

- 1 The table below shows some estimates of some physical quantities.
Which quantity is **not** a reasonable estimate?

	quantity	value
A	electric current in a heater	12 A
B	mass of an adult person	70 kg
C	maximum speed of an Olympic sprinter	10 m s ⁻¹
D	water pressure at the bottom of a swimming pool	10 ⁸ Pa

- 2 The table shows some measurable quantities.
Which row gives the correct order of magnitude of the measurable quantity in the stated unit?

	measurable quantity	order of magnitude	unit
A	mass of a coin	10 ⁻⁴	kg
B	thickness of a sheet of paper	10 ⁻²	m
C	weight of an apple	10 ⁰	N
D	temperature of a person's body	10 ¹	K

- 3 A micrometer is used to measure the diameters of two cylinders.

diameter of first cylinder = (12.78 ± 0.02) mm

diameter of second cylinder = (16.24 ± 0.03) mm

The difference in the diameters is calculated.

What is the percentage uncertainty in this difference?

- A** 0.29 **B** 0.58 **C** 0.87 **D** 1.4

- 4 Which estimate is realistic?

- A** The kinetic energy of a bus travelling on an expressway is 30 000 J.
B The power of a domestic light is 300 W.
C The temperature of a hot oven is 300 K.
D The volume of air in a car tyre is 0.03 m³.

5

A radio aerial of length L , when the current is I , emits a signal of wavelength λ and power P . These quantities are related by

$$P = kI^2 \left(\frac{L}{\lambda}\right)^2$$

where k is a constant.

What unit, if any, should be used for the constant k ?

- A** volt **B** ohm **C** watt **D** no unit

6

A byte (b) comprises 8 bits.

How many bits are there in 2 terabytes (2Tb)?

- A** 2×10^9 **B** 16×10^9 **C** 2×10^{12} **D** 16×10^{12}

7

The speed v of waves on a stretched wire is given by the equation

$$v = T^p \mu^q$$

where T is the tension in the wire and μ is the mass per unit length of the wire.

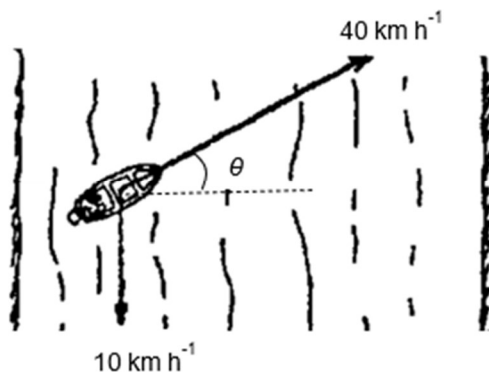
What are the values of p and q ?

- | | p | q |
|----------|----------------|----------------|
| A | $-\frac{1}{2}$ | $-\frac{1}{2}$ |
| B | $-\frac{1}{2}$ | $\frac{1}{2}$ |
| C | $\frac{1}{2}$ | $-\frac{1}{2}$ |
| D | $\frac{1}{2}$ | $\frac{1}{2}$ |

- 8 Which of the following estimates is realistic?

- A The kinetic energy of a bus travelling on an expressway is 50 000 J.
- B The upthrust on a ping-pong ball fully submerged in water is 0.3 N.
- C The power of a domestic light bulb is 300 W.
- D The energy of a microwave photon is 6.63×10^{-26} J.

- 9 The diagram shows the top view of a motorboat crossing a river. The water current causes the motorboat to drift at a speed of 10 km h^{-1} downstream, along the length of the river.



If the engine drives the motorboat at a speed of 40 km h^{-1} relative to the water, what should the angle θ be in order for the motorboat to (a) take the shortest path to the opposite shore and (b) take the shortest time to reach the opposite shore?

- | | (a) | (b) |
|---|------------|------------|
| A | 14° | 14° |
| B | 14° | 0° |
| C | 0° | 14° |
| D | 0° | 0° |
- 10 Forces of 3 N and 4 N act at a point. Which one of the following could **not** be the magnitude of their resultant?
- A 1 N B 3 N C 4 N D 8 N
- 11 Which of the following gives a good estimate of the order of magnitude of the volume of an average human adult?
- A 10^{-2} m^3 B 10^{-1} m^3 C 10^0 m^3 D 10^1 m^3

12

Which of the following is considered as a random error?

