



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. variable
2. independent variable
3. dependent variable
4. controlled variables
5. fundamental unit
6. seven
7. derived unit
8. units

K • 4

Each carries 0.5 mark.

2 Label the diagram

- | | |
|------------------|--------------------------|
| 1. e = extension | 4. thumb |
| 2. rubber band | 5. forefinger |
| 3. paper bullet | 6. x = distance traveled |

K • 3

Each carries 0.5 mark.

3 Multiple choice

- i. c. kilogram

K • 1

The kilogram is one of the seven SI base units. The newton, pascal and joule are all made from kg, m and s.

- ii. b. velocity

K • 1

Velocity is displacement ÷ time: $m \div s = m s^{-1}$. Acceleration is $m s^{-2}$.

- iii. c. joule

K • 1

The joule is $kg m^2 s^{-2}$. The candela, ampere and kelvin are base units.

- iv. a. $kg m s^{-2}$

U • 1

$F = ma$: $kg \times m s^{-2} = kg m s^{-2}$. ($kg m^2 s^{-2}$ is the joule; $kg m s^{-1}$ is the unit of momentum.)

- v. b. the time the ice takes to melt

A • 1

The melting time is what she **measures**; it depends on the water's temperature, which is what she **changes** (independent). The size of the ice and the amount of water are kept the same (controlled).

4 Very short answers

- a. MARKING SCHEME

K • 1

✓ A fixed, agreed amount of a physical quantity that other amounts are compared with when they are measured.

- b. MARKING SCHEME

K • 1

✓ The horizontal x-axis.

- c. MARKING SCHEME

U • 1

✓ The distance s.



5 Short answers

a. MARKING SCHEME

U • 2

- ✓ If anything besides the independent variable changes, it may also change the result, and we can't say what caused the effect.
- ✓ Keeping the other variables the same makes the test fair, so the result is valid and reliable.

b. MARKING SCHEME

A • 2

- ✓ Left side: v^2 has units $(\text{m s}^{-1})^2 = \text{m}^2 \text{s}^{-2}$; right side: ut has units $\text{m s}^{-1} \times \text{s} = \text{m}$.
- ✓ The two sides have different units, so the equation can't be correct.

c. MARKING SCHEME

U • 2

- ✓ Any one difference, e.g. a fundamental unit does not depend on any other unit; a derived unit is made by combining fundamental units.
- ✓ Any second difference, e.g. there are only seven fundamental units in SI but many derived units; or kilogram, meter, second against newton, joule, m/s.

d. MARKING SCHEME

A • 2

- ✓ She is changing two independent variables at once (the amount of food and the time of feeding), so she can't tell which one made the dog eat faster.
- ✓ She should change one at a time: only the amount of food at the same time each day, then, separately, only the time with the same amount of food.

6 Long answer

ANSWER

A • 4

- The substance mixed into the soil.
- The height of the plants.
- Any two of: the same soil, the same size of pot, the same kind of seed, the same amount of substance (two spoons), the same sunlight, the same watering.
- One plant can grow badly for a reason that has nothing to do with the substance, such as a weak seed. With three pots she can take the average height, so the result is more reliable.

MARKING SCHEME

- ✓ i. The substance mixed into the soil.
- ✓ ii. The height of the plants.
- ✓ iii. Any two controlled variables, e.g. the soil, the size of pot, the kind of seed, the amount of substance, sunlight, watering.
- ✓ iv. To take the average of three, so that one odd plant can't spoil the result and it is more reliable.

7 Problem with units

ANSWER

A • 4

- $N = \text{kg m s}^{-2}$ (from $F = ma$)
- $W = J \div s = \text{kg m}^2 \text{s}^{-3}$ (from $\text{power} = \text{work} \div \text{time}$)
- $J = N \times m = \text{kg m}^2 \text{s}^{-2}$ (from $\text{work} = \text{force} \times \text{distance}$)
- $\text{Pa} = N \div \text{m}^2 = \text{kg m}^{-1} \text{s}^{-2}$ (from $\text{pressure} = \text{force} \div \text{area}$)

MARKING SCHEME

- ✓ i. $N = \text{kg m s}^{-2}$, from $F = ma$.
- ✓ ii. $W = \text{kg m}^2 \text{s}^{-3}$, from $\text{power} = \text{work} \div \text{time}$.
- ✓ iii. $J = \text{kg m}^2 \text{s}^{-2}$, from $\text{work} = \text{force} \times \text{distance}$.
- ✓ iv. $\text{Pa} = \text{kg m}^{-1} \text{s}^{-2}$, from $\text{pressure} = \text{force} \div \text{area}$.



8 Think

ANSWER

HA · 2

No. Every term does have the unit m, but the correct formula is $s = ut + \frac{1}{2}at^2$. Numbers such as $\frac{1}{2}$ have no units, so a unit check can't catch a missing or wrong number. If the units don't match, an equation is surely wrong; if they match, it only might be right.

MARKING SCHEME

- ✓ No: the correct formula is $s = ut + \frac{1}{2}at^2$.
- ✓ Numbers like $\frac{1}{2}$ have no units, so matching units show only that an equation might be right, not that it is.

9 Activity: A rubber-band catapult (Activity 1.1)

(not marked)

WHAT STUDENTS SHOULD FIND

The bullet flies farther the more the band is stretched. Independent: the extension; dependent: the distance; controlled: the thickness of the rubber band and the size of the paper bullet. Doubling the stretch usually more than doubles the distance (the band stores about four times the energy), but air slows a light paper bullet, so the distance is less than four times.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	12	6	13	2	33

