Physics Paper 2 Mark Scheme

Sample assessment 2026–27

Time allowed: 2 hours Total marks: 85

STAFF ONLY

Credit valid equivalent scientific responses where they meet the approved set-specific marking criteria. Reconcile every maximum mark to the candidate paper and answer booklet.

Section A · Multiple-choice questions

Award 1 mark for each correct answer.

Question	Correct answer
A1	C · It becomes one quarter. Coulomb force is inversely proportional to separation squared.
A2	A · They point radially inwards. Field direction is the force direction on a positive test charge.
A3	D · 6.0×10^3 N C^{-1}. $E = F/q = 0.012/(2.0 \times 10^{-6})$.
A4	B · A parabola. Constant acceleration opposite to the field combines with unchanged perpendicular velocity.
A5	D · The field is perpendicular to the plane. Flux is BA cos θ, where θ is measured from the normal.
A6	B · Zero. F = Bqv sin θ and sin 0° = 0.
A7	A · Up the page. For a positive charge, the force direction is v × B.
A8	C · Anticlockwise. The right-hand grip rule gives an anticlockwise field when the thumb points towards the observer.
A9	A · A changing current produces changing magnetic flux linking the secondary. Changing flux linkage induces secondary emf.
A10	D · 4.0 V. Vs/Vp = Ns/Np = 100/500.
A11	B · Opposes the change producing it. It opposes the change in flux, not necessarily the original flux itself.
A12	C · It is zero. Flux linkage is constant, so its rate of change is zero.
A13	D · Charge +2e; mass approximately four nucleon masses. An alpha particle is a helium-4 nucleus.
A14	A · The strong nuclear interaction. The attractive nuclear interaction can overcome proton electrostatic repulsion over nuclear distances.
A15	C · N/8. The remaining fraction is $(1/2)^3$.

Question	Correct answer
A16	B · 6.0×10^3 Bq. $A = \lambda N$.
A17	D · The sum of the free constituent nucleon masses minus the nuclear mass. Binding energy corresponds to this positive mass difference.
A18	C · The products have a smaller total rest mass. With nucleon number conserved, increased total binding corresponds to reduced total rest mass.
A19	A · Z increases by 1; A is unchanged. A neutron converts to a proton, with an electron and antineutrino emitted.
A20	B · Its proton number and nucleon number. Gamma emission lowers nuclear energy without changing Z or A.
A21	C · 2. Photon energy is proportional to frequency.
A22	A · The energy gained by an electron moving through a potential difference of one volt. It is a unit of energy, equal to the elementary charge multiplied by one volt.
A23	D · No photoelectrons are emitted. Individual photon energy remains below the work function.
A24	B · The saturation photocurrent. More incident photons per second produce more emitted electrons per second under the stated conditions.
A25	C · Its allowed electronic energy differences are discrete. Each emitted photon corresponds to a permitted energy difference.

Section B · Extended-response marking map

Question B1 · 10 marks

(a) 3 marks
1 mark: $F = kq_1q_2/r^2 = (8.99 \times 10^9)(2.0 \times 10^{-9})(3.0 \times 10^{-9})/0.10^2$.
1 mark: $F = 5.39 \times 10^{-6}$ N.
1 mark: The force is repulsive.
Mapping: LO32; AO2 3

(b) 2 marks
1 mark: $E = V/d = 600/0.020 = 3.0 \times 10^4$ V m^{-1}.
1 mark: From the positive plate to the negative plate.
Mapping: LO33; AO2 2

(c) 3 marks
1 mark: $K = eV = 9.60 \times 10^{-17}$ J.
1 mark: Uses $\frac{1}{2}mv^2 = eV$, hence $v = \sqrt{(2eV/m)}$.
1 mark: $v = 1.45 \times 10^7$ m s^{-1}.
Mapping: LO33; AO2 3

(d) 2 marks
1 mark: The electron charge is negative, so the electric force is opposite to the field direction.
1 mark: Its acceleration is therefore towards the positive plate; the learner has treated q as positive.
Mapping: LO33; AO3 2

Alternative valid responses / allocation: (c) Follow through the calculated energy where physically valid.

Question B2 · 10 marks

(a) 2 marks
1 mark: $F = Bqv = 0.20 \times 1.60 \times 10^{-19} \times 3.0 \times 10^{6}$.
1 mark: $F = 9.60 \times 10^{-14}$ N.
Mapping: LO35; AO2 2

(b) 3 marks
1 mark: The magnetic force is perpendicular to the instantaneous velocity.
1 mark: It therefore does no work and does not change kinetic energy or speed.
1 mark: Its inward force changes velocity direction and provides centripetal acceleration.
Mapping: LO35; AO1 3

(c) 3 marks
1 mark: Equates Bqv to mv^2/r.
1 mark: $r = mv/(Bq) = (1.67 \times 10^{-27} \times 3.0 \times 10^{6})/(0.20 \times 1.60 \times 10^{-19})$.
1 mark: $r = 0.157$ m.
Mapping: LO35; AO2 3

(d) 2 marks
1 mark: r is proportional to v for fixed m, q and B, so it doubles.
1 mark: New radius = 0.313 m (accept 0.314 m using rounded earlier radius).
Mapping: LO35; AO2 2

Alternative valid responses / allocation: Credit equivalent valid scientific wording without double-crediting a repeated point.

