GET BETTER AT PHYSICS · MARK SCHEME

Fundamental Forces & Exchange Particles: tiered multiple choice

AQA A-level Physics · 7407 / 7408 · Specification 3.2.1.4 · 5 questions · 5 marks

1 mark per correct letter | Worked reasoning for every question | **How students did** = from AQA examiner reports, where available

Answer key

Q1	Q2	Q3	Q4	Q5
B	A	D	B	B

Easy

Questions 1–4

1 **B**

Electron capture: exchange particle and products · AQA June 2018 · AS Paper 2 · Q7

In electron capture a proton (uud) turns into a neutron (udd = dud): one u changes to d. The proton loses +1 charge, so the exchange particle carries +1 charge away from the quarks to the electron: W^+. The electron becomes a neutrino.

Watch out: The W boson's charge is fixed by charge conservation at each vertex. Check it at the quark side.

How students did: 62.7% of students got this right in June 2018.

2 **A**

Beta-plus decay diagram · AQA June 2017 · A-level Paper 1 · Q9

In β^+ decay a proton becomes a neutron, so an up quark changes into a down quark (u in, d out), emitting a W^+. The W^+ decays into a positron and an electron neutrino (not an antineutrino), so lepton number is conserved. Only A has u in, d out and ν_e.

Watch out: C and D have the quark change the wrong way round (d → u is β^- decay).

3 **D**

Exchange particle in electron capture · AQA June 2023 · AS Paper 2 · Q15

Electron capture is a weak interaction, and charge is transferred between the proton and the electron, so the exchange particle is a W boson (W^+).

Watch out: Pions are exchanged in the strong interaction and virtual photons in the electromagnetic interaction; neither changes quark type.

How students did: At least 65% of students got this right in June 2023.

4 **B**

Beta-minus decay diagram · AQA June 2023 · A-level Paper 1 · Q11

An electron antineutrino is produced, so this is β^- decay: a down quark changes into an up quark (E = d, F = u), emitting a W^- that decays into a β^- particle (electron) and the antineutrino.

Watch out: β^+ decay (C, D) produces a neutrino, not an antineutrino.

How students did: Over 75% of students got this right in June 2023.

Medium

Question 5

5 **B**

What exchange particles must have · AQA June 2023 · AS Paper 2 · Q23

An exchange particle transfers force between particles, which means it transfers momentum (force = rate of change of momentum). It need not have charge or rest mass: the photon has neither.

> **Watch out:** A and D fail because the photon, the exchange particle for electromagnetism, has no charge and no rest mass.

How students did: 35% or fewer of students got this right in June 2023.

End of mark scheme. Answers from AQA's published keys; explanations written for this pack. AQA material is © AQA. More free packs and 1-to-1 tuition: **www.getbetteratphysics.co.uk**

GET BETTER AT PHYSICS · WHAT NEXT?

Got some of these wrong?

Good. The questions you got wrong show you exactly what to work on next. The quickest way to fix them is to work through them with someone who marks these papers.

Book a free 15-minute call

Tell me which questions caught you out. We'll talk about what's going wrong and whether 1-to-1 or small-group tuition would help. There's no obligation.

Book your free call

calendly.com/getbetteratphysics/freechat

Scan to book

Current AQA examiner
I know what the mark schemes reward and where marks are lost.

Matched to your exam board
Sessions follow your specification and the topics you find hardest.

Pay per session
No block booking. 1-to-1 or small groups of up to 4.

More free packs

Tiered past-paper questions with full mark schemes, sorted by topic.
getbetteratphysics.co.uk/free-revision-packs

Masterclasses are coming

Want to hear first? Email **helpme@getbetteratphysics.co.uk** and I'll let you know when dates are announced.

Parents: I use these packs in my own tutoring sessions. Tuition options and prices:
getbetteratphysics.co.uk/tuitionpricing