Q1. An electron initially at rest is accelerated through a potential difference. It is then brought to rest in a collision, and all of its kinetic energy is converted into a single photon of electromagnetic radiation. Which one of the following quantities is **not** required to find a value for the wavelength of the photon?

A The mass of the electron

B The charge on the electron

C The velocity of electromagnetic waves

D The value of the potential difference

(Total 1 mark)

Q2. Electron capture can be represented by the following equation.

$$p + e^- \rightarrow X + Y$$

Which row correctly identifies **X** and **Y**?

	X	**Y**	
A	p	K^-	⬭
B	e^-	e^+	⬭
C	n	V_e	⬭
D	n	π^0	⬭

(Total 1 mark)

Q3. What are the numbers of hadrons, baryons and mesons in an atom of $^{7}_{3}Li$?

	hadrons	**baryons**	**mesons**	
A	7	3	3	⬭
B	7	4	4	⬭
C	7	7	0	⬭
D	10	7	0	⬭

(Total 1 mark)

Q4. A calcium ion is formed by removing two electrons from an atom of $^{40}_{20}Ca$. What is the specific charge of the calcium ion?

A 3.2×10^{-19} C kg^{-1} ⬭

B 2.9×10^{-18} C kg^{-1} ⬭

C 4.8×10^{6} C kg^{-1} ⬭

D 4.8×10^{7} C kg^{-1} ⬭

(Total 1 mark)

Q5. Which of the following is **not** true?

A Each meson consists of a single quark and a single antiquark. ⬭

B Each baryon consists of three quarks. ⬭

C The magnitude of the charge on every quark is $\frac{1}{3}$ ⬭

D A particle consisting of a single quark has not been observed. ⬭

(Total 1 mark)

Q6. Electrons and protons in two beams are travelling at the same speed. The beams are diffracted by objects of the same size.

Which correctly compares the de Broglie wavelength λ_e of the electrons with the de Broglie wavelength λ_p of the protons and the width of the diffraction patterns that are produced by these beams?

	comparison of de Broglie wavelength	diffraction pattern	
A	$\lambda_e > \lambda_p$	electron beam width > proton beam width	⬭
B	$\lambda_e < \lambda_p$	electron beam width > proton beam width	⬭
C	$\lambda_e > \lambda_p$	electron beam width < proton beam width	⬭
D	$\lambda_e < \lambda_p$	electron beam width < proton beam width	⬭

(Total 1 mark)

Q7. The intensity of a monochromatic light source is increased. Which of the following is correct?

	Energy of an emitted photon	Number of photons emitted per second	
A	increases	increases	⬭
B	increases	unchanged	⬭
C	unchanged	increases	⬭
D	unchanged	unchanged	⬭

(Total 1 mark)

Q8. Monochromatic radiation from a source of light (source A) is shone on to a metallic surface and electrons are emitted from the surface. When a second source (source B) is used no electrons are emitted from the metallic surface. Which property of the radiation from source A must be greater than that from source B?

A amplitude ⬭

B frequency ⬭

C intensity ⬭

D wavelength ⬭

(Total 1 mark)

Q9. The nucleus of $^{9}_{4}Be$ captures a proton and emits an α particle. What is the product nucleus?

A $^{10}_{6}C$ ⬭

B $^{7}_{3}Li$ ⬭

C $^{6}_{3}Li$ ⬭

D $^{6}_{2}He$ ⬭

(Total 1 mark)

Q10. A radioactive nucleus emits a β^-. particle then an α particle and finally another β^-. particle. The final nuclide is

A an isotope of the original element ⬭

B the same element with a different proton number ⬭

C a new element of higher proton number ⬭

D a new element of lower nucleon number ⬭

(Total 1 mark)

Q11. An electron has a kinetic energy E and a de Broglie wavelength λ. The kinetic energy is increased to $4E$. What is the new de Broglie wavelength?

A $\frac{\lambda}{4}$ ⬭

B $\frac{\lambda}{2}$ ⬭

C λ ⬭

D 4λ ⬭

(Total 1 mark)

Q12. When comparing X-rays with UV radiation, which statement is correct?

A X-rays have a lower frequency. ⬭

B X-rays travel faster in a vacuum. ⬭

C X-rays do not show diffraction and interference effects. ⬭

D Using the same element, photoelectrons emitted using X-rays have the greater maximum kinetic energy. ⬭

(Total 1 mark)

Q13. In a photoelectric experiment, light is incident on the metal surface of a photocell. Increasing the intensity of the illumination at the surface leads to an increase in the

A work function

B minimum frequency at which electrons are emitted

C current through the photocell

D speed of the electrons

(Total 1 mark)

Q14. An electron collides with a neutral atom and ionizes it. Which of the following describes the particles present after the collision?

A An electron and an excited atom.

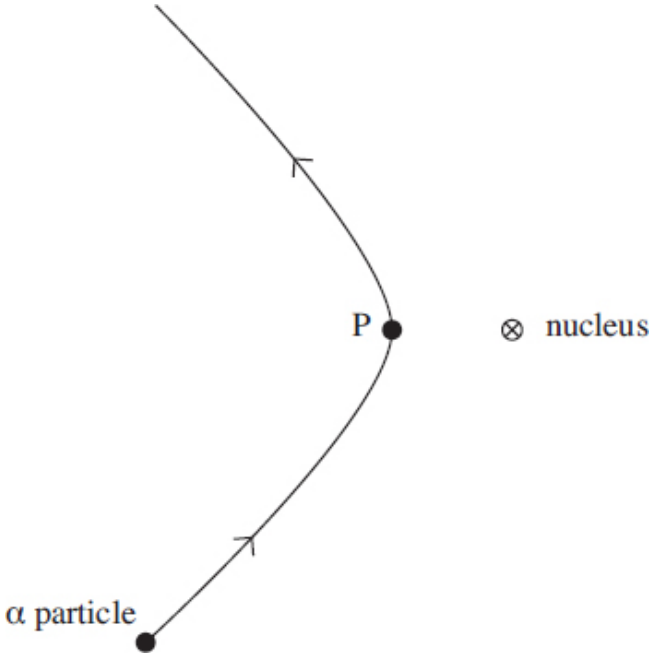
B An excited atom containing an excess electron.

C Two electrons and a positive ion.

D Two electrons and a neutral atom in the ground state.

(Total 1 mark)

Q15. The diagram shows the path of an α particle deflected by the nucleus of an atom. Point P on the path is the point of