Question B3 · 10 marks

(a) 3 marks
1 mark: Uses $\Phi = BA$ because the field is parallel to the normal.
1 mark: $\Phi = 2.0 \times 10^{-4}$ Wb.
1 mark: $N\Phi = 0.040$ Wb turns.
Mapping: LO34; AO2 3

(b) 2 marks
1 mark: Magnitude of emf = $|\Delta(N\Phi)/\Delta t| = 0.040/0.020$.
1 mark: Magnitude = 2.0 V.
Mapping: LO37; AO2 2

(c) 2 marks
1 mark: The induced field opposes the decrease in the original flux.
1 mark: It is in the same direction as the original field during this decrease.
Mapping: LO37; AO1 2

(d) 3 marks
1 mark: $V_s = V_pN_s/N_p = 120 \times 100/1000 = 12$ V.
1 mark: For an ideal transformer $V_pI_p = V_sI_s$.
1 mark: $I_p = 12 \times 2.0/120 = 0.20$ A.
Mapping: LO36, LO37; AO2 3

Alternative valid responses / allocation: (d) Award one mark for voltage and two for current method/result.

Question B4 · 10 marks

(a) 1 mark
1 mark: The time for half of the radioactive nuclei in a sample to decay, or for its activity to halve.
Mapping: LO39; AO1 1

(b) 3 marks
1 mark: Subtracts background to obtain source rates 800 and 100 counts per minute.
1 mark: The fraction 100/800 = 1/8 corresponds to three half-lives.
1 mark: Half-life = 18.0/3 = 6.0 minutes.
Mapping: LO39; AO2 3

(c) 2 marks
1 mark: $\lambda = \ln 2/T_{½}$, with $T_{½} = 360$ s.
1 mark: $\lambda = 1.93 \times 10^{-3}\ s^{-1}$.
Mapping: LO39; AO2 2

(d) 2 marks
1 mark: Background makes the final/initial ratio larger than the true source-only ratio, so the apparent fractional decrease is too small.
1 mark: The inferred half-life would be too long.
Mapping: LO39; AO3 2

(e) 2 marks
1 mark: Minimise handling/exposure time.
1 mark: Increase distance using suitable handling tools, or use shielding appropriate to the radiation.
Mapping: LO41; AO1 2

Alternative valid responses / allocation: (e) Credit any two distinct valid measures, including secure shielded storage when not in use. Do not credit gloves alone as shielding from penetrating radiation.

Question B5 · 10 marks

(a) 3 marks
1 mark: Free nucleon mass = 2(1.00728) + 2(1.00866) = 4.03188 u.
1 mark: Mass defect = 4.03188 − 4.00151 = 0.03037 u.
1 mark: Mass defect = 5.04×10^{-29} kg.
Mapping: LO40; AO2 3

(b) 3 marks
1 mark: $E = \Delta mc^2 = 4.54 \times 10^{-12}$ J.
1 mark: E = 28.4 MeV.
1 mark: Binding energy per nucleon = total binding energy/4 = 7.09 MeV using unrounded energy (accept 7.10 from 28.4 MeV).
Mapping: LO40; AO2 3

(c) 2 marks
1 mark: Proton number = 90.
1 mark: Nucleon number = 234.
Mapping: LO41; AO2 2

(d) 2 marks
1 mark: Binding energy per nucleon indicates how strongly nucleons are bound on average, but it does not by itself exclude all possible decays.
1 mark: A decay can release energy if the total rest energy of its products is lower; stability depends on available decay channels, not this single comparison.
Mapping: LO38, LO40; AO3 2

Alternative valid responses / allocation: (d) Credit an equivalent explanation involving a more strongly bound set of products or neutron/proton balance; do not require advanced decay-rate theory.

Question B6 · 10 marks

(a) 3 marks
1 mark: Photon energy hf = 5.304×10^{-19} J.
1 mark: Work function = 3.20×10^{-19} J.
1 mark: K(max) = hf − work function = 2.10×10^{-19} J.
Mapping: LO42, LO43; AO2 3

(b) 2 marks
1 mark: f_0 = work function/h = $(3.20 \times 10^{-19})/(6.63 \times 10^{-34})$.
1 mark: $f_0 = 4.83 \times 10^{14}$ Hz.
Mapping: LO43; AO2 2

(c) 3 marks
1 mark: A photon is emitted because the electron loses energy.
1 mark: Energy difference = 3.0 eV = 4.80×10^{-19} J; uses $\lambda = hc/\Delta E$.
1 mark: $\lambda = 4.14 \times 10^{-7}$ m.
Mapping: LO42, LO44; AO2 3

(d) 2 marks
1 mark: Each electron receives energy in an individual photon of energy hf.
1 mark: Emission requires that one photon supply at least the work function; below threshold greater intensity cannot make individual photons energetic enough.
Mapping: LO43; AO1 2

Alternative valid responses / allocation: Credit equivalent valid scientific wording without double-crediting a repeated point.

Marking principles

Award one mark for the single correct MCQ option; otherwise award zero. No negative marking. If an answer is clearly replaced, mark the final unambiguous choice.

For Section B, use the stated point allocations and specific calculation rules. Credit equivalent scientifically correct responses; do not double-credit a repeated point.

Where a later calculation uses an earlier incorrect value correctly, credit the independent subsequent method unless this makes the task trivial. Do not award the final accuracy mark for an incorrect result.

Credit scientifically equivalent explanations and valid alternative calculations. Do not penalise spelling unless physical meaning becomes unclear.

All raw marks, marker identities, moderation decisions and release approvals must be recorded through the controlled pack processes.

Paper total: 85 marks. AO1, AO2 and AO3 are assessed.