

Name of the Student: \_\_\_\_\_

Max. Marks : 20 Marks

Time : 20 Minutes

**Q1.**In photoelectricity,  $V_s$  is the stopping potential.What quantity is  $eV_s$ ?

- A energy of an incident photon
- B maximum kinetic energy of a photoelectron
- C threshold frequency  $\times$  the Planck constant
- D work function

(Total 1 mark)

**Q2.**

Which row gives evidence for the wave nature of electrons and evidence for the particulate nature of light?

	Wave nature of electrons	Particulate nature of light	
A	electron diffraction	photoelectric effect	<input type="checkbox"/>
B	electron diffraction	single-slit diffraction	<input type="checkbox"/>
C	photoelectric effect	single-slit diffraction	<input type="checkbox"/>
D	photoelectric effect	electron diffraction	<input type="checkbox"/>

(Total 1 mark)

**Q3.**

A fluorescent tube contains a gas.

The coating of the tube

- A becomes ionised by the gas and emits photons of ultraviolet light.
- B absorbs photons of ultraviolet light from the gas and emits visible light.

C absorbs photons of ultraviolet light from the gas and emits photoelectrons.

D absorbs several photons of visible light from the gas and then emits one photon of ultraviolet light.

(Total 1 mark)

**Q4.**

Which particle has the smallest de Broglie wavelength?

A an electron moving at  $4 \times 10^3 \text{ m s}^{-1}$

B a proton moving at  $4 \times 10^3 \text{ m s}^{-1}$

C an electron moving at  $8 \times 10^5 \text{ m s}^{-1}$

D a proton moving at  $8 \times 10^5 \text{ m s}^{-1}$

(Total 1 mark)

**Q5.**

An atom of oxygen-15  $\left( \begin{smallmatrix} 15 \\ 8 \end{smallmatrix} \text{O} \right)$  gains two electrons to form an ion.

What is the specific charge of the ion?

A  $-1.3 \times 10^7 \text{ C kg}^{-1}$

B  $-2.4 \times 10^7 \text{ C kg}^{-1}$

C  $-5.1 \times 10^7 \text{ C kg}^{-1}$

D  $-6.4 \times 10^7 \text{ C kg}^{-1}$

(Total 1 mark)

**Q6.**

Which is an exchange particle for the weak interaction?

A lepton

B photon

C pion

D  $W^+$

(Total 1 mark)

**Q7.**

A particular baryon has a quark structure dss and decays by the weak interaction.

What are possible decay products of this baryon?

The quark structure of  $\Lambda^0$  is uds.

- A**  $\Lambda^0 + \pi^-$
- B**  $n + \pi^-$
- C**  $\Lambda^0 + e^-$
- D**  $K^+ + K^0$

(Total 1 mark)

**Q8.**

A muon and an antimuon annihilate to produce the minimum number of photons.

What is the maximum wavelength of the photons?

- A**  $5.9 \times 10^{-15}$  m
- B**  $1.2 \times 10^{-14}$  m
- C**  $5.9 \times 10^{-9}$  m
- D**  $1.2 \times 10^{-8}$  m

(Total 1 mark)

**Q9.**

Which row describes the nature of the strong nuclear force between two nucleons at separations of 0.25 fm, 2.0 fm and 8.0 fm?

	At a separation of 0.25 fm	At a separation of 2.0 fm	At a separation of 8.0 fm	
<b>A</b>	attractive	repulsive	negligible	<input type="checkbox"/>
<b>B</b>	repulsive	attractive	attractive	<input type="checkbox"/>
<b>C</b>	negligible	repulsive	attractive	<input type="checkbox"/>
<b>D</b>	repulsive	attractive	negligible	<input type="checkbox"/>

(Total 1 mark)

**Q10.**

Some energy levels of a lithium atom are shown below.

ionisation \_\_\_\_\_ 0

$n = 2$  \_\_\_\_\_  $-2.9 \times 10^{-19} \text{ J}$

A free electron with kinetic energy  $6.0 \times 10^{-19} \text{ J}$  collides with a stationary lithium atom in its  $n = 1$  energy level. The lithium atom is excited to the  $n = 2$  energy level.

What is the kinetic energy of the free electron after the collision?

- A**  $0.3 \times 10^{-19} \text{ J}$
- B**  $2.6 \times 10^{-19} \text{ J}$
- C**  $3.1 \times 10^{-19} \text{ J}$
- D**  $5.7 \times 10^{-19} \text{ J}$

(Total 1 mark)

**Q11.**

What are the products when a free neutron decays?

