



ANSWER BOOK

SI units and prefixes

Measurements · Year 12

AQA 3.1.1 · CIE 1.1.1, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 15.1.1

OCR A 2.1.1(a), 2.1.2(a), 2.1.2(b), 2.1.2(c), 2.1.2(d), 2.1.2(e), 2.1.2(f), 3.2.1(b), 4.2.5(c)

19 questions · 53 marks

NAVY EDITION

SECTION A · Warm-up

- A1** Mass (kilogram, kg) and length (metre, m) (1); time (second, s) and electric current (ampere, A) (1); temperature (kelvin, K) and amount of substance (mole, mol) (1). One mark for each two correct pairs. [3]
- A2** (a) $5.0 \text{ km} = 5000 \text{ m}$, that is $5.0 \times 10^3 \text{ m}$ (1) [2]
(b) $2.5 \text{ GHz} = 2.5 \times 10^9 \text{ Hz}$ (1)
- A3** From $F = ma$ (1), $1 \text{ N} = 1 \text{ kg m s}^{-2}$ (1). [2]
- A4** (a) $85 \text{ pF} = 8.5 \times 10^{-11} \text{ F}$ (1). (b) $2.4 \text{ fm} = 2.4 \times 10^{-15} \text{ m}$ (1). [2]
- A5** Energy in eV = energy in J $\div (1.60 \times 10^{-19})$ (1) = $3.2 \times 10^{-19} / (1.60 \times 10^{-19}) = 2.0 \text{ eV}$ (1). [2]

SECTION B · Standard

- B1** (a) $\text{J} = \text{N m}$ (1) = $\text{kg m}^2 \text{ s}^{-2}$ (1). (b) $\text{W} = \text{J s}^{-1} = \text{kg m}^2 \text{ s}^{-3}$ (1). [3]
- B2** (a) $3.0 \text{ mA} = 3.0 \times 10^{-3} \text{ A}$ (1). (b) $450 \text{ nm} = 4.5 \times 10^{-7} \text{ m}$ (1). (c) $12 \text{ M}\Omega = 1.2 \times 10^7 \Omega$ (1). [3]
- B3** LHS: $(\text{m s}^{-1})^2 = \text{m}^2 \text{ s}^{-2}$ (1) [3]
RHS: $a \times s = (\text{m s}^{-2})(\text{m}) = \text{m}^2 \text{ s}^{-2}$ (1)
Both sides have the same units, so the equation is homogeneous (1)
- B4** $\text{Pa} = \text{N m}^{-2} = \text{kg m s}^{-2} / \text{m}^2$ (1) = $\text{kg m}^{-1} \text{ s}^{-2}$ (1). [2]
- B5** (a) 90 minutes = 1.5 h (1), so energy = $2.4 \times 1.5 = 3.6 \text{ kW h}$ (1). (b) Energy = $3.6 \times 3.6 \times 10^6 = 1.3 \times 10^7 \text{ J}$ (1). [3]
- B6** $1 \text{ mm}^2 = (10^{-3} \text{ m})^2 = 10^{-6} \text{ m}^2$: the prefix must be squared with the unit (1). $0.020 \text{ mm}^2 = 2.0 \times 10^{-8} \text{ m}^2$ (1). [2]
- B7** $580 \text{ nm} = 5.8 \times 10^{-7} \text{ m}$ and $0.65 \mu\text{m} = 6.5 \times 10^{-7} \text{ m}$ (1); $0.00071 \text{ mm} = 7.1 \times 10^{-7} \text{ m}$ (1). Order: $580 \text{ nm} < 6.2 \times 10^{-7} \text{ m} < 0.65 \mu\text{m} < 0.00071 \text{ mm}$ (1). [3]
- B8** Unit of $l/g = \text{m}/(\text{m s}^{-2})$ (1) = s^2 (1). Taking the square root gives the unit of $\sqrt{l/g}$ as s, so T is in seconds (2π has no unit) (1). [3]

SECTION C · Stretch

- C1** Rearranging, $G = Fr^2/(Mm)$ (1) [3]
 Units = $(\text{kg m s}^{-2} \times \text{m}^2)/(\text{kg} \times \text{kg})$ (1)
 $= \text{m}^3 \text{kg}^{-1} \text{s}^{-2}$ (1)
-
- C2** (a) $2.7 \text{ g cm}^{-3} \times 1000$ (1) [4]
 $= 2700 \text{ kg m}^{-3}$ (1)
 (b) $90 \text{ km h}^{-1} = (90 \times 1000)/3600$ (1)
 $= 25 \text{ m s}^{-1}$ (1)
-
- C3** A correct physical equation must have the same units on both sides (1). If the [3]
 units do not match, the equation must be wrong (1), so a units check quickly catches
 errors such as a missing factor or a wrongly placed quantity, before any numbers are
 used (1).
-
- C4** Convert both prefixes: $2.5 \text{ mJ} = 2.5 \times 10^{-3} \text{ J}$ and $6.0 \text{ ns} = 6.0 \times 10^{-9} \text{ s}$ (1). $P = E/t =$ [3]
 $2.5 \times 10^{-3}/(6.0 \times 10^{-9}) = 4.2 \times 10^5 \text{ W}$ (1) = about 0.42 MW (or 420 kW) (1).
-
- C5** Unit of $T/\mu = (\text{kg m s}^{-2})/(\text{kg m}^{-1}) = \text{m}^2 \text{s}^{-2}$ (1), so $\sqrt{T/\mu}$ has unit m s^{-1} , the unit of [3]
 speed (1). $\sqrt{(\mu/T)}$ would have unit s m^{-1} , so only $v = \sqrt{T/\mu}$ can be correct (1).
-
- C6** Energy each day = $3.0 \times 2.0 = 6.0 \text{ kW h}$ (1). Energy in the month = $6.0 \times 30 = 180$ [4]
 kW h (1). Evidence of cost = $180 \times 28\text{p}$ (1); cost = £50.40 (1).
-