Particle Physics – 2020 June AS Physics

1. June/2020/Paper_11/No.39

An element has two isotopic forms.

What are the nuclear arrangements of these two isotopes?

A They have different nucleon numbers and different proton numbers.

B They have different nucleon numbers but the same proton number.

C They have the same nucleon number and the same proton number.

D They have the same nucleon number but different proton numbers.

2. June/2020/Paper_11/No.40

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

3. June/2020/Paper_12/No.39

An unstable nucleus goes through successive decays to become a final, stable nucleus.

The initial nucleus and the final nucleus are isotopes of each other.

How many α and β^- particles could have been emitted during the decay sequence?

	particle	
	α	β^-
A	1	0
B	1	2
C	2	0
D	2	1

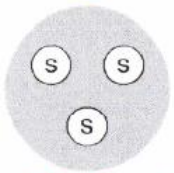
4. June/2020/Paper_12/No.40

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

What could be the quark composition of the hadron?

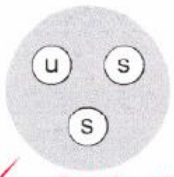
quark	charge
u	$+\frac{2}{3}$
d	$-\frac{1}{3}$
s	$-\frac{1}{3}$

A ✓



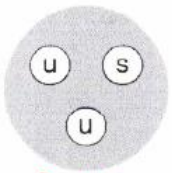
$-\frac{1}{3}+-\frac{1}{3}+-\frac{1}{3}=-1e$ ✓

B



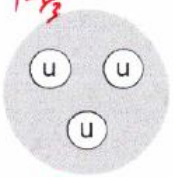
$\frac{2}{3}+-\frac{1}{3}+-\frac{1}{3}=0$

C



$\frac{2}{3}+\frac{2}{3}-\frac{1}{3}=+1e$

D



$\frac{2}{3}+\frac{2}{3}+\frac{2}{3}=\frac{6}{3}=+2e$

key

u = up quark
s = strange quark

5. June/2020/Paper_13/No.39

Radiation from a radioactive source has a range of a few millimetres in air and can be deflected by an electric field.

Which type of radiation is being emitted?

α

α is true so can be deflected.

A ✓ α-radiation

B β^- radiation

C β^+ radiation

} range is longer than a few mm.

D γ-rays ← has infinite range and is not deflected by electric field.

6. June/2020/Paper_13/No.40

Which equation describes the process of β^+ decay?

key:

u = up quark

d = down quark

ν = (electron) neutrino

$\bar{\nu}$ = (electron) antineutrino

$^1_1p \rightarrow {}^1_0n + {}^0_{+}e + \nu$

$uud \rightarrow udd + \beta^+ + \nu$

proton, neutron, neutrino

A $ddu \rightarrow uud + \beta^+ + \nu$

B $ddu \rightarrow uud + \beta^+ + \bar{\nu}$

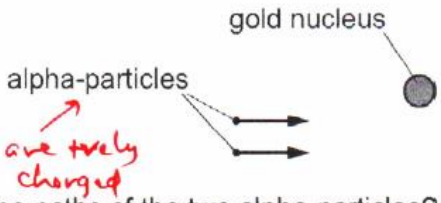
C ✓ $uud \rightarrow ddu + \beta^+ + \nu$

D $uud \rightarrow ddu + \beta^+ + \bar{\nu}$

7. March/2020/Paper_12/No.38

Two alpha-particles with the same kinetic energy are moving towards, and are then deflected by, a gold nucleus.

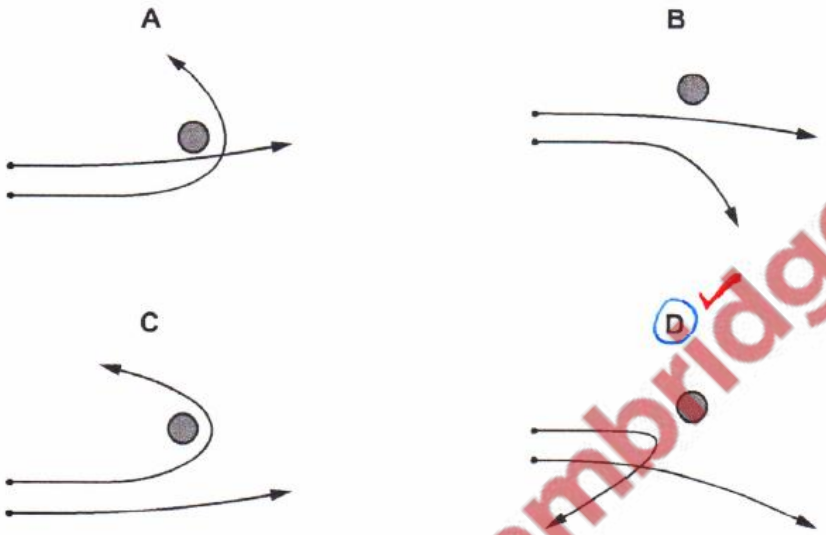
is truly charged



are truly charged

- Like charges repel.
- The closer the charges the greater the repulsion.

Which diagram could show the paths of the two alpha-particles?



8. March/2020/Paper_12/No.39

The equation represents the decay of a nucleus X to a nucleus Y.

$$^{A}_{Z}X \rightarrow {}^{A}_{Z-1}Y + p + q$$

This is a beta plus decay
- A proton is turned to a neutron.
- The nucleon number A does not change while the proton number Z decreases by 1.
- So

$$^{1}_{1}p \longrightarrow {}^{1}_{0}n + {}^{0}_{+1}e + \nu$$

β^+ neutrino.

What are particles p and q?

	p	q
A	β^- particle	neutron
B	β^- particle	proton
C	β^+ particle	antineutrino
D ✓	β^+ particle	neutrino

9. March/2020/Paper_12/No.40

Which row gives the correct type and quark composition for the named particle?

	particle	type	quark composition
A	neutron	hadron ✓	u u d ✗
B ✓	neutron	lepton ✗	u d d ✓
(C)	proton	hadron ✓	u u d ✓
D	proton	lepton ✗	u d d ✓

key

u = up quark

d = down quark

– Both neutron and proton are hadrons.

neutron – udd

proton – uud.