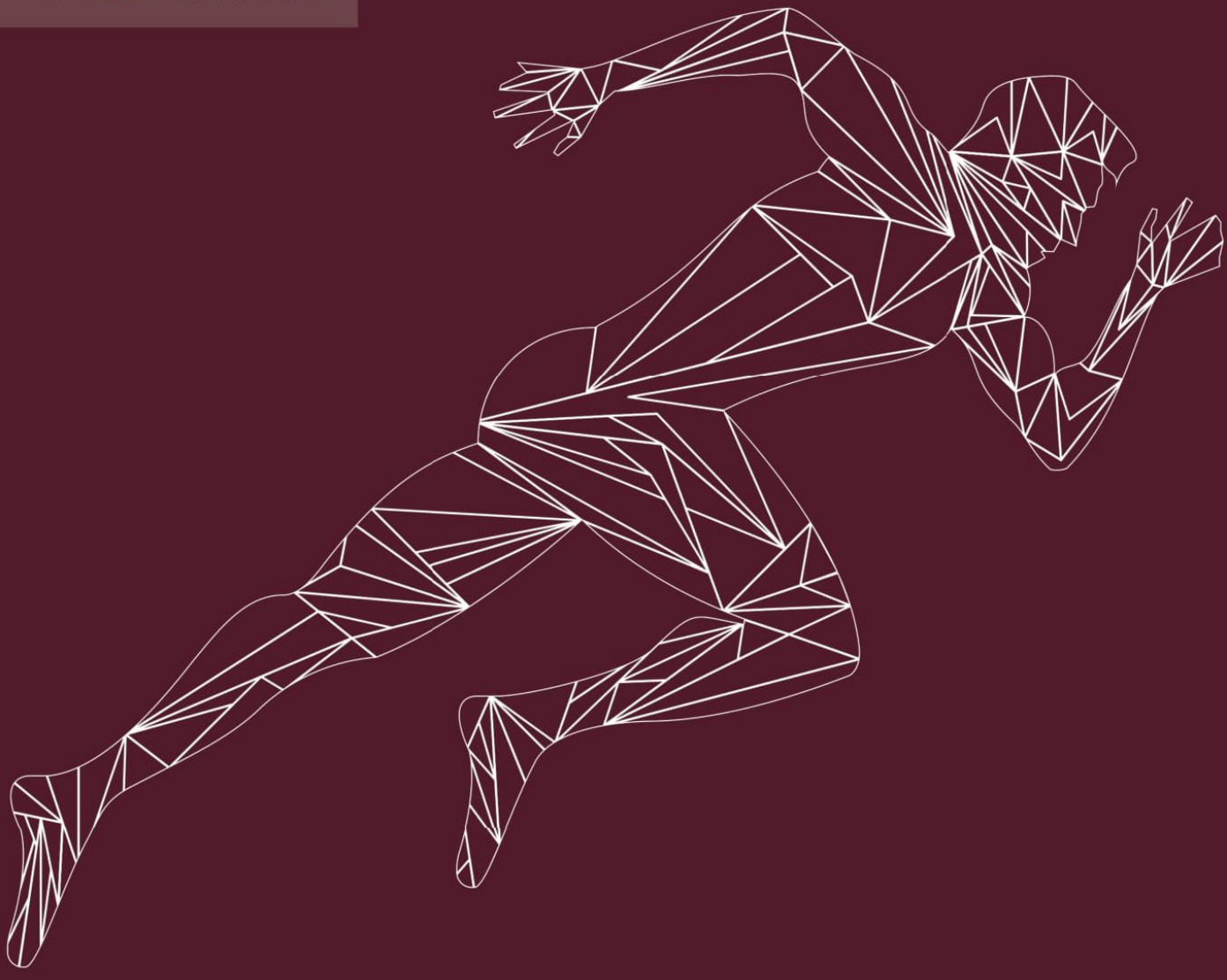
11 - 19 PROGRESSION



Pearson Edexcel AS and A level Mathematics

Statistics and Mechanics

Year 1/AS

Practice Book

Pearson

Pearson Edexcel AS and A level Mathematics

Statistics and Mechanics Year 1/AS

Series Editor: Harry Smith

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- Each chapter finishes with two sets of problem-solving practice questions at three different difficulty levels.
- An Exam question bank at the end of the book provides mixed exam-style questions to help you practise selecting the correct mathematical skills and techniques.

