A-Level Physics

Particles and Radiation (Multiple Choice)

Question Paper

Time available: 20 minutes
Marks available: 20 marks

1. Which row has the largest value for

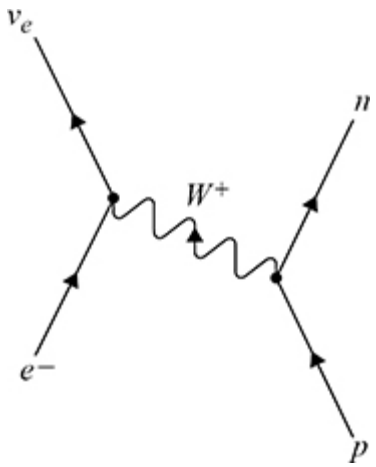
$$\frac{\text{specific charge of the particle in column X}}{\text{specific charge of the particle in column Y}}?$$

	X	Y	
A	electron	alpha particle	⬭
B	alpha particle	electron	⬭
C	electron	proton	⬭
D	proton	alpha particle	⬭

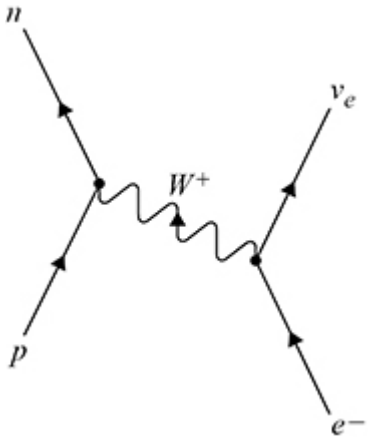
(Total 1 mark)

2. Which diagram represents the process of electron capture?

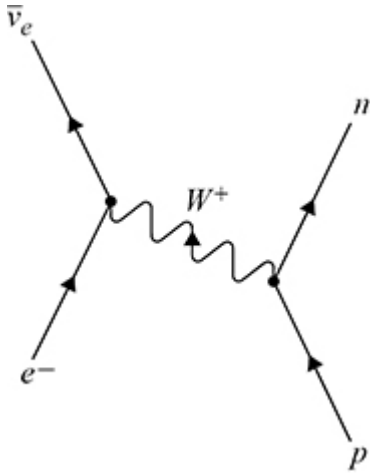
A



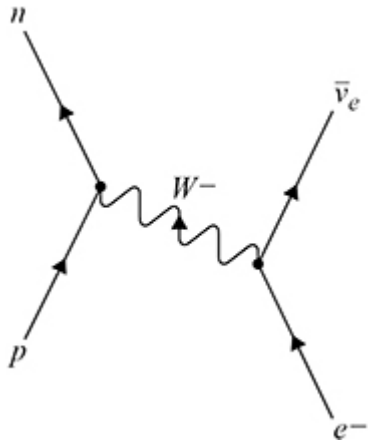
B



C



D



A ⬭

B ⬭

C ⬭

D ⬭

(Total 1 mark)

3. Which row is correct?

	Name of particle	Classification	Quark structure	
A	antineutron	meson	$\bar{u}\bar{u}\bar{d}$	⬭
B	positive kaon	baryon	$\bar{u}\,s$	⬭
C	antiproton	baryon	$\bar{u}\bar{u}\bar{d}$	⬭
D	positive pion	meson	$\bar{u}\,d$	⬭

(Total 1 mark)

4. Which provides evidence for discrete atomic energy levels?

A β^+ decay ⬭

B electron diffraction ⬭

C line spectra ⬭

D the photoelectric effect ⬭

(Total 1 mark)

5. What is the specific charge of a $^{13}_{6}C$ nucleus?

A 4.4×10^7 C kg^{-1} ⬭

B 5.2×10^7 C kg^{-1} ⬭

C 8.3×10^7 C kg^{-1} ⬭

D 2.1×10^8 C kg^{-1} ⬭

(Total 1 mark)

6. 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)

7. 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	⬭
B	electron diffraction	single-slit diffraction	⬭
C	photoelectric effect	single-slit diffraction	⬭
D	photoelectric effect	electron diffraction	⬭

(Total 1 mark)

8. Which particle has the smallest de Broglie wavelength?

A an electron moving at 4×10^3 m s^{-1} ⬭

B a proton moving at 4×10^3 m s^{-1} ⬭

C an electron moving at 8×10^5 m s^{-1} ⬭

D a proton moving at 8×10^5 m s^{-1} ⬭

(Total 1 mark)

9. An atom of oxygen-15 $\left({}^{15}_{8}\mathrm{O}\right)$ gains two electrons to form an ion.

What is the specific charge of the ion?

A -1.3×10^{7} C kg^{-1} ⬭

B -2.4×10^{7} C kg^{-1} ⬭

C -5.1×10^{7} C kg^{-1} ⬭

D -6.4×10^{7} C kg^{-1} ⬭

(Total 1 mark)

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

What is the maximum wavelength of the photons?

