# IQM3013 A3 Teacher marking exercise

*IQM3013 Physics Assessment 3 Paper 2 v3  internal synthetic response and teacher practice materials*

The selected synthetic extracts below form an unmarked exercise. Apply the supplied assessment criteria, record evidence and propose marks or bands before consulting the separate teacher reference.

Source set is the controlled IQM3013 A3 Physics Paper 2 v3 Candidate Question Paper, separate Candidate Answer Booklet, IQM3013-DFB-2026 Data and Formulae Booklet, and Staff Mark Scheme and Marking Map v3. Source SHA-256 values are recorded in the authoring QA and marking ledger.

These are fictional, AI-generated written responses for internal staff-practice. They are not authentic candidate work and do not evidence a real sitting, identity, invigilation, practical/observed performance, moderation, academic approval, or release. Proposed marks are documentary judgements on the written evidence only.

## Teacher practice  instructions

This internal exercise contains four selected extracts from fictional synthetic written responses. Apply the exact source criteria, note evidence and propose marks before consulting the separate reference. Extracts are unmarked; full scripts and proposed decisions remain restricted to internal materials.

Source set is the controlled IQM3013 A3 Physics Paper 2 v3 Candidate Question Paper, separate Candidate Answer Booklet, IQM3013-DFB-2026 Data and Formulae Booklet, and Staff Mark Scheme and Marking Map v3. Source SHA-256 values are recorded in the authoring QA and marking ledger.

For each extract, mark only the quoted part against its source-point criteria. Do not infer unobserved performance or make a whole-candidate judgement.

## Extract A  S1 B1 c  electron energy and speed

Two positive point charges, +2.0 nC and +3.0 nC, are separated by 0.10 m in vacuum. Use $k=8.99\times10^{9}$ N m² C⁻². In a separate apparatus, parallel plates have 600 V potential difference and 0.020 m separation. Ignore edge effects. An electron is released from rest at the negative plate and reaches the positive plate without collision. Use $e=1.60\times10^{-19}$ C and $m=9.11\times10^{-31}$ kg; assume non-relativistic motion. Parts: (a) force magnitude and whether attractive/repulsive (3); (b) field strength and direction (2); (c) electron kinetic energy in joules and speed (3); (d) evaluate the claim that the electron accelerates along the field because F=qE (2).

Source criteria and maximum: B1cP1 (AO2, 1 mark): $K=eV=9.60\times10^{-17}$ J. B1cP2 (AO2, 1 mark): Uses $\tfrac{1}{2}mv^2=eV$ and rearranges to $v=\sqrt{(2eV/m)}$. B1cP3 (AO2, 1 mark): Speed is $1.45\times10^{7}$ m s⁻¹. Maximum 3 marks.

Student response extract (verbatim):

$$K = eV = \left(1.60 \times 10^{-19}\right)\left(600\right) = 9.60 \times 10^{-17} \ \text{J}$$

$$\frac{1}{2}mv^2 = eV\,; \quad v = \sqrt{\frac{2eV}{m}}$$

$$v = \sqrt{\frac{2\left(9.60 \times 10^{-17}\right)}{9.11 \times 10^{-31}}} = 1.45 \times 10^{7} \ \text{m} \ \text{s}^{-1}$$

**Extract B  S2 B1 b  field direction**

Two positive point charges, +2.0 nC and +3.0 nC, are separated by 0.10 m in vacuum. Use $k=8.99\times10^{9}$ N m² C⁻². In a separate apparatus, parallel plates have 600 V potential difference and 0.020 m separation. Ignore edge effects. An electron is released from rest at the negative plate and reaches the positive plate without collision. Use $e=1.60\times10^{-19}$ C and $m=9.11\times10^{-31}$ kg; assume non-relativistic motion. Parts: (a) force magnitude and whether attractive/repulsive (3); (b) field strength and direction (2); (c) electron kinetic energy in joules and speed (3); (d) evaluate the claim that the electron accelerates along the field because F=qE (2).

Source criteria and maximum: B1bP1 (AO2, 1 mark): $E=V/d=600/0.020=3.0\times10^{4}$ V m⁻¹. B1bP2 (AO2, 1 mark): Field direction is from the positive plate to the negative plate. Maximum 2 marks.

Student response extract (verbatim):

$$E=\frac{600}{0.020}=3.0\times10^{4}\ \text{V}\ \ \text{m}^{-1}$$

I think the field goes from the negative plate to the positive plate.

### Extract C  S3 B5 a  mass defect conversion

For helium-4 use proton mass 1.00728 u, neutron mass 1.00866 u, nuclear mass 4.00151 u; 1 u=1.66054×$10^{-27}$ kg, c=3.00×$10^{8}$ m $s^{-1}$ and 1 MeV=1.60×$10^{-13}$ J. Separately, uranium-238 has proton number 92 and undergoes alpha decay. Parts: (a) mass defect in u and kg (3); (b) total binding energy in MeV and binding energy per nucleon (3); (c) daughter Z and A (2); (d) evaluate the claim that greater binding energy per nucleon means a nucleus can never decay (2).

Source criteria and maximum: B5aP1 (AO2, 1 mark): Free nucleon mass is 2(1.00728)+2(1.00866)=4.03188 u. B5aP2 (AO2, 1 mark): Mass defect is 4.03188−4.00151=0.03037 u. B5aP3 (AO2, 1 mark): Mass defect is 5.04×$10^{-29}$ kg using 1 u=1.66054×$10^{-27}$ kg. Maximum 3 marks.

Student response extract (verbatim):

$$m_{free} = 2(1.00728) + 2(1.00866) = 4.03188 \text{ u}$$

$$\Delta m = 4.03188 - 4.00151 = 0.03037 \text{ u}$$

$$\Delta m = (0.03037)(1.66054 \times 10^{-25}) = 5.04 \times 10^{-27} \text{ kg}$$

### Extract D  S3 B6 c  photon transition

Light of frequency $8.0\times10^{14}$ Hz illuminates a metal of work function 2.0 eV. Use $h=6.63\times10^{-34}$ J s, 1 eV$=1.60\times10^{-19}$ J, $c=3.00\times10^{8}$ m s$^{-1}$. In a separate atom, permitted levels are −2.0 eV and −5.0 eV. Parts: (a) photon energy and maximum photoelectron kinetic energy, both in joules (3); (b) threshold frequency (2); (c) emission/absorption and wavelength for transition −2.0 to −5.0 eV (3); (d) why threshold frequency supports photon model (2).

Source criteria and maximum: B6cP1 (AO2, 1 mark): A photon is emitted because the electron loses energy. B6cP2 (AO2, 1 mark): Energy difference is 3.0 eV$=4.80\times10^{-19}$ J and uses $\lambda=hc/\Delta E$. B6cP3 (AO2, 1 mark): Wavelength is $4.14\times10^{-7}$ m. Maximum 3 marks.

Student response extract (verbatim):

A photon is absorbed because the electron moves to a different level.

$$\Delta E = 3.0 \text{ eV} = 4.80 \times 10^{-19} \text{ J}$$

$$\lambda = \frac{hc}{\Delta E} = 4.14 \times 10^{-7} \text{ m}$$