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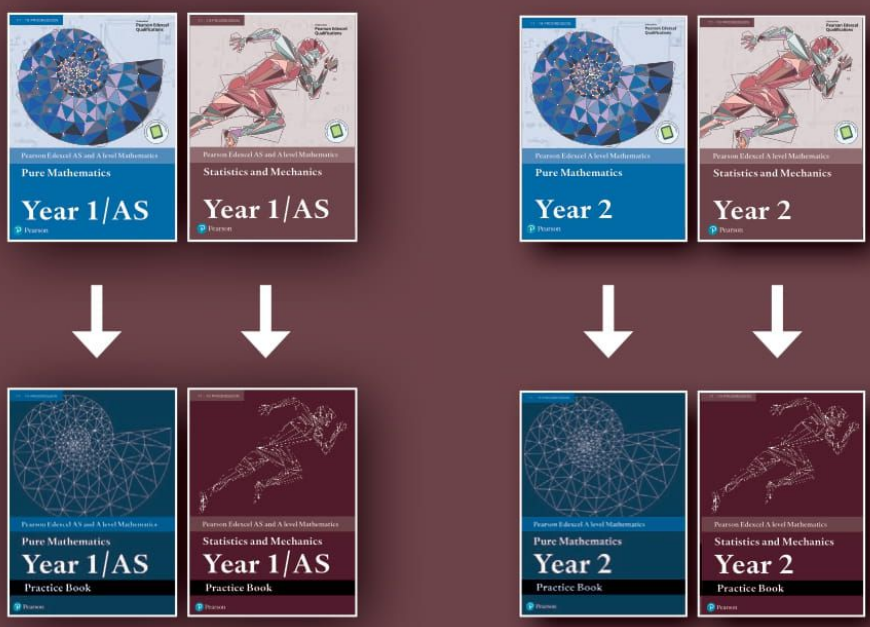

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Contents

How to use this book

The Statistics and Mechanics Year 1/AS Practice Book is designed to be used alongside your Pearson Edexcel AS and A level Mathematics Statistics and Mechanics Year 1/AS textbook. It provides additional practice, including problem-solving and exam-style questions, to help make sure you are ready for your exam.

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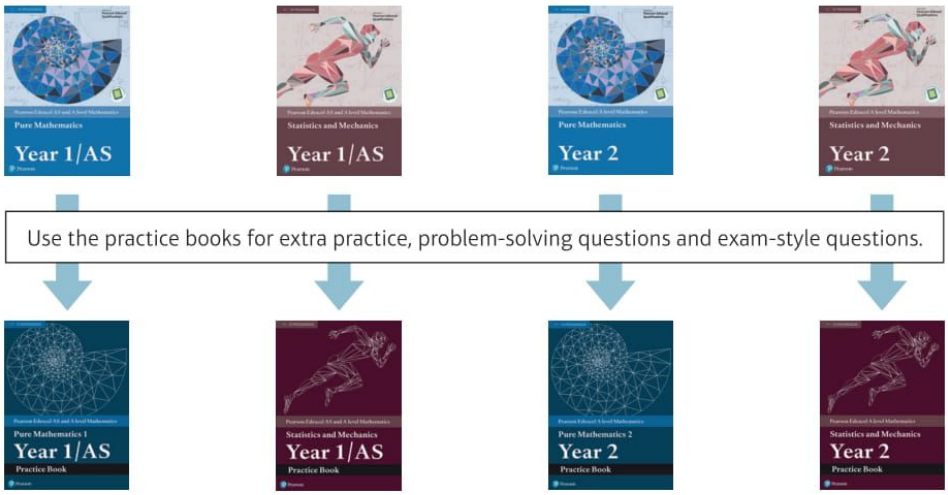
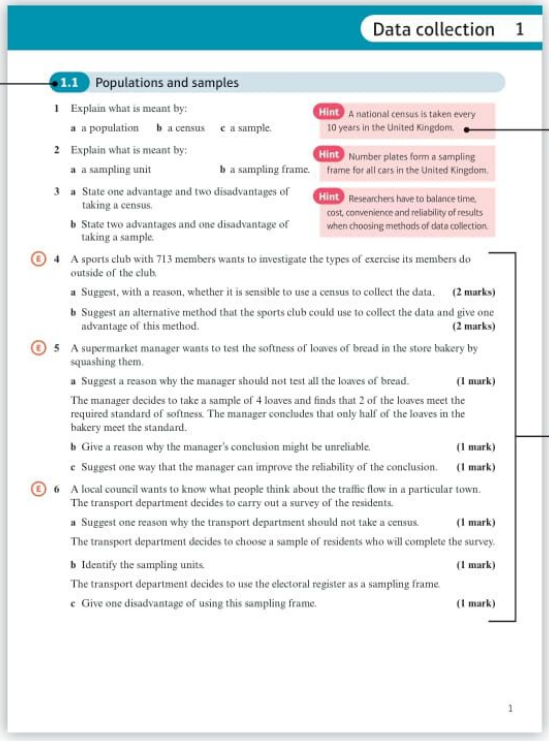


