4.2 Working Scientifically: Data, Graphs and Evaluation: Test Pack

Calculator allowed · about 20 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A water sample is warmed. A pupil records time in seconds and temperature in degrees Celsius. Write suitable headings, including units, for the two columns below.

Column 1	Column 2
0	18
20	26
40	33

(2)

2 These are mean sugar-dissolving times, each from three trials with equal sugar mass and water volume. State a conclusion supported by the data, quote two values and explain why "the time halves whenever temperature doubles" is not supported.

Temperature (°C)	Mean time (s)
20	65
40	42
60	30

(4)

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3 A pupil times the same short event four times: 0.24 s, 0.31 s, 0.27 s and 0.30 s. The pupil sometimes presses the stopwatch slightly early and sometimes slightly late. Identify the type of error and explain how repeats and a mean help, and what they cannot fix.

(3)

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4 Two materials are tested as insulation on identical cups. Water starts at the same temperature. Temperature fall after 5 min is measured in three repeats. Calculate each mean and state each observed span (lowest to highest). Evaluate the claim "A is definitely better than B".

Material	Fall 1 (°C)	Fall 2 (°C)	Fall 3 (°C)
A	9	10	11
B	10	11	12

(4)

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5 The same volume of water is poured through each soil type. The volume draining out in five minutes is recorded. Choose a suitable graph type and give both axis labels.

Soil type	Volume drained (ml)
Sand	25
Loam	16
Clay	7

(3)

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Mark scheme · 4.2 Working Scientifically: Data, Graphs and Evaluation: Test Pack

Question 1

Time (s), or time / s.	**B1**
Temperature (°C), or temperature / °C.	**B1**

Answer: **Time (s); Temperature (°C).**

Question 2

Warmer water gave shorter times over the tested temperatures.	**B1**
Quotes a correct pair with units, e.g. 65 s at 20 °C and 30 s at 60 °C.	**B1**
Half of 65 = 32.5 s.	**M1**
42 s is not 32.5 s, so the proposed halving rule fails.	**B1**

Answer: **In these tests, warmer water gave shorter dissolving times: 65 s at 20 °C and 30 s at 60 °C. Doubling from 20 °C to 40 °C gave 42 s, not half of 65 s (32.5 s).**

Question 3

Random error, linked to varying early/late reactions.	**B1**
Repeats and a mean reduce random uncertainty through partial cancellation; do not guarantee its removal.	**B1**
Repeats do not remove systematic error.	**B1**

Answer: **This is random timing error. Repeating and taking a mean reduces random uncertainty because early and late timing differences can partly cancel. It does not remove a systematic error such as a consistently slow stopwatch.**

Question 4

Mean falls A 10 °C and B 11 °C.	**A1**
Spans A 9 to 11 °C and B 10 to 12 °C.	**B1**
Lower mean fall favours A in these tests.	**B1**
Spans overlap; limited evidence does not establish definitely better; suggests more repeats.	**B1**

Answer: **Mean falls: A 10 °C, B 11 °C. Spans: A 9 to 11 °C; B 10 to 12 °C. A has a smaller mean fall and so appears better in these tests, but the observed spans overlap; three repeats do not justify "definitely". More repeats would help assess the difference.**

Question 5

Bar chart with separate bars because soil types are categories.	**B1**
Horizontal: Soil type.	**B1**
Vertical: Volume drained (ml).	**B1**

Answer: **A bar chart with gaps: horizontal axis Soil type; vertical axis Volume drained (ml).**

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