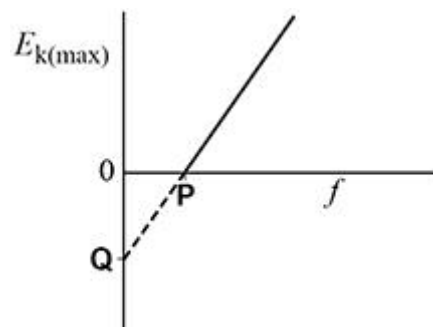
- A**  $p + e^- + \nu_e$
- B**  $p + e^+ + \bar{\nu}_e$
- C**  $p + e^- + \bar{\nu}_e$
- D**  $p + e^+ + \nu_e$

(Total 1 mark)

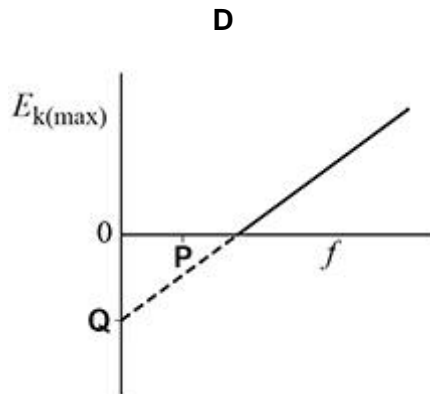
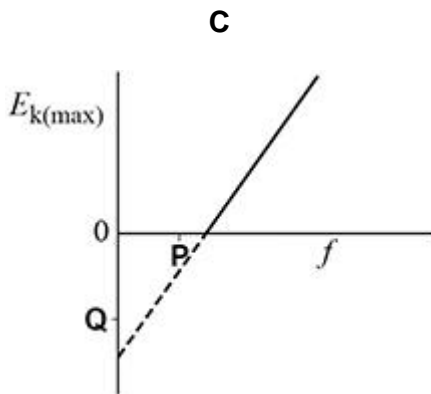
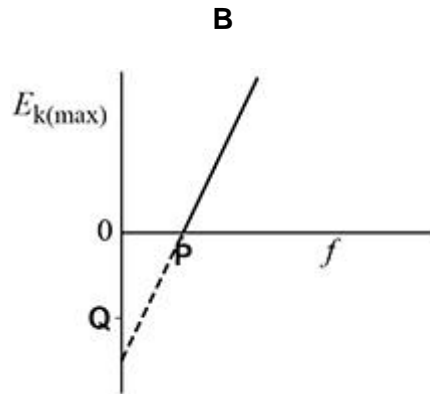
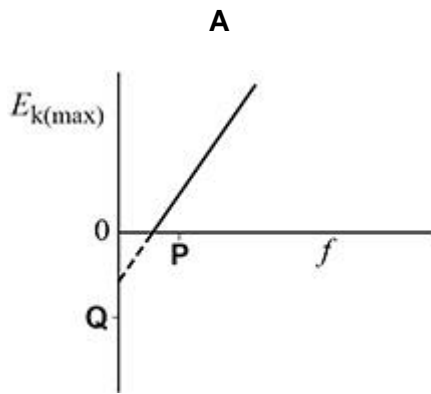
**Q12.**

The graph shows how the maximum kinetic energy  $E_{k(max)}$  of photoelectrons emitted from a metal surface varies with the frequency  $f$  of the incident radiation.

**P** is the intercept on the  $f$  axis. **Q** is the intercept on the  $E_{k(max)}$  axis.



Which graph shows the variation of  $E_{k(max)}$  with  $f$  for a metal with a greater work function?

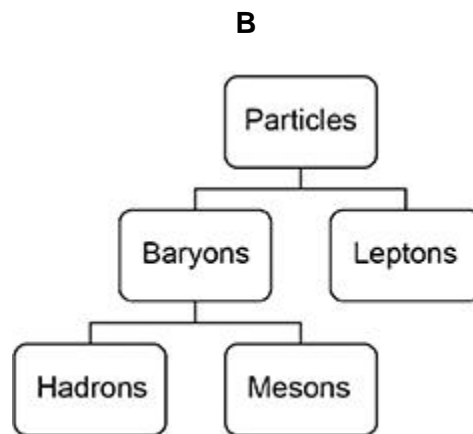
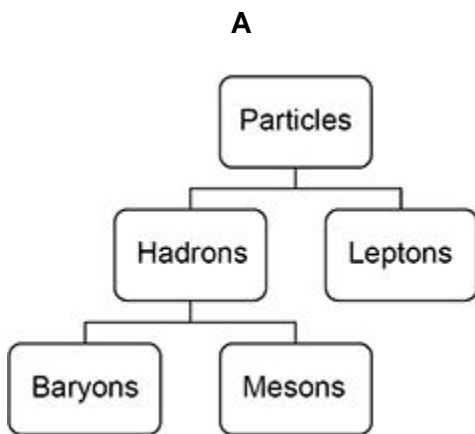


- A
- B
- C
- D

(Total 1 mark)