Finding your way around the book

One-to-one match between exercises in this practice book and sections in your textbook.


Data collection 1

1.1 Populations and samples

1 Explain what is meant by:
a a population b a census c a sample.

Hint A national census is taken every 10 years in the United Kingdom.

2 Explain what is meant by:
a a sampling unit b a sampling frame.

Hint Number plates form a sampling frame for all cars in the United Kingdom.

3 a State one advantage and two disadvantages of taking a census.
b State two advantages and one disadvantage of taking a sample.

Hint Researchers have to balance time, cost, convenience and reliability of results when choosing methods of data collection.

E 4 A sports club with 713 members wants to investigate the types of exercise its members do outside of the club.
a Suggest, with a reason, whether it is sensible to use a census to collect the data. (2 marks)
b Suggest an alternative method that the sports club could use to collect the data and give one advantage of this method. (2 marks)

E 5 A supermarket manager wants to test the softness of loaves of bread in the store bakery by squashing them.
a Suggest a reason why the manager should not test all the loaves of bread. (1 mark)
The manager decides to take a sample of 4 loaves and finds that 2 of the loaves meet the required standard of softness. The manager concludes that only half of the loaves in the bakery meet the standard.
b Give a reason why the manager's conclusion might be unreliable. (1 mark)
c Suggest one way that the manager can improve the reliability of the conclusion. (1 mark)

E 6 A local council wants to know what people think about the traffic flow in a particular town. The transport department decides to carry out a survey of the residents.
a Suggest one reason why the transport department should not take a census. (1 mark)
The transport department decides to choose a sample of residents who will complete the survey.
b Identify the sampling units. (1 mark)
The transport department decides to use the electoral register as a sampling frame.
c Give one disadvantage of using this sampling frame. (1 mark)

1

Hints in each exercise remind you of the key skills, formulae or techniques for that section. If you need more help, look at the corresponding section of your textbook.

Use the exam-style questions in every exercise to check that you are working at exam standard.

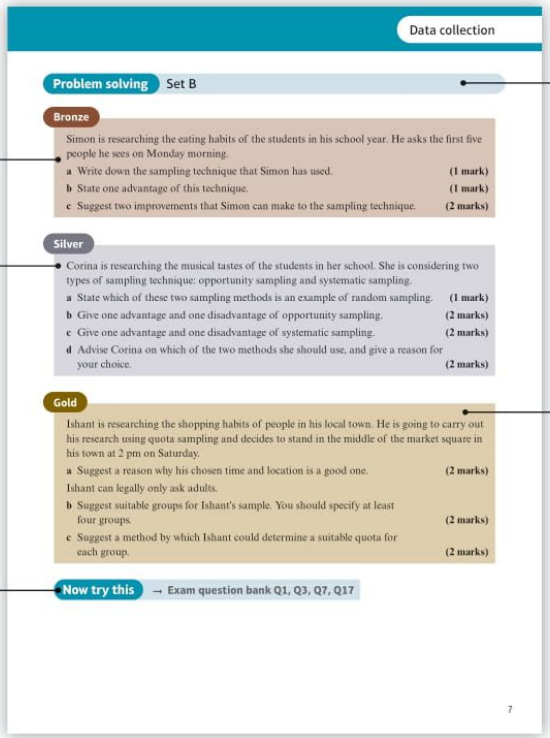
Exam-style questions are flagged with (E) and have marks allocated to them.

