furniture.

£ ....

[2]

d) Use your graph to estimate the monthly sales value if the company spends £600 on advertising.

£ ....

[1]

e) The company plan to increase their monthly spend on advertising to at least £3000.
They use the trend in the data above to predict future sales values.
Comment on how reliable this prediction is likely to be.

....

....

....

[2]

[Total 7 marks]

Score:

15

Section Seven — Probability and Statistics