4.2 Working Scientifically: Data, Graphs and Evaluation: 30-minute Pack

Calculator allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A balance is checked with known masses. It then shows 82 g for a sample. Identify the error pattern, estimate the corrected sample mass and explain whether simply repeating the weighing fixes the problem.

Known mass (g)	Balance reading (g)
50	52
100	102
150	152

(3)

2 Two groups each roll a toy car down the same ramp three times, using their own unchanged method and equipment. Calculate the mean and range for each group. Which set is more repeatable? Can these data alone show which group is more accurate?

Group	Run 1 (cm)	Run 2 (cm)	Run 3 (cm)
A	51	50	52
B	47	55	51

(5)

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3 A pupil tests whether light affects seedling growth. One seedling is near a window and receives 10 ml of water daily. Another is in a cupboard and receives 30 ml daily. The cupboard seedling grows taller. Explain why this does not isolate the effect of light and suggest two improvements, explaining their purposes.

(3)

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4 Five ponds with different depths are measured once on the same afternoon. Shade cover and water temperature are recorded. Describe the association with numerical evidence and explain why these results alone do not prove that shade caused the temperature differences.

Shade cover (%)	Water temperature (°C)
0	24
20	23
40	21
60	20
80	18

(3)

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5 Three seedlings have heights 14 mm, 17 mm and 17 mm. Calculate their mean height.

(2)

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6 A cup cools. Choose a suitable graph type to show temperature changing with time, give the axis labels and suggest regular scales covering all values.

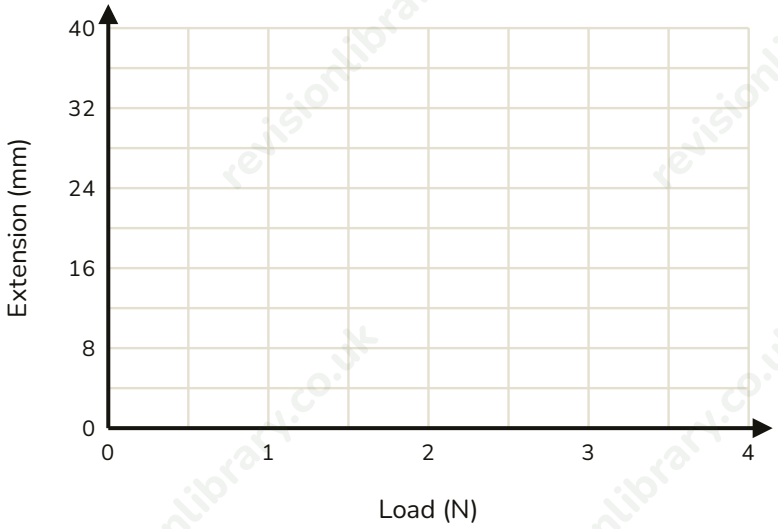
Time (min)	Temperature (°C)
0	70
2	54
4	44
6	38
8	34

(3)

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7 A spring is tested with small loads. Plot all five points on the supplied grid. Draw a straight line through the points. Use crosses for points.

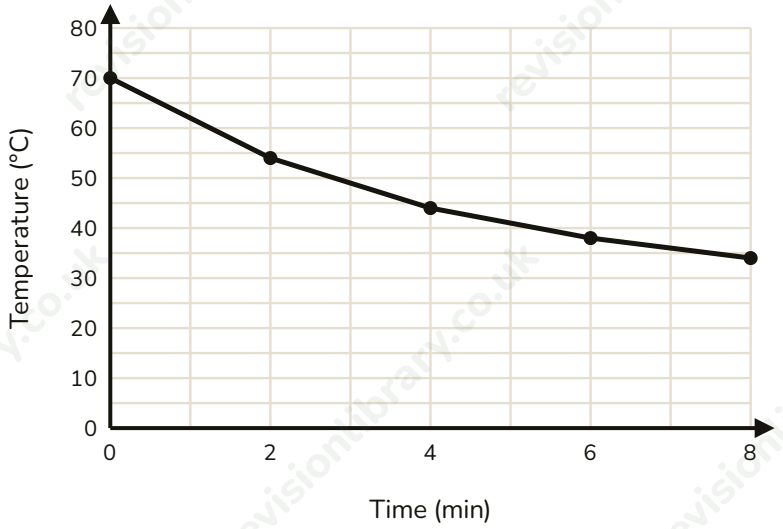
Load (N)	Extension (mm)
0	0
1	8
2	16
3	24
4	32



(4)

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8 The graph shows a cup cooling. Read its temperature at 4 min. Calculate the temperature fall from 0 to 8 min.



(3)

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Mark scheme · 4.2 Working Scientifically: Data, Graphs and Evaluation: 30-minute Pack

Question 1

Systematic offset of +2 g in every check.	B1
Corrected estimate 80 g.	A1
Repeats do not remove the offset; zero/check/calibrate and remeasure.	B1

Answer: **Each reading is 2 g too high, consistent with a systematic offset. Corrected sample mass = 82 - 2 = 80 g. Repeats do not remove this bias; check/zero or calibrate the balance and remeasure.**

Question 2

Uses sum/3 for means and maximum minus minimum for ranges.	M1
Both means 51 cm.	A1
A range 2 cm and B range 8 cm.	A1
A is more repeatable: smaller spread using its own unchanged method.	B1
Cannot judge accuracy without a reference value.	B1

Answer: **Both means are 51 cm. A range = 2 cm; B range = 8 cm. A is more repeatable because its results are closer together. Accuracy cannot be judged without a trustworthy reference value.**

Question 3

Water and light both changed, so water is a confounding variable.	B1
Keep daily water equal to isolate the effect of light.	B1
Use several similar seedlings in each condition and compare means to reduce the influence of individual variation; accept another explained improvement such as matching temperature.	B1

Answer: **Both light and water changed, so the growth difference cannot be attributed to light alone. Give equal water to control that variable. Use several similar seedlings in each light condition and compare means to reduce the influence of individual variation.**

Question 4

Negative association: more shade, lower temperature.	B1
Correct numerical evidence, e.g. 24 °C at 0% and 18 °C at 80%.	B1
Depth differs and may affect temperature; no controlled test isolates shade.	B1

Answer: **Greater shade cover is associated with lower temperature: 24 °C at 0% and 18 °C at 80%. The ponds also differ in depth, which could affect temperature, so this observational association alone does not prove causation.**

Question 5

Adds 14 + 17 + 17 and divides by 3.	M1
16 mm.	A1

Answer: **16 mm.**

Question 6

Line graph, or scatter graph with a suitable trend line, for two continuous variables.	B1
Time (min) horizontal and Temperature (°C) vertical.	B1
Regular numerical scales covering all data; accepts other sensible scales.	B1

Answer: **A line graph: Time (min) horizontally, Temperature (°C) vertically. For example, x from 0 to 8 in steps of 2 min; y from 0 to 80 in steps of 10 °C.**

Question 7

Plots (0, 0) and (1, 8) correctly.	B1
Plots (2, 16) and (3, 24) correctly.	B1
Plots (4, 32) correctly.	B1
Draws the straight line through the plotted points; allow plotting within half a small grid division.	B1

Answer: **Points (0, 0), (1, 8), (2, 16), (3, 24), (4, 32), joined by a straight line from (0, 0) to (4, 32).**

Question 8

44 °C; allow 43 to 45 °C when reading.	B1
Subtracts final temperature from initial: 70 - 34.	M1
36 °C fall.	A1

Answer: **44 °C at 4 min; fall = 70 - 34 = 36 °C.**

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