Problem-solving questions are flagged with (P)

Bronze questions might have more steps to lead you through the technique, or require a more straightforward application of the skills from that chapter.

Silver questions are more challenging, and provide less scaffolding. If you're struggling with the Silver question, try the Bronze question first.

You can find more exam-style questions on this chapter in the Exam question bank.



Data collection

Problem solving Set B

Bronze

Simon is researching the eating habits of the students in his school year. He asks the first five people he sees on Monday morning.

a Write down the sampling technique that Simon has used. **(1 mark)**
b State one advantage of this technique. **(1 mark)**
c Suggest two improvements that Simon can make to the sampling technique. **(2 marks)**

Silver

Corina is researching the musical tastes of the students in her school. She is considering two types of sampling technique: opportunity sampling and systematic sampling.

a State which of these two sampling methods is an example of random sampling. **(1 mark)**
b Give one advantage and one disadvantage of opportunity sampling. **(2 marks)**
c Give one advantage and one disadvantage of systematic sampling. **(2 marks)**
d Advise Corina on which of the two methods she should use, and give a reason for your choice. **(2 marks)**

Gold

Ishant is researching the shopping habits of people in his local town. He is going to carry out his research using quota sampling and decides to stand in the middle of the market square in his town at 2 pm on Saturday.

a Suggest a reason why his chosen time and location is a good one. **(2 marks)**

Ishant can legally only ask adults.

b Suggest suitable groups for Ishant's sample. You should specify at least four groups. **(2 marks)**
c Suggest a method by which Ishant could determine a suitable quota for each group. **(2 marks)**

Now try this → Exam question bank Q1, Q3, Q7, Q17

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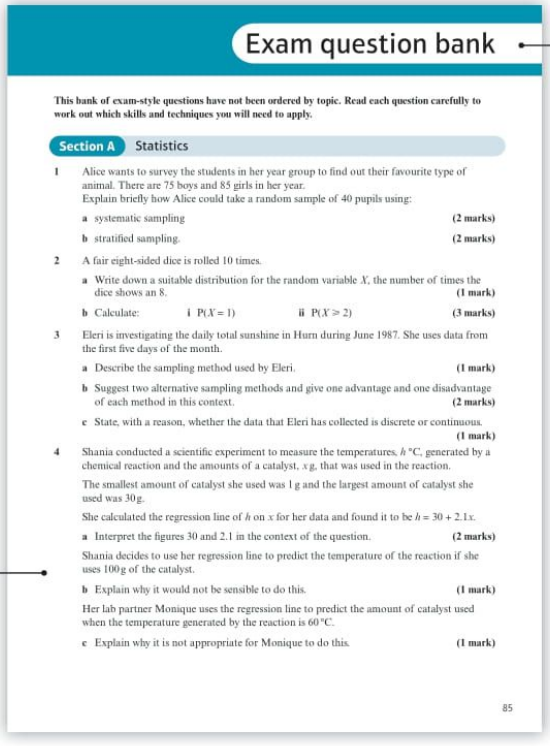
Each chapter ends with two sets of exam-style problem-solving questions which draw on material from throughout the chapter and from earlier chapters.

Gold questions involve tricky problem-solving elements, or might require you to think more creatively. If you can answer the Gold questions then you can be confident that you are ready to tackle the hardest exam questions.



Exam question bank

This bank of exam-style questions have not been ordered by topic. Read each question carefully to work out which skills and techniques you will need to apply.

