IQM3013 A2 Teacher marking reference

IQM3013 A2 Synthetic Physics Paper 1 Responses

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

Controlling sources: IQM3013 Physics Assessment 2 Paper 1 Candidate Question Paper, Candidate Answer Booklet, Candidate Data and Formulae Booklet (IQM3013-DFB-2026), and current Staff Mark Scheme and Marking Map v3. All 25 Section A items and six Section B questions are compulsory; the paper is 85 marks in two hours.

These are AI-generated fictional written responses for internal staff-practice only. The live paper prohibits AI, internet and unauthorised electronic assistance. They must not be submitted as candidate work or distributed as a live answer key. No authentic sitting, candidate identity, centre, invigilation, practical observation, authenticity, moderation, academic approval or release is represented. Proposed marks apply only to the written synthetic evidence.

Teacher reference use limits

The following commentary gives proposed documentary decisions for the four selected exercise excerpts. Judgements remain subject to human academic review.

Reference A S1 B1 c ideal gas volume

A heater transfers 9000 J to a 0.50 kg metal block, increasing its temperature by 20 K. Initially neglect heat transfer to surroundings and apparatus. A separate sample contains 0.200 mol of ideal gas at 300 K and 1.00 × 10^5 Pa. Use R = 8.31 J mol^{-1} K^{-1}. B1(c) asks for the gas volume in m^3. Maximum 3 marks. Relevant alternative: accept 0.004986 m^3 or appropriate rounding; method marks require sufficient relevant working.

Source criteria and maximum: Uses pV=nRT and rearranges V=nRT/p (1). Correct substitution of the supplied values (1). V=4.99×10^{-3} m^3 or accepted equivalent with units (1).

Selected student evidence (verbatim):

$$pV = nRT$$

$$V = \frac{nRT}{p} = \frac{0.200 \times 8.31 \times 300}{1.00 \times 10^5} = 4.99 \times 10^{-3} \ \text{m}^3$$

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

The source method and substitution are shown. The final 4.99×10^{-3} m^3 includes the required unit, supporting all three proposed points.

Reference B S2 B2 c kinetic energy change

A 0.40 kg trolley starts from rest and accelerates uniformly along a horizontal track at 1.5 m s^{-2} for 2.0 s. It then collides with a stationary 0.60 kg trolley. They couple and move together. Take the initial direction as positive and neglect external impulse during the collision. The preceding parts give 3.0 m s^{-1} before and +1.2 m s^{-1} after collision. B2(c) asks for the decrease in total kinetic energy. Maximum 2 marks. Follow through physically valid velocities; first point requires both energy values or equivalent expression.

Source criteria and maximum: Before and after kinetic energies 1.8 J and 0.72 J, or equivalent expression (1). Decrease 1.08 J (1).

Selected student evidence (verbatim):

$$E_{before} = \frac{1}{2}(0.40)(3.0)^2 = 1.8 \text{ J}$$

$$E_{after} = \frac{1}{2}(1.00)(1.2)^2 = 0.72 \text{ J}$$

$$decrease = 0.72 - 1.8 = -1.08 \text{ J}$$

Proposed decision: 1/2. Earned source points: B2cP1.

Both kinetic energies are calculated correctly: 1.8 J before and 0.72 J after. The subtraction is reversed, giving −1.08 J (the signed change), rather than the requested positive decrease of 1.08 J; only the first point is supported.

Reference C S3 B4 b measurement uncertainty

Monochromatic light passes through two narrow slits separated by 0.250 mm. A screen is 2.00 m from the slits. The distance from the centre of the first bright fringe to the centre of the sixth bright fringe on the same side of the central maximum is 24.0 mm. In a separate stationary-wave experiment, adjacent displacement nodes on a string are 0.150 m apart. B4(b) asks why several fringe intervals are preferable to one when ruler resolution is unchanged. Maximum 2 marks.

Source criteria and maximum: Distance across multiple intervals is larger while endpoint reading uncertainty is approximately unchanged (1). Dividing by interval count gives lower fractional uncertainty in fringe spacing/wavelength (1).

Selected student evidence (verbatim):

It averages out the errors.

Proposed decision: 0/2. Earned source points: none.

“It averages out the errors” does not connect the larger measured distance to approximately unchanged endpoint-reading uncertainty, or explain that dividing by the interval count lowers fractional uncertainty. Neither source point is evidenced.

Reference D S1 B5 d NTC potential divider

A cell supplies a 4.0 Ω resistor. Its emf is 6.0 V and its internal resistance is 1.0 Ω. In a separate unloaded potential divider across an ideal 6.0 V supply, a 2.0 kΩ fixed resistor is connected in series with an NTC thermistor of resistance 4.0 kΩ. The output is measured across the thermistor using an ideal voltmeter. B5(d) asks for the predicted output change as the thermistor warms and an explanation. Maximum 2 marks.

Source criteria and maximum: NTC resistance decreases on warming (1). Its fraction of total series resistance decreases, so voltage across it/output decreases (1).

Selected student evidence (verbatim):

When warmed, the NTC resistance decreases. Its share of the total series resistance becomes smaller, so the voltage across the thermistor and the output voltage decrease.

Proposed decision: 2/2. Earned source points: B5dP1, B5dP2.

The response identifies that an NTC resistance falls as it warms and links its smaller share of the series resistance to a lower voltage across it. Both source points are supported.