A 5.9×10^{-15} m ⬭

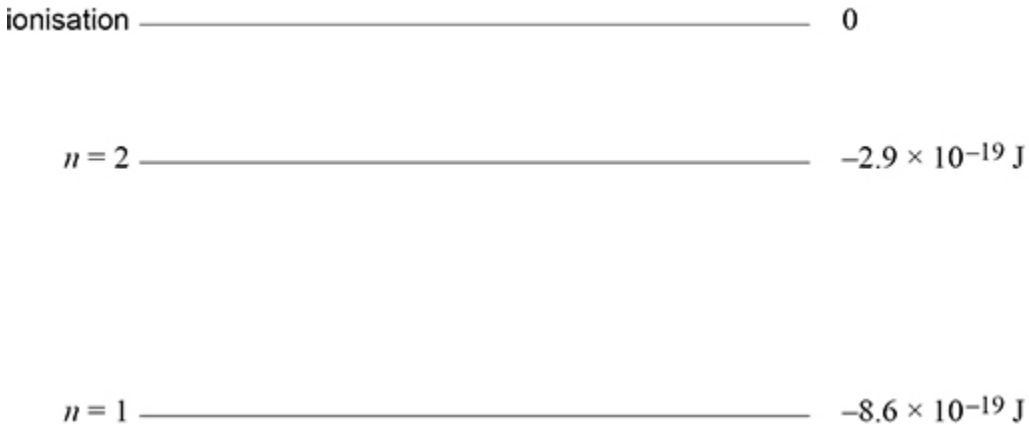
B 1.2×10^{-14} m ⬭

C 5.9×10^{-9} m ⬭

D 1.2×10^{-8} m ⬭

(Total 1 mark)

11. Some energy levels of a lithium atom are shown below.



A free electron with kinetic energy 6.0×10^{-19} 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 0.3×10^{-19} J ⬭

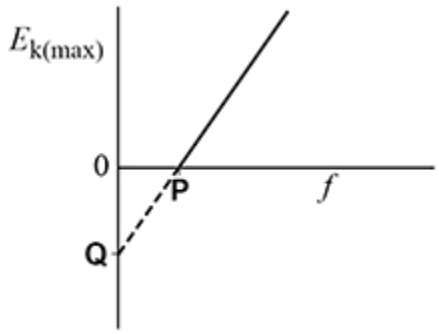
B 2.6×10^{-19} J ⬭

C 3.1×10^{-19} J ⬭

D 5.7×10^{-19} J ⬭

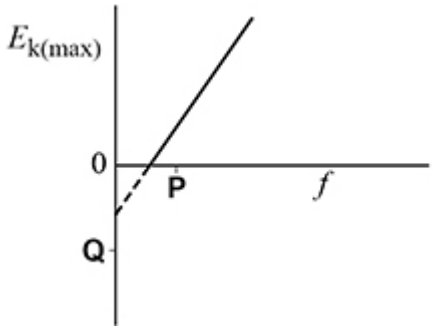
(Total 1 mark)

12. The graph shows how the maximum kinetic energy $Ek_{(max)}$ 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 $Ek_{(max)}$ axis.

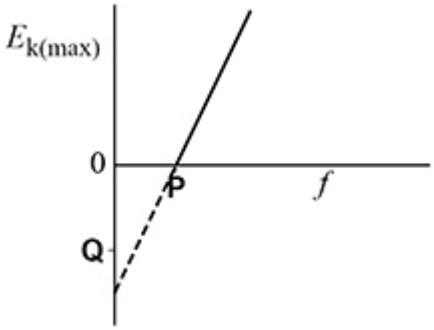


Which graph shows the variation of $Ek_{(max)}$ with f for a metal with a greater work function?

A



B



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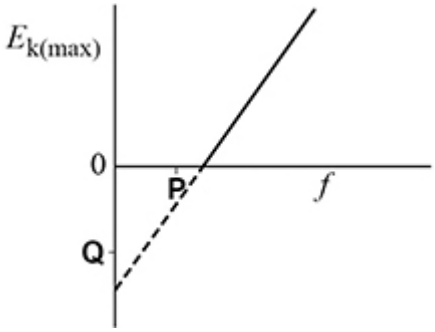
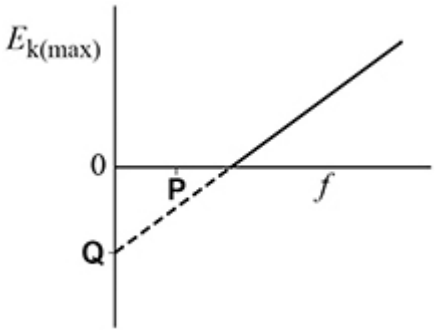


D



A ⬭

B ⬭

C ⬭

D ⬭

(Total 1 mark)

13. 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 $\beta^- + \beta^- + \alpha + \beta^- + \alpha$ ⬭