Section A Statistics

1 Alice wants to survey the students in her year group to find out their favourite type of animal. There are 75 boys and 85 girls in her year.
Explain briefly how Alice could take a random sample of 40 pupils using:

a systematic sampling **(2 marks)**
b stratified sampling. **(2 marks)**

2 A fair eight-sided dice is rolled 10 times.

a Write down a suitable distribution for the random variable X, the number of times the dice shows an 8. **(1 mark)**
b Calculate: **i** $P(X = 1)$ **ii** $P(X \geqslant 2)$ **(3 marks)**

3 Eleri is investigating the daily total sunshine in Hurn during June 1987. She uses data from the first five days of the month.

a Describe the sampling method used by Eleri. **(1 mark)**
b Suggest two alternative sampling methods and give one advantage and one disadvantage of each method in this context. **(2 marks)**
c State, with a reason, whether the data that Eleri has collected is discrete or continuous. **(1 mark)**

4 Shania conducted a scientific experiment to measure the temperatures, h °C, generated by a chemical reaction and the amounts of a catalyst, x g, that was used in the reaction.

The smallest amount of catalyst she used was 1 g and the largest amount of catalyst she used was 30 g.

She calculated the regression line of h on x for her data and found it to be $h = 30 + 2.1x$.

a Interpret the figures 30 and 2.1 in the context of the question. **(2 marks)**

Shania decides to use her regression line to predict the temperature of the reaction if she uses 100 g of the catalyst.

b Explain why it would not be sensible to do this. **(1 mark)**

Her lab partner Monique uses the regression line to predict the amount of catalyst used when the temperature generated by the reaction is 60 °C.

c Explain why it is not appropriate for Monique to do this. **(1 mark)**

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One challenge of the exam is that you aren't usually told which techniques or strategies you need to apply to a particular question. The questions in the Exam question bank are not ordered by topic, so you need to choose the appropriate mathematical skills.

There are a lot more questions in the Exam question bank than there will be on your exam paper. Don't try and tackle them all at once, but make sure you try some of the trickier questions from the end of each section in the question bank.

1.1 Populations and samples

1 Explain what is meant by:

a a population **b** a census **c** a sample.

Hint A national census is taken every 10 years in the United Kingdom.

2 Explain what is meant by:

a a sampling unit **b** a sampling frame.

Hint Number plates form a sampling frame for all cars in the United Kingdom.

3 **a** State one advantage and two disadvantages of taking a census.

b State two advantages and one disadvantage of taking a sample.

Hint Researchers have to balance time, cost, convenience and reliability of results when choosing methods of data collection.

E **4** A sports club with 713 members wants to investigate the types of exercise its members do outside of the club.

a Suggest, with a reason, whether it is sensible to use a census to collect the data. **(2 marks)**

b Suggest an alternative method that the sports club could use to collect the data and give one advantage of this method. **(2 marks)**

E **5** A supermarket manager wants to test the softness of loaves of bread in the store bakery by squashing them.

a Suggest a reason why the manager should not test all the loaves of bread. **(1 mark)**

The manager decides to take a sample of 4 loaves and finds that 2 of the loaves meet the required standard of softness. The manager concludes that only half of the loaves in the bakery meet the standard.

b Give a reason why the manager's conclusion might be unreliable. **(1 mark)**

c Suggest one way that the manager can improve the reliability of the conclusion. **(1 mark)**

E **6** A local council wants to know what people think about the traffic flow in a particular town. The transport department decides to carry out a survey of the residents.

a Suggest one reason why the transport department should not take a census. **(1 mark)**

The transport department decides to choose a sample of residents who will complete the survey.

b Identify the sampling units. **(1 mark)**

The transport department decides to use the electoral register as a sampling frame.

c Give one disadvantage of using this sampling frame. **(1 mark)**

E/P **7** A manufacturer of light bulbs is testing the lifetime of the bulbs. The manufacturer switches the bulbs on and records the number of hours each bulb is lit before it blows.

a Explain why the manufacturer should take a sample rather than a census. **(1 mark)**

The manufacturer tests a sample of three bulbs and obtains the following results:

762 hours 851 hours 801 hours

b The company claims that the lifetime of its bulbs is 800 hours.

i Use the sample data to comment on this claim.

ii Suggest one way in which the manufacturer can improve its prediction about the lifetime of a bulb. **(3 marks)**

1.2 Sampling

1 **a** Explain what is meant by a simple random sample.

b Explain how you would take a simple random sample of size 20 from a population of 100.

