

2021 Ph H1 Q14

Section: Particles and Waves

Topic: The Standard Model

Brief summary of the question

Which of the following particles are fermions?

Worked solution

- Fermions are particles with half-integer spin (spin $1/2$, $3/2$, etc.).
- In the Standard Model, all quarks and leptons are fermions.
- Bosons (force carriers) have integer spin and are not fermions.
- From the options, the correct ones are quarks and leptons.

Final answer

C — quarks and leptons.

Revision tips

Fermions: quarks (up, down, charm, strange, top, bottom) and leptons (electron, muon, tau, and three neutrinos).

Bosons: photon, W and Z bosons, gluon, Higgs boson.

Fermions make up matter; bosons mediate forces.