- A Error as a result of using $g = 10 \text{ m s}^{-2}$, instead of $g = 9.81 \text{ m s}^{-2}$.
- B Error in measuring the time duration of a 100 m sprint using a stopwatch.
- C Error due to a stopwatch running too fast.
- D Zero error of a measuring instrument.

13

In an experiment to determine the density of a sphere, the following measurements are made.

$$\text{mass} = (80 \pm 2) \text{ g}$$

$$\text{diameter} = (4.0 \pm 0.1) \text{ cm}$$

How should the value of density of the sphere be expressed?

- A $(2.4 \pm 0.1) \text{ g cm}^{-3}$
- B $(2.4 \pm 0.2) \text{ g cm}^{-3}$
- C $(2.4 \pm 0.4) \text{ g cm}^{-3}$
- D $(2 \pm 2) \text{ g cm}^{-3}$

14

Which of the following gives the correct base units for the permittivity of free space, ϵ_0 ?

- A $\text{C}^2 \text{ N}^{-1} \text{ m}^{-2}$
- B $\text{kg}^{-1} \text{ m}^{-3} \text{ s}^4 \text{ A}^2$
- C $\text{kg m}^{-3} \text{ A}^2$
- D $\text{kg}^{-1} \text{ m}^3 \text{ s}^2 \text{ A}^{-2}$

15

Using an ohm-meter, a student measures the resistance of two resistors R_1 and R_2 separately with their associated uncertainties shown as follows:

$$R_1 = 200 \pm 5 \, \Omega$$

$$R_2 = 800 \pm 5 \, \Omega$$

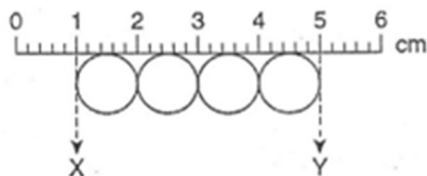
The two resistors R_1 and R_2 are then connected in parallel. He calculated the effective resistance, R to be $160 \, \Omega$. What is the uncertainty of the effective resistance?

- A $2.5 \, \Omega$ B $3.4 \, \Omega$ C $5 \, \Omega$ D $10 \, \Omega$

-
- 16 Which of the following expressions has the same SI base units as electric potential difference?
- A $\frac{\text{length} \times \text{mass}}{\text{current} \times \text{time}}$
- B $\frac{\text{length} \times \text{mass}}{\text{current} \times (\text{time})^3}$
- C $\frac{(\text{length})^2 \times \text{mass}}{\text{current} \times \text{time}}$
- D $\frac{(\text{length})^2 \times \text{mass}}{\text{current} \times (\text{time})^3}$
- 17 A straight river is flowing from west to east with a speed 0.50 m s^{-1} . A man can swim in still waters at a speed 0.80 m s^{-1} .
- In which direction should the man swim to take the shortest path from the south bank to the north bank?
- A 39° east of north
- B 51° east of north
- C 39° west of north
- D 51° west of north
- 18 The density of a steel ball was determined by measuring its mass and diameter. The mass was measured within 1% and the diameter within 3%. The error in the calculated density of the steel ball is at most
- A 2%
- B 4%
- C 8%
- D 10%
- 19 Which of the following answers gives a reasonable estimate of the number of water molecules present in a cup? *The mass number of oxygen is 16.* The mass of the water is approximately 200 g.
- A 10^{17} B 10^{20} C 10^{25} D 10^{29}
-

20

A student attempts to measure the diameter of a steel ball by using a metre rule to measure four similar balls in a row.



The student estimates the positions on the scale to be as follows.

X: (1.0 ± 0.2) cm

Y: (5.0 ± 0.2) cm

What is the diameter of a steel ball together with its associated uncertainty?

- A (1.0 ± 0.1) cm
- B (1.0 ± 0.2) cm
- C (1.0 ± 0.24) cm
- D (1.0 ± 0.4) cm