Hint You can use your calculator to generate random numbers.

2 **a** Explain what is meant by a systematic sample.

b Explain how you would take a systematic sample of size 20 from a population of 100.

Hint Work out the proportion of the population that you are going to sample.

3 **a** Explain what is meant by a stratified sample.

b Explain how you would take a stratified sample of size 20 from a population composed of 40 males and 60 females.

Hint Work out the proportion of males and females in the population.

E/P **4** A dance school teacher wants to take a sample of the school's members.
Each member has a unique ID number.

a State two advantages of using simple random sampling. **(2 marks)**

There are 75 boys and 125 girls at the school.

b Using this information, state one disadvantage of using simple random sampling. **(1 mark)**

The teacher decides to use a stratified sampling method.

c Explain how the teacher can take a stratified sample of size 40. **(2 marks)**

E/P **5** A company wants to take a sample of its employees.
There are 700 employees and each has a unique employee number.

a Explain how the company could take a systematic sample of size 35 from the employees. **(2 marks)**

It is known that the management team all have employee numbers ending in 0.

b Using this information, state one disadvantage of using a systematic sample. **(2 marks)**

E/P **6** A school wants to carry out an investigation into the eating habits of its students. There are 1200 students in the school.

a Explain how the school could take a simple random sample of size 50 from the students and state one disadvantage of using this sampling method. **(2 marks)**

b Suggest a better sampling method and explain how the school should take this sample. **(3 marks)**

1.3 Non-random sampling

1 **a** Explain what is meant by opportunity sampling.

Researchers want to investigate the habits of shoppers in a town's high street.

b Explain how they might select an opportunity sample of size 20.

Hint Opportunity sampling and quota sampling are examples of non-random sampling methods. Using non-random sampling methods can introduce bias.

2 **a** Explain what is meant by quota sampling.

Researchers want to investigate people's attitudes to advertising in the cinema.

b Explain how they might select a quota sample of size 30.

Hint Make sure your answer refers to the context of the question.

E/P **3** A coach of a basketball team wants to take a sample from all the players on the team. The coach has a list of the players in order of height.

a Explain how the coach can carry out an opportunity sample of size 5. **(1 mark)**

b State one disadvantage of using an opportunity sample in this context. **(1 mark)**

c Suggest an alternative sampling method that could be used and explain how the coach can take this sample. **(2 marks)**

E/P **4** Researchers are collecting data on the number of hours of television watched by people in a local village. They ask the first four people they see coming out of the cinema on a Tuesday evening.

a Describe the sampling method used and comment on the reliability of the data gathered. **(2 marks)**

b Suggest two ways to improve the method used by the researchers. **(2 marks)**

E/P **5** A researcher wants to investigate the types of car owned by people living on a housing estate. It is known that there are 150 male drivers and 200 female drivers on the particular estate.

a Explain how the researcher can take a quota sample of size 70. **(2 marks)**

b State one key difference between quota sampling and stratified sampling. **(1 mark)**

c Give one advantage of using quota sampling over stratified sampling. **(1 mark)**

The researcher stands at the entrance to the estate. For each car entering the estate, the researcher notes the gender of the driver and the type of car.

d Criticise this method of collecting the data. **(2 marks)**

1.4 Types of data

1 State whether the following variables are qualitative or quantitative:

a height of a house **b** hair colour

c time taken to run 50 m.

Hint **Quantitative** data can be recorded as a numerical observation. **Qualitative** data must be recorded as words or categories.

2 State whether the following variables are discrete or continuous:

a length of a worm **b** number of slugs

c height of an ant.

Hint Variables that can take any value in a given range are **continuous**. Variables that can only take specific values are **discrete**.

E **3** The table shows the masses of children on a summer camp.

Mass, x (kg)	Frequency
$35 \leqslant x < 40$	14
$40 \leqslant x < 45$	18
$45 \leqslant x < 50$	12
$50 \leqslant x < 55$	7

a Explain why the data in the table is continuous. **(1 mark)**

b For the third group, write down:

i the class boundaries **ii** the class width **iii** the midpoint. **(3 marks)**

E/P **4** The table shows the numbers of caterpillars found on each tree in a forest.

