Name of the Student:_____
Max. Marks : 21 Marks **Time : 21 Minutes**

Mark Schemes

Q1.

(a) THREE FROM:
the strong interaction ✔
has short range OR mention range (less than 5 fm) ✔
attraction up to 5 fm ✔
repulsive (any distance below 1fm) ✔
is zero/negligible beyond 5 fm ✔
only affects hadrons/ baryons and mesons ✔
mediated by gluons/pions ✔

*If **wrong** interaction identified then zero marks*
If refer to strong interaction correctly then ignore any subsequent reference to other interactions

1
1
1
(3 max)

(b) in alpha decay number of nucleons/protons and neutrons is unchanged OR baryons in parent nucleus equals the total number of baryons in daughter nucleus and the alpha particle ✔

1

in beta decay a neutron changes into a proton (and both have same baryon number) ✔

1

beta (-) particle and antineutrino have zero baryon number/beta(+) and neutrino have zero baryon number ✔

If only refer to baryon number/nucleon number of alpha particle then do not award first mark
Can be shown by equations
e.g. ${}^{A}_{Z}X \rightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}\alpha$
Second marking point can also be shown in equation

1

(c) quark structure π^- = $\bar{u}$d and p = uud
quark structure kaon = d$\bar{s}$ ✔

1

hence as strong interaction quark structure Λ^0 = uds ✔

If two of the quark structures correct then 1 mark
Any correct answer (uds) full marks

1

(d) strangeness is not conserved/lost ✔

1

(e) TWO FROM:

results of experiments must be independently checked/validated/peer reviewed before they are accepted/can be confirmed ✔
particle accelerators are very expensive and collaboration helps to spread the cost of building them ✔
many skills and disciplines are required (which one team are unlikely to have) ✔
lots of data to process (so more teams needed) ✔

1
1
(2 max)

[11]

Q2.

(a)

Transition	Ultraviolet	Visible	Infrared
A			✔
B		✔	
C	✔		

all correct 1 mark

1

(b) EITHER
energy needed for electron to move to higher level/orbital ✔
OR
for a transition/excitation/change of levels an exact amount of energy is needed ✔
all the photon's energy absorbed(in 1 to 1 interaction) ✔
electron can transfer part of its energy (to cause a transition/excitation)/ continues moving/ lower kinetic energy/ lower speed ✔

Any implication of photoelectric effect max 1
Accept one energy level to another

1
1
1

(c) (use of $\varphi = hf_0$)
$\varphi = 6.63 \times 10^{-34} \times 5.1 \times 10^{14}$ ✔ $(= 3.38 \times 10^{-19})$
$\varphi = 3.38 \times 10^{-19}/1.6 \times 10^{-19} = 2.1(1)$ (eV) ✔
OR
$\varphi = 6.63 \times 10^{-34} \times 5.1 \times 10^{14}$ ✔$(= 3.38 \times 10^{-19})$
energy in J $10.2 \times 1.6 \times 10^{-19} = 1.63 \times 10{-}18$ ✔
OR
energy levels in J = $10.2 \times 1.6 \times 10^{-19} = 1.63 \times 10^{-18}$ ✔
photons frequencies giving this energy= 2.46×10^{15} ✔

If see 2.1 get these first two marks

1
1

$2 \rightarrow 1$ / C possible ✔

Last mark dependent on previous 2

1

(d) (use of $hf = \varphi + E_k$)
$12.1 \times 1.6 \times 10^{-19} = 2.1 \times 1.6 \times 10^{-19} + E_k$ ✔
$E_k = 1.6 \times 10^{-18}$(J) ✔
$v = \sqrt{(2 \times 1.6 \times 10^{-18}/9.11 \times 10^{-31})}$ ✔$(= 1.9 \times 10^6$ m s$^{-1})$

Photoelectric equation must be used
Ecf for third mark their calculated kinetic energy having used

photoelectric equation even if not converted eV to J or frequency to J
Correct answer gets (1.9×10^6 m s^{-1}) full marks

1
1
1

[10]