7.3 The Structure of Matter

Question Paper

Course	DP IB Physics
Section	7. Atomic, Nuclear & Particle Physics
Topic	7.3 The Structure of Matter
Difficulty	Medium

Time allowed: 20

Score: /10

Percentage: /100

Question 1

The decay of a Σ^+ baryon is given by the equation

$$\Sigma^+ \rightarrow X + p$$

Which row, **A** to **D** in the table, correctly identifies the charge, baryon number and lepton number of particle X?

	Charge	Baryon number	Lepton number
A.	-1	0	0
B.	0	0	0
C.	1	1	0
D.	0	-1	1

[1 mark]

Question 2

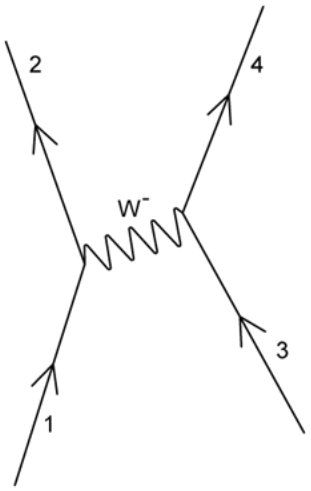
Which row in the table gives the correct quark combination for the particle?

	particle	category	quark combination
A.	proton	baryon	udd
B.	positive pion	meson	$u\bar{d}$
C.	neutron	meson	udd
D.	negative pion	meson	$u\bar{d}$

[1 mark]

Question 3

This Feynman diagram shows particles interacting via a W^- boson.



Which of the following particle choices are correct?

	1	2	3	4
A.	proton	neutron	electron neutrino	β^- particle
B.	neutron	proton	electron neutrino	β^- particle
C.	up quark	down quark	β^- particle	anti-electron neutrino
D.	down quark	up quark	anti-electron neutrino	β^- particle

[1 mark]

Question 4

The decay of a neutral kaon K^0 is given by the equation

$$K^0 \rightarrow X + Y + \overline{\nu}_e$$

What must particles X and Y be?

A. π^+ and e^-

B. $\pi-$ and e^+

C. μ^+ and e^-

D. π^+ and μ^-

[1 mark]

Question 5

A pion can decay to produce two leptons.

Which of the following reactions is possible?

A. $\pi^0 \rightarrow \mu^+ + \nu_e$

B. $\pi^0 \rightarrow \pi^+ + \mu^-$

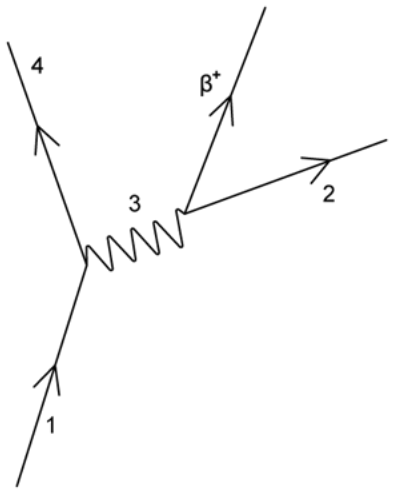
C. $\pi^+ \rightarrow e^+ + \nu_\mu$

D. $\pi^+ \rightarrow \mu^+ + \nu_\mu$

[1 mark]

Question 6

This Feynman diagram shows particles interacting leading to the production of a β^+ particle.



Which of the following particle choices are correct?

	1	2	3	4
A.	proton	neutrino	W^+ boson	neutron
B.	up quark	antineutrino	W^+ boson	down quark
C.	proton	neutrino	W^- boson	neutron
D.	up quark	antineutrino	W^- boson	down quark

[1 mark]

Question 7

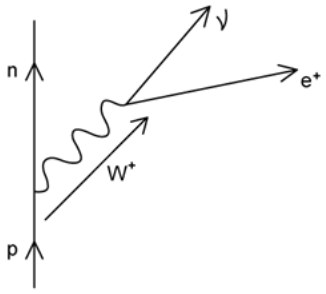
Which row in the table, **A** to **D**, includes a valid particle for every column?

	Stable	Interacts via weak force	Interacts via electromagnetic force	Interacts via strong force
A.	antiproton	muon	proton	neutrino
B.	proton	electron	muon	neutron
C.	electron	proton	neutron	proton
D.	kaon	neutron	electron	pion

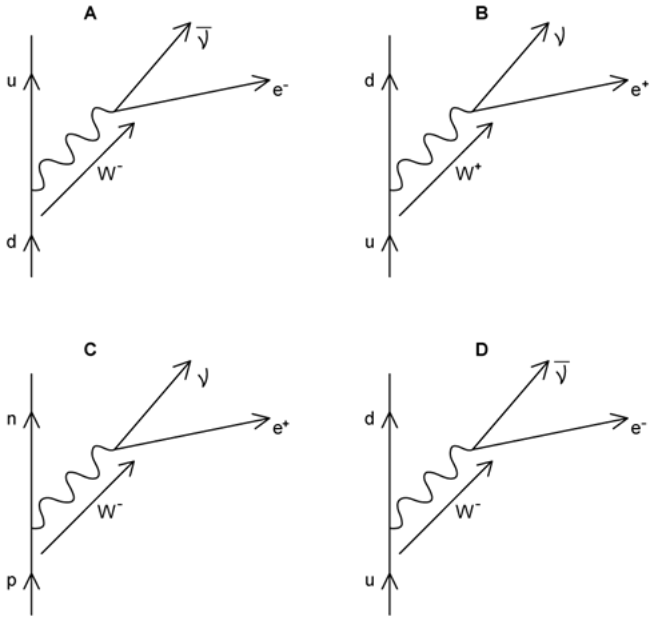
[1 mark]

Question 8

The following Feynman diagram shows the baryons and leptons in a nuclear decay.



Which of the four Feynman diagrams, **A** to **D**, is physically equivalent to the diagram given for this decay?



[1 mark]

Question 9

In the Geiger–Marsden experiment, alpha particles are used to investigate scattering by gold atoms.

What do the results of the experiment provide evidence for?

A. charge is distributed evenly throughout an atom

B. the nucleus is comprised of protons and neutrons

C. alpha particles have discrete amounts of kinetic energy

D. most of the mass and all of the positive charge of an atom is contained in a small volume

[1 mark]

Question 10

Which of the following statements correctly describes why quarks were first hypothesised?

A. To account for patterns in properties of elementary particles

B. To describe nuclear emission and absorption spectra

C. To account for the missing energy and momentum in beta decay

D. To explain the existence of isotopes

[1 mark]