1 Hadrons can be classified into mesons and baryons.
Which of the following statements is true?

☒ **A** Mesons always consist of three quarks.

☒ **B** Mesons always include a quark and an antiquark.

☒ **C** Mesons are formed during beta decay.

☒ **D** Neutrons and protons are examples of mesons.

(Total for Question = 1 mark)

2 The table shows the charge on some quarks.

Quark	Charge / e
u	+ 2/
d	− 1/

Which of the following is a possible quark composition of a π^- particle?

☒ **A** dd

☒ **B** uu

☒ **C** dū

☒ **D** d̄u

(Total for Question = 1 mark)

3 The Large Hadron Collider is designed to accelerate protons to very high energies for particle physics experiments.

Very high energies are required to

☒ **A** annihilate protons and antiprotons.

☒ **B** allow protons to collide with other protons.

☒ **C** create particles with large mass.

☒ **D** to produce individual quarks.

(Total for Question = 1 mark)

4 A muon has a mass of 106 MeV/c².

The mass of a muon, to two significant figures, is

☒ **A** 1.7×10^{-11} kg

☒ **B** 5.7×10^{-20} kg

☒ **C** 1.9×10^{-28} kg

☒ **D** 1.9×10^{-34} kg

(Total for Question = 1 mark)

5 A pion can decay to produce two leptons. Which one of the following is possible?

☒ **A** $\pi^+ \rightarrow e^+ + v_e$

☒ **B** $\pi^0 \rightarrow e + v_e$

☒ **C** $\pi^+ \rightarrow e^+ + e$

☒ **D** $\pi^0 \rightarrow \pi^+ + e$

(Total for Question   1 mark)

6 The mass in MeV/c^2 of a 1.8×10^{-29} kg positron is

⊠   **A** 10

⊠   **B** 3.2×10^{-59}

⊠   **C** 3.3×10^{-8}

⊠   **D** 1.0×10^{7}

(Total for Question = 1 mark)

7 The Large Hadron Collider is designed to accelerate protons to very high energies for particle physics experiments. Very high energies are required to

⊠   **A** annihilate hadrons.

⊠   **B** collide hadrons.

⊠   **C** create particles with large mass.

⊠   **D** produce individual quarks.

(Total for Question = 1 mark)

8 A positive kaon (K^+) is a meson which includes a strange quark. Its structure could be

⊠   **A** $u\bar{s}$

⊠   **B** us

⊠   **C** $\bar{s}\bar{d}\bar{d}$

⊠   **D** usd

(Total for Question   1 mark)

9 The K^+ is likely to decay to

☒   **A** $\pi^+ + \mu^+ + \nu_\mu$

☒   **B** $\pi^+ + \pi^0$

☒   **C** $\pi^+ + \pi^-$

☒   **D** $\pi^0 + \mu^+ + \nu_\mu$

(Total for Question   1 mark)

10 A pion could consist of

☒   **A** $u\bar{d}$

☒   **B** ud

☒   **C** uud

☒   **D** $uu\bar{d}$

(Total for Question   1 mark)

11 Data at the back of the examination paper can be used with the formula $\Delta E = c^2 \Delta m$ to calculate

☒   **A** the amount of energy in a proton.

☒   **B** the mass of coal that produces 6 MJ of energy when burnt.

☒   **C** the energy produced when an electron and a positron annihilate.

☒   **D** the energy produced when two protons collide.

(Total for Question   1 mark)

12 Pions are the lightest mesons. A negative pion (π^-) has a mass of 2.48×10^{-28}

kg.   Which of the following is the mass of the π^- in MeV/c²?

☒ **A** 1.4×10^8

☒ **B** 1.4×10^2

☒ **C** 4.7×10^{-7}

☒ **D** 3.6×10^{-24}

(Total for Question = 1 mark)