



Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Key words

1. hypothesis
2. data
3. process skills
4. interdisciplinary
5. scientific notation
6. 10
7. metric prefix
8. least count

K • 4

Each carries 0.5 mark.

2 Label the diagram

1. Observe, ask a question
2. Make a hypothesis
3. Experiment: collect data

4. Result and conclusion
5. Test the hypothesis
6. Report: share it

K • 3

Each carries 0.5 mark.

3 Multiple choice

- i. b. a millimeter

K • 1

Each centimeter on a ruler is divided into 10 small divisions, so one division is $0.1\text{ cm} = 1\text{ mm}$.

- ii. a. 10^9

K • 1

Giga (G) is 10^9 , a thousand million. Tera (T) is 10^{12} .

- iii. b. predicting

U • 1

She is saying what she **expects** before testing it, and giving a reason: that is a **prediction**. A prediction with a reason behind it is also a kind of hypothesis. Observing and measuring come during the test; communicating comes after it.

- iv. d. 2.4×10^{-5}

A • 1

Move the point 5 places right to get 2.4, a coefficient from 1 to less than 10; the number was less than 1, so the power is -5 . (2×10^{-5} drops the 0.4; 24×10^{-5} is 0.00024, ten times too big, and its coefficient is more than 10; 0.24×10^{-6} is 0.00000024, a hundred times too small, and its coefficient is less than 1.)

- v. b. 2°C

A • 1

$(40 - 30)^\circ\text{C} \div 5\text{ divisions} = 2^\circ\text{C}$. The tempting answer, 1°C , comes from assuming every thermometer has ten divisions between numbered marks. Always count them.

4 Very short answers

- a. MARKING SCHEME

K • 1

✓ 0.01 s written.

- b. MARKING SCHEME

A • 1

✓ 320,000 written.

- c. MARKING SCHEME

U • 1

✓ Alcohol (its vapor) catches fire easily.



5 Short answers

a. MARKING SCHEME

K · 2

- ✓ A way of writing a very big or very small number as a coefficient from 1 to less than 10 multiplied by a power of 10.
- ✓ A correct example, e.g. $150,000,000 \text{ km} = 1.5 \times 10^8 \text{ km}$.

b. MARKING SCHEME

U · 2

- ✓ Mixing a concentrated acid with water gives out a lot of heat.
- ✓ A little water poured into acid boils at once and spits hot acid out; acid poured slowly into a lot of water spreads the heat through all the water, so nothing boils.

c. MARKING SCHEME

U · 2

- ✓ The smallest amount an instrument can measure: the value of one smallest division on its scale (the difference between two numbered marks $\div$ the number of divisions between them).
- ✓ A correct example, e.g. a ruler's least count is 1 mm ($1 \text{ cm} \div 10$), a protractor's 1° , a digital stopwatch's 0.01 s.

6 Long answer

ANSWER

U · 4

A scientific study follows planned steps:

1. **Observation and question:** something in nature is observed and a question is asked about it.
2. **Hypothesis:** a possible answer that can be tested is suggested.
3. **Experiment:** the hypothesis is tested by an experiment, in a laboratory or outdoors, and data are collected by measuring (taking several readings and their average).
4. **Result and conclusion:** the data are analyzed and a conclusion is drawn.
5. **Testing the hypothesis:** the conclusion is compared with the hypothesis.
6. **Report:** if the hypothesis is proved, a report is written and shared; if not, the hypothesis is changed and the steps are repeated.

Example: to find whether lemon juice is acidic, we guess that it is (hypothesis), test it with pH paper (experiment), find pH about 2 (data), conclude that it is acidic, and report it.

MARKING SCHEME

- ✓ Observation and a question, then a hypothesis: a possible answer that can be tested.
- ✓ An experiment tests the hypothesis and gives data (several readings, and their average).
- ✓ The data are analyzed and a conclusion is drawn and compared with the hypothesis; if it is proved, a report is written and shared; if not, the hypothesis is changed and the steps repeated.
- ✓ A suitable example, e.g. lemon juice: guess it is acidic, test it with pH paper, pH about 2, conclude it is acidic, report.



7 Numerical problems

a. ANSWER

A · 2

- i. 1.23×10^6
- ii. 4.2×10^{-4}
- iii. 1×10^{-8}
- iv. 3×10^8

MARKING SCHEME

- ✓ 1.23×10^6 for (i) and 4.2×10^{-4} for (ii).
- ✓ 1×10^{-8} for (iii) and 3×10^8 for (iv).

b. ANSWER

A · 2

Average = $(0.58 + 0.66 + 0.62) \div 3 \text{ s} = 1.86 \div 3 \text{ s} = 0.62 \text{ s}$

MARKING SCHEME

- ✓ The three times added and divided by 3: $(0.58 + 0.66 + 0.62) \div 3$.
- ✓ Average = 0.62 s.

c. ANSWER

A · 2

Least count = $(20 - 10) \text{ mL} \div 5 = 2 \text{ mL}$. Volume = $10 \text{ mL} + 3 \times 2 \text{ mL} = 16 \text{ mL}$.

MARKING SCHEME

- ✓ Least count = $(20 - 10) \div 5 = 2 \text{ mL}$.
- ✓ Volume = $10 + 3 \times 2 = 16 \text{ mL}$.

8 Think

ANSWER

HA · 2

It is **precise**: the readings are very close to each other. But it is **not accurate**: they are all far from the true value (about 0.64 s). **Accurate** means close to the true value; **precise** means close to each other. Averaging helps with random errors, which go both ways, but it can't remove an error that is always in the same direction, like a faulty instrument or a slow hand. For that you need a better instrument, or a check against a known value.

MARKING SCHEME

- ✓ Precise: the five readings are very close to each other.
- ✓ Not accurate: they are all far from the true value (about 0.64 s), because the error is always in the same direction, which averaging can't remove.

9 Activity: How long does a stone take to fall? (Activity 1.6)

(not marked)

WHAT STUDENTS SHOULD FIND

The three times differ a little, even though the stone falls the same height, because the hand starts and stops the stopwatch a little early or late each time. The average evens out these random errors, so it is closer to the true time (about 0.64 s) than a single reading. Most averages come out a little high, because a hand always takes a moment to react.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	12	10	9	2	33

