11. Particle Physics

11.2 Fundamental particles

Paper 1

Question Paper

1 Which particle is **not** a fundamental particle?

A electron

B neutrino

C neutron

D top quark

2 What is the charge of an anti-top quark?

A $-\frac{2}{3}e$ **B** $-\frac{1}{3}e$ **C** $+\frac{1}{3}e$ **D** $+\frac{2}{3}e$

3 Which fundamental particles form a hadron?

A leptons

B nucleons

C photons

D quarks

4 Which particle is **not** a fundamental particle?

A charm quark

B electron

C neutrino

D neutron

5 Which statement is correct?

A A baryon is a hadron and consists of 2 quarks.

B A meson is a hadron and consists of 3 quarks.

C An electron is a fundamental particle and is a lepton.

D A neutrino is a fundamental particle and is a hadron.

6 What is **not** a quark flavour?

A charm

B meson

C strange

D up

7 How many down quarks are in a nucleus of hydrogen-3, ${}^{3}_{1}\mathrm{H}$?

A 2 **B** 3 **C** 4 **D** 5

8 Which statement about a proton is correct?

A A proton is a baryon but not a meson.

B A proton is a meson but not a hadron.

C A proton is both a hadron and a meson.

D A proton is both a meson and a baryon.

9 A π^+ meson has a charge of $+e$, where e is the elementary charge. It consists of an up quark and one other quark.

What could be the other quark in the π^+ meson?

A anti-down

B anti-up

C bottom

D charm

10 A particular hadron is composed of three quarks and has zero charge.

What is a possible quark composition of the hadron?

A down, down, strange

B up, down, strange

C up, up, down

D up, up, strange

11 Which combination of up (u) and down (d) quarks forms a neutron?

A u u u **B** u u d **C** u d d **D** d d d

12 How many hadrons, baryons and mesons are there in a nucleus of $^{9}_{4}$Be?

	hadrons	baryons	mesons
A	9	4	5
B	9	5	4
C	9	9	0
D	13	9	0

13 A neutron is composed of one up (u) quark and two down (d) quarks. When a neutron decays to a proton, a beta-particle is emitted.

What is the change in the quark structure of the neutron due to the emission of the beta-particle?

(The symbol for a neutrino is ν_e and for an antineutrino is $\overline{\nu_e}$.)

A $d \rightarrow u + \beta^- + \nu_e$

B $d \rightarrow u + \beta^- + \overline{\nu_e}$

C $u \rightarrow d + \beta^+ + \nu_e$

D $u \rightarrow d + \beta^+ + \overline{\nu_e}$

14 Which list of particles contains **only** fundamental particles?

A antineutrino, beta, meson

B baryon, neutrino, positron

C electron, neutrino, alpha

D lepton, quark, positron

15 Which particle is a lepton?

A meson

B positron

C proton

D quark

16 Which particle is a fundamental particle?

A electron

B hadron

C neutron

D proton

17 In β^- decay, a neutron inside a nucleus changes to a proton.

Which statement describes the quark composition of the nucleus during the decay?

A The number of down quarks decreases by one.

B The number of down quarks increases by one.

C The number of down quarks stays the same.

D The number of up quarks stays the same.

18 Which combination of up (u) and down (d) quarks forms a proton?

A u u u **B** u u d **C** u d d **D** d d d

19 Which statement is **not** correct?

A An antineutrino is a fundamental particle.

B An electron is made up of a quark and an antiquark.

C A neutrino is a lepton.

D A neutron is composed of three quarks.

20 A hadron has a charge +*e*, where *e* is the elementary charge.

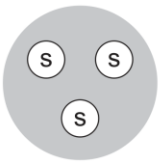
Which combination of up (u) and down (d) quarks could form this hadron?

A ddd **B** udd **C** uud **D** uuu

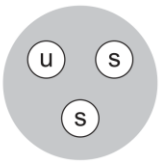
21 A hadron has a charge of –*e* and is composed of three quarks.

