



**Test Papers
Hub.**

QCAA Physics Units 3 & 4 Practice Paper 1

External Assessment: Paper 1 — Multiple Choice & Short Response

**Perusal 10 minutes · Working time 90 minutes · Section I: 20 multiple-choice ·
Section II: 30 marks · 50 marks in all**

How to use this booklet

- Perusal time – 10 minutes. Working time – 90 minutes. Write using black or blue pen.
- A QCAA-approved scientific or graphics calculator may be used. A formula and data sheet is provided at the back of the paper.
- Section I: 20 multiple-choice questions (1 mark each). Section II: 8 short-response questions (30 marks).
- Worked solutions follow the paper: every question has step-by-step working, a key takeaway and (for multiple choice) a note on why each wrong option is wrong.

SECTION I

20 marks · Attempt Questions 1 – 20 · Allow about 30 minutes

Select the alternative A, B, C or D that best answers the question. Each question is worth 1 mark.

1. An electron is accelerated from rest through a potential difference of 5700 V. ($h = 6.626 \times 10^{-34} \text{ J s}$, $m_e = 9.109 \times 10^{-31} \text{ kg}$, $e = 1.602 \times 10^{-19} \text{ C}$.) What is the de Broglie wavelength of the electron?

- A $7.26 \times 10^{-19} \text{ m}$
- B $1.62 \times 10^{-11} \text{ m}$
- C $2.70 \times 10^{-56} \text{ m}$
- D $3.25 \times 10^{-11} \text{ m}$

2. An emission line spectrum from a hot gas consists of bright lines at discrete wavelengths because:

- A the electrons move in continuous orbits of any radius
- B electrons make transitions between discrete energy levels, emitting photons of specific energies
- C the gas absorbs all the other wavelengths
- D the atoms vibrate at only certain frequencies like a string

3. As the temperature of a black body increases, the wavelength at which it radiates most strongly:

- A decreases, and the total power radiated decreases
- B increases, and the total power radiated increases
- C stays the same, and the total power radiated increases
- D decreases, and the total power radiated increases

4. Light of frequency $1.01 \times 10^{15} \text{ Hz}$ falls on a clean calcium surface, which has a work function of 2.90 eV. ($h = 6.626 \times 10^{-34} \text{ J s}$, $e = 1.602 \times 10^{-19} \text{ C}$.) What is the maximum kinetic energy of the emitted photoelectrons, in eV?

- A $2.05 \times 10^{-19} \text{ eV}$
- B 7.08 eV
- C 4.18 eV
- D 1.28 eV

5. A 10 kg block slides from rest down a rough slope inclined at 15° to the horizontal. The coefficient of kinetic friction is 0.050. What is the block's acceleration down the slope?

- A 9.34 m s^{-2}
- B 2.54 m s^{-2}
- C 2.06 m s^{-2}
- D 2.05 m s^{-2}

6. A probe of mass 840 kg is at a height equal to 1.0 Earth radii above Earth's surface. (Use $G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$, $M_E = 5.97 \times 10^{24} \text{ kg}$, $R_E = 6.371 \times 10^6 \text{ m}$.) What is the gravitational field strength at the probe's position?

- A 2.45 N kg^{-1}
- B 4.90 N kg^{-1}
- C 9.81 N kg^{-1}
- D 9.80 N kg^{-1}

7. A rectangular coil of 100 turns and area 0.042 m^2 rotates at 50 Hz in a uniform magnetic field of 0.59 T. What is the peak emf produced?

- A 7.78 V
- B 550 V
- C 778 V
- D 124 V

8. A ball is kicked from level ground at 16 m s^{-1} at 35° above the horizontal. Ignore air resistance and take $g = 9.8 \text{ m s}^{-2}$. What is the ball's time of flight?

- A 1.87 s
- B 3.27 s
- C 0.936 s
- D 2.67 s

9. Muons created in the upper atmosphere reach the ground even though their half-life is about $2 \mu\text{s}$. This is evidence for:

- A length expansion
- B time dilation
- C the conservation of momentum only
- D the particle nature of light

WORKED SOLUTIONS

Answers & worked solutions

Multiple-choice answer key

1	B	2	B	3	D	4	D	5	C	6	A
7	C	8	A	9	B	10	C	11	A	12	D
13	D	14	A	15	B	16	C	17	D	18	C
19	A	20	B								

SECTION I

1. An electron is accelerated from rest through a potential difference of 5700 V. ($h = 6.626 \times 10^{-34} \text{ J s}$, $m_e = 9.109 \times 10^{-31} \text{ kg}$, $e = 1.602 \times 10^{-19} \text{ C}$.) What is the de Broglie wavelength of the electron? [Quantum model of light]

Correct answer: B — $1.62 \times 10^{-11} \text{ m}$

- Kinetic energy gained: $\frac{1}{2}mv^2 = eV$, so momentum $p = \sqrt{2meV} = 4.08 \times 10^{-23} \text{ kg m s}^{-1}$.
- $\lambda = h \div p = 6.626 \times 10^{-34} \div 4.08 \times 10^{-23} = 1.62 \times 10^{-11} \text{ m}$
- Why the other options are wrong:
- A ($7.26 \times 10^{-19} \text{ m}$): used energy instead of momentum
- C ($2.70 \times 10^{-56} \text{ m}$): multiplied by the momentum
- D ($3.25 \times 10^{-11} \text{ m}$): doubled the wavelength

LOS: Quantum model of light

KEY TAKEAWAY

de Broglie wavelength $\lambda = h/p$: matter has wave properties, and a bigger momentum means a shorter wavelength.

2. An emission line spectrum from a hot gas consists of bright lines at discrete wavelengths because: [Atomic spectra]

Correct answer: B — electrons make transitions between discrete energy levels, emitting photons of specific energies

- Each transition between energy levels releases a photon with energy equal to the difference.
- Only certain differences are possible, so only certain wavelengths appear.
- Why the other options are wrong:
- A (the electrons move in continuous orbits of any radius): electron energies are quantised
- C (the gas absorbs all the other wavelengths): that would produce an absorption spectrum
- D (the atoms vibrate at only certain frequencies like a string): the lines arise from electron transitions, not mechanical vibrations

LOS: Atomic spectra