Number of caterpillars	Number of trees
7	78
8	45
9	63
10	18

a State whether this data is discrete or continuous. **(1 mark)**

A researcher wants to see if there is a relationship between the number of caterpillars on each tree and the lengths of the caterpillars.

b Explain how the researcher can take a stratified sample of size 20 from all of the trees in the forest. **(2 marks)**

The researcher measures the lengths of the caterpillars on each of the sampled trees.

c Describe the type of data the researcher is collecting. **(1 mark)**

1.5 The large data set

1 From the five UK weather stations featured in the large data set, write down the station that is furthest:

a north **b** south **c** west.

Hint You need to know the approximate locations of all the weather stations in the large data set.

2 Explain what is meant by:

a daily total rainfall **b** daily maximum gust.

Hint You need to know the units for all of the data set variables.

E/P **3** Delilah is interested in how the daily total sunshine changes the further north you go. She chooses five days, at random, from the large data set for Heathrow and Hurn in 2015.

a Criticise:

i her sample size **ii** her choices of location. **(2 marks)**

b Explain how Delilah can take a simple random sample of size 15 from the large data set for Heathrow in 2015. **(2 marks)**

During her sampling, Delilah selects the same date twice.

c Explain why this is wrong and describe how she could correctly generate her sample.

(2 marks)

E/P **4** From the large data set, Jerome calculates the average mean daily temperature for Leuchars and Camborne in 2015 using a random sample of 5 days from each location.

a Give a geographical reason why the average mean daily temperature for Leuchars might be lower than for Camborne. **(1 mark)**

b Criticise Jerome's sampling method and suggest an improvement. **(2 marks)**

E/P **5** Amara is investigating daily total rainfall in Leeming in 2015.

a Explain how she can take a systematic sample of size 20 from the data. **(2 marks)**

She finds that on several days, the reading is recorded as 'tr'.
She discards these readings and chooses additional readings for her sample.

b State the meaning of 'tr', and evaluate Amara's method. **(2 marks)**

c Suggest how Amara should deal with 'tr' readings in her investigation. **(1 mark)**

E/P **6** Jagdeep records the daily mean windspeed for a randomly chosen day in June 1987 in Hurn as 31 knots. He records the daily maximum gust on the same day as 25 knots.

a Explain why Jagdeep must have recorded at least one of the values incorrectly. **(1 mark)**

The correct value for the daily mean windspeed is in fact 11 knots.

b Convert this reading using the Beaufort scale, giving your answer as a description. **(1 mark)**

E/P **7** A researcher is investigating average weather conditions in July 2015 in Beijing, Perth and Hurn. The researcher records the following data:

Location	A	B	C
Average temperature (°C)	16.8	26.8	13.3
Average windspeed (kn)	8.3	4.0	7.4

Using your knowledge of the large data set, suggest the name of the weather station that is recorded as:

a location A **b** location B **c** location C. **(3 marks)**

Problem solving Set A

Bronze

Joanna is investigating the daily total rainfall in Perth in 2015.
She uses the large data set to select a sample from all 184 days.

a Describe how Joanna could take a random sample of 5 days. **(2 marks)**

b Give one advantage and one disadvantage of using a random sample. **(2 marks)**

c Suggest one improvement that Joanna can make to improve the reliability of the data she collects. **(2 marks)**

Silver

Francine is investigating the daily mean windspeed for Beijing for August, September and October 2015. She uses the large data set to select a sample of size 20 by generating a random starting number between 1 and 5 and choosing every fifth value thereafter.

a Describe the sampling method that Francine has used. **(1 mark)**

b Using your knowledge of the large data set, explain why Francine's method will not generate a sample of size 20. **(2 marks)**

Gold

Ali is investigating the daily mean wind speed in May, June and July in Jacksonville in 2015.
He uses the large data set to select a sample from all 92 days.

a Describe how Ali can select a sample of size 15 stratified by month. **(2 marks)**

b Give one advantage of using a stratified sample in this context. **(1 mark)**

c Describe the two ways that Ali's data is recorded in the large data set. **(2 marks)**