What could be the quark composition of the hadron?

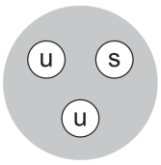
A



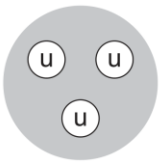
B



C



D

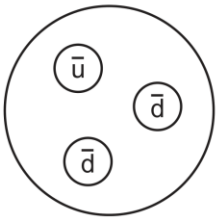


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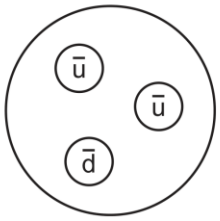
u = up quark
s = strange quark

22 Which diagram represents the quark composition of an antineutron?

A



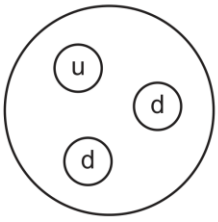
B



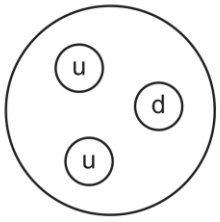
key

u up quark
d down quark
ū up antiquark
d̄ down antiquark

C



D



23 Which particle is a hadron?

A electron

B neutrino

C positron

D proton

24 Some particles are a combination of three quarks.

Which combination of quarks would **not** result in a particle with a charge of either $+1.6 \times 10^{-19}$ C or zero?

A up, down, down

B up, strange, strange

C up, up, down

D up, up, up

25 Which equation describes the changes to the quark composition of a nucleus and the lepton emission during the process of β^+ decay?

A down $\rightarrow$ up + positron + electron neutrino

B down $\rightarrow$ up + positron + electron antineutrino

C up $\rightarrow$ down + positron + electron neutrino

D up $\rightarrow$ down + positron + electron antineutrino

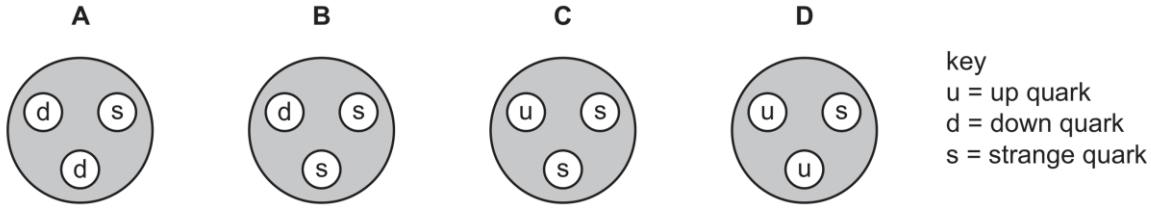
26 There are protons, neutrons and electrons in the simple model of an atom.

To which class (group), hadron or lepton, do these particles belong?

	hadron	lepton
A	electron	proton and neutron
B	neutron	proton and electron
C	proton and electron	neutron
D	proton and neutron	electron

27 The diagrams show the quark composition of four different hadrons. One of the hadrons is a Σ^+ particle. It has a charge of $+e$, where e is the elementary charge.

Which hadron could be the Σ^+ particle?



28 What is **not** a fundamental particle?

A electron

B neutrino

C neutron

D positron

29 An unstable nucleus decays and emits a β^- particle.

Which changes, if any, occur to the quark composition of the nucleus?

	quark changes	
	up quarks	down quarks
A	+1	0
B	+1	–1
C	–1	+1
D	0	+1

30 Which elementary particle is a lepton?

A proton

B neutron

C electron

D quark

31 How many up quarks and how many down quarks are in a nucleus of the nuclide $^{37}_{17}Cl$?

	up quarks	down quarks
A	51	60
B	54	57
C	57	54
D	60	51

32 A certain type of hadron has zero charge. It is composed of a down quark, a strange quark and one other quark.

What could be the other quark?

A up

B down

C strange

D anti-strange