IQM3013 A3 Teacher marking reference

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

This reference supports discussion of the selected exercise extracts. Marks and bands are proposed documentary judgements, subject to human subject review.

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 reference use limits

The commentary below records proposed documentary decisions for the four selected extracts. It is separate from the unmarked exercise and remains subject to human academic review.

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Reference 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=8.99×10⁹ 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=1.60×10⁻¹⁹ C and m=9.11×10⁻³¹ 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=9.60×10⁻¹⁷ J. B1cP2 (AO2, 1 mark): Uses ½mv²=eV and rearranges to v=√(2eV/m). B1cP3 (AO2, 1 mark): Speed is 1.45×10⁷ m s⁻¹. Maximum 3 marks.

Selected student evidence (verbatim):

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

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

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

Proposed decision: 3/3. Earned source points: B1cP1, B1cP2, B1cP3.

S1 correctly converts the electron’s potential energy gain to kinetic energy and uses it to obtain speed. B1cP1: awarded because the response provides the required source evidence: K=eV=9.60×10⁻¹⁷ J.; B1cP2: awarded because the response provides the required source evidence: Uses ½mv²=eV and rearranges to v=√(2eV/m).; B1cP3: awarded because the response provides the required source evidence: Speed is 1.45×10⁷ m s⁻¹.

Reference 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.

Selected student evidence (verbatim):

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

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

Proposed decision: 1/2. Earned source points: B1bP1.

S2’s field magnitude is correct, but the direction is reversed. B1bP1: awarded because the response provides the required source evidence: $E=V/d=600/0.020=3.0\times10^{4}$ V m⁻¹.; B1bP2: not awarded. The response gives the correct magnitude but states the field runs from the negative plate to the positive plate, reversing the source direction.

Reference 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.

Selected student evidence (verbatim):

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

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

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

Proposed decision: 2/3. Earned source points: B5aP1, B5aP2.

S3 finds the mass defect in u but makes a power-of-ten error converting u to kg. B5aP1: awarded because the response provides the required source evidence: Free nucleon mass is 2(1.00728)+2(1.00866)=4.03188 u.; B5aP2: awarded because the response provides the required source evidence: Mass defect is 4.03188−4.00151=0.03037 u.; B5aP3: not awarded. The kg conversion uses 10^{-25} kg/u instead of the supplied 1.66054×10^{-27} kg/u, giving 5.04×10^{-27} kg.

Reference D S3 B6 c photon transition

Light of frequency 8.0×10^{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 4.14×10^{-7} m. Maximum 3 marks.

Selected student evidence (verbatim):

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

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

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

Proposed decision: 2/3. Earned source points: B6cP2, B6cP3.

S3 calculates the energy difference and wavelength but misidentifies emission as absorption. B6cP1: not awarded. The transition is from −2.0 eV to −5.0 eV, so the electron loses energy and emits a photon; the response says absorbed.; B6cP2: awarded because the response provides the required source evidence: Energy difference is 3.0 eV$=4.80\times10^{-19}$ J and uses $\lambda=hc/\Delta E$.; B6cP3: awarded because the response provides the required source evidence: Wavelength is 4.14×10^{-7} m.