GET BETTER AT PHYSICS · MARK SCHEME

Accelerators & Thermionic Emission: tiered multiple choice

Edexcel IAL Physics · Unit 4 (WPH14) · Specification points 113–115 · 5 questions · 5 marks

1 mark per correct letter

Worked reasoning for every question

How students did = from Pearson examiner reports, where available

Answer key

Q1	Q2	Q3	Q4	Q5
D	D	D	C	A

Easy

Questions 1–4

1 **D**

Electrons released from a heated filament · Edexcel IAL January 2024 · Unit 4 · Q2

Heating a metal filament gives some conduction electrons enough energy to escape from the surface. This is thermionic emission.

How students did: 96% of students got this right in January 2024.

2 **D**

How an electron gun releases electrons · Edexcel IAL October 2024 · Unit 4 · Q1

A current heats the metal filament, and the hot filament releases electrons by thermionic emission.

Watch out: The photoelectric effect needs incident photons; here the energy comes from heating.

How students did: 85% of students got this right in October 2024.

3 **D**

Incorrect statement about a cyclotron · Edexcel IAL October 2024 · Unit 4 · Q8

Inside the hollow dees there is no electric field; the particles are accelerated only as they cross the gap between the dees. The magnetic field is perpendicular to their velocity and keeps them on circular paths.

How students did: 81% of students got this right in October 2024.

4 **C**

True statement about a cyclotron · Edexcel IAL January 2023 · Unit 4 · Q7

An alternating p.d. across the gap between the dees accelerates the particles each time they cross. Because the time for each half-circle does not depend on speed, the p.d. can alternate at a constant frequency. The magnetic field only bends the path; it cannot change the speed. Neutrons are uncharged and cannot be accelerated.

How students did: 74% of students got this right in January 2023.

Hard

Question 5

5 **A**

Fields in a cyclotron · Edexcel IAL June 2024 · Unit 4 · Q5

The electric field between the dees speeds the particles up, and the magnetic field provides a centripetal acceleration that keeps them on a curved path. So the particles are accelerated by both fields. The radius increases as they speed up, and it is the electric field (not the magnetic field) that switches direction while the particles are inside the dees.

> **Watch out:** Acceleration includes change of direction: a magnetic field accelerates a charge centripetally without changing its speed.

How students did: 21% of students got this right in June 2024.

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