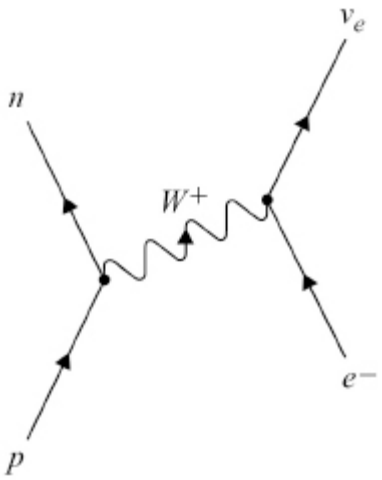
C $\alpha + \alpha + \alpha + \alpha + \beta^-$ ⬭

D $\beta^- + \beta^- + \beta^- + \beta^- + \alpha$ ⬭

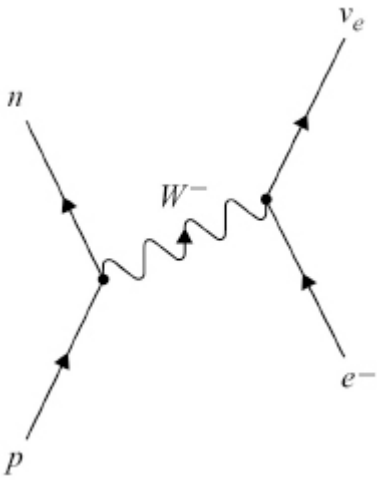
(Total 1 mark)

14. Which diagram represents electron capture?

A



B



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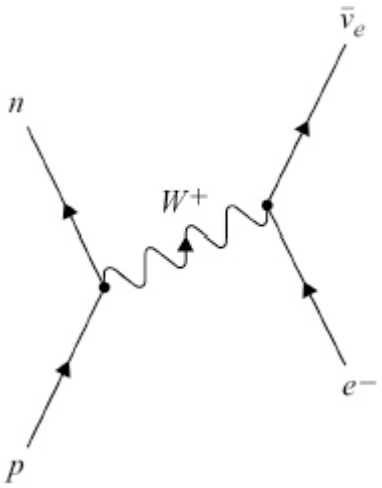
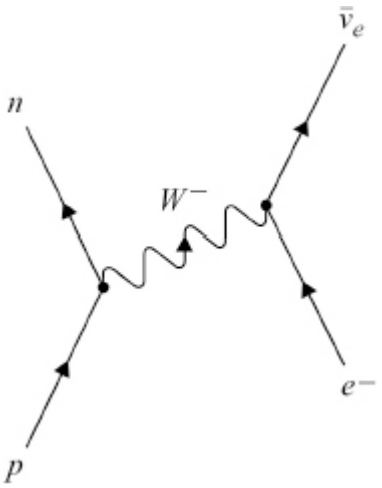


D



A ⬭

B ⬭

C ⬭

D ⬭

(Total 1 mark)

15. $^{x}_{81}Tl$ decays to $^{206}_{82}Pb$ by a series of four radioactive decays.

Each decay involves the emission of either a single α particle or a single β^- particle.

What is *x*?

A 207 ⬭

B 209 ⬭

C 210 ⬭

D 212 ⬭

(Total 1 mark)

16. What is the number of up quarks and down quarks in a $^{9}_{4}Be$ nucleus?

	Number of up quarks	Number of down quarks	
A	11	16	⬭
B	13	14	⬭
C	14	13	⬭
D	16	11	⬭

(Total 1 mark)

17. Which decay of a positive kaon (K^+) particle is possible?

A $K^+ \rightarrow \pi^0 + e^+ + \bar{\nu}_e$ ⬭

B $K^+ \rightarrow p + \nu_\mu$ ⬭

C $K^+ \rightarrow \pi^+ + \pi^+ + \pi^0$ ⬭

D $K^+ \rightarrow \mu^+ + \nu_\mu$ ⬭

(Total 1 mark)

18. A particle has a kinetic energy of E_k and a de Broglie wavelength of λ.

What is the de Broglie wavelength when the particle has a kinetic energy of $4E_k$?

A $\frac{\lambda}{2}$ ⬭

B $\frac{\lambda}{\sqrt{2}}$ ⬭

C $\sqrt{2}\lambda$ ⬭

D 2λ ⬭

(Total 1 mark)

19. The radioactive nuclide $^{232}_{90}\text{Th}$ decays by one α emission followed by two β^- emissions.

Which nuclide is formed as a result of these decays?

A $^{238}_{92}\text{U}$ ⬭

B $^{230}_{90}\text{Th}$ ⬭

C $^{228}_{90}\text{Th}$ ⬭

D $^{228}_{88}\text{Rn}$ ⬭

(Total 1 mark)

20. Unstable nuclide **P** decays to nuclide **T** through a series of alpha (α) and beta-minus (β^-) decays.

$$\mathbf{P} \xrightarrow{\alpha} \mathbf{Q} \xrightarrow{\beta^-} \mathbf{R} \xrightarrow{\beta^-} \mathbf{S} \xrightarrow{\alpha} \mathbf{T}$$

Which statement is correct?

A **P** and **S** are isotopes. ⬭

B **Q** and **T** have different proton numbers. ⬭

C **Q** and **S** have different nucleon numbers. ⬭

D **R** has a greater proton number than **P**. ⬭

(Total 1 mark)