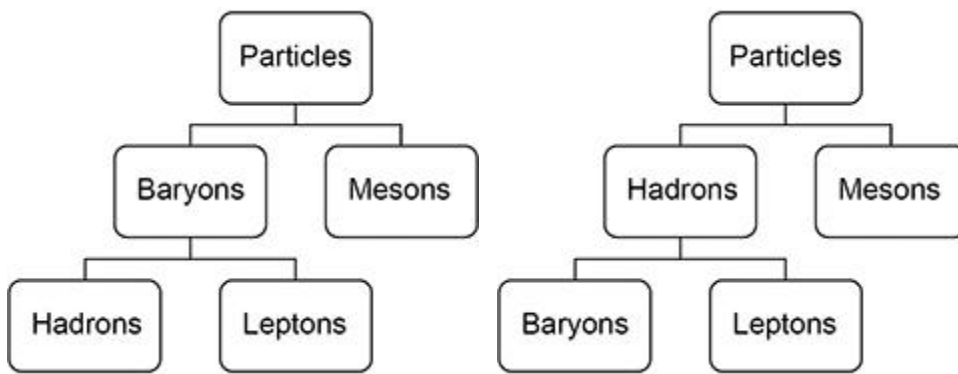
**Q13.**

Which shows the classification of particles?



**C**

**D**



- A
- B
- C
- D

(Total 1 mark)

**Q14.**

The gravitational force is one of the four fundamental forces.  
The ticks in the table match particles with the other fundamental forces.

In which row is the particle matched to the only other fundamental forces it experiences?

	Particle	Electromagnetic force	Weak nuclear force	Strong nuclear force	
A	$\mu^+$	✓	✓		<input type="checkbox"/>
B	$\bar{p}$	✓		✓	<input type="checkbox"/>
C	$\pi^0$	✓	✓	✓	<input type="checkbox"/>
D	$\nu_e$		✓	✓	<input type="checkbox"/>

(Total 1 mark)

**Q15.**

The proton number of uranium is 92 and the proton number of radon is 88

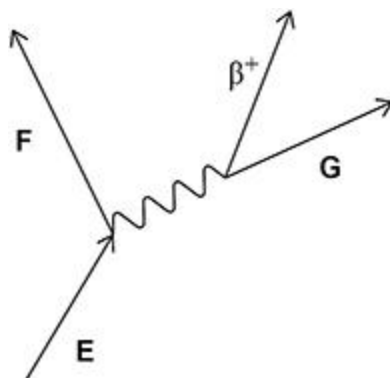
Which series of decays turns a uranium nucleus into a radon nucleus?

- A  $\alpha + \beta^- + \beta^- + \alpha + \alpha$
- B  $\beta^- + \beta^- + \alpha + \beta^- + \alpha$
- C  $\alpha + \alpha + \alpha + \alpha + \beta^-$
- D  $\beta^- + \beta^- + \beta^- + \beta^- + \alpha$

(Total 1 mark)

**Q16.**

The diagram represents a particle interaction.



Which row identifies particles **E**, **F** and **G**?

	<b>E</b>	<b>F</b>	<b>G</b>	
<b>A</b>	up quark	down quark	neutrino	<input type="checkbox"/>
<b>B</b>	down quark	up quark	neutrino	<input type="checkbox"/>
<b>C</b>	up quark	down quark	antineutrino	<input type="checkbox"/>
<b>D</b>	down quark	up quark	antineutrino	<input type="checkbox"/>

(Total 1 mark)

**Q17.**

The quark combination of a particle is  $s\bar{u}$ .

Which is true for this particle?

- A** It has a baryon number of 1
- B** It has a charge of  $-1.6 \times 10^{-19}$  C.
- C** It is a pion.
- D** It has a strangeness of  $-\frac{1}{3}$

(Total 1 mark)

**Q18.**

Monochromatic light with a photon energy of  $4.1 \times 10^{-19}$  J is incident on a metal surface. The maximum speed of the photoelectrons released is  $4.2 \times 10^5$  m s<sup>-1</sup>.

What is the work function of the metal?

- A**  $2.5 \times 10^{-19}$  J
- B**  $3.3 \times 10^{-19}$  J
- C**  $4.1 \times 10^{-19}$  J

D  $4.9 \times 10^{-19}$  J

(Total 1 mark)

**Q19.**

What is the role of the mercury vapour in a fluorescent tube?

A It absorbs photons of UV light and emits visible light.

B It absorbs photons of visible light and emits UV light.

C It emits photons of visible light following ionisation or excitation.

D It emits photons of UV light following ionisation or excitation.

(Total 1 mark)

**Q20.**

The diagram shows the three lowest energy levels for an atom.

The energy levels have been drawn to scale.

level 2 \_\_\_\_\_

level 1 \_\_\_\_\_

ground state \_\_\_\_\_

Transitions of electrons between these energy levels produce photons of the following frequencies:

$4.56 \times 10^{14}$  Hz

$2.46 \times 10^{15}$  Hz

$2.92 \times 10^{15}$  Hz.

What is the difference in energy between the ground state and energy level 1?

A  $0.3 \times 10^{-18}$  J

B  $1.3 \times 10^{-18}$  J

C  $1.6 \times 10^{-18}$  J

D  $1.9 \times 10^{-18} \text{ J}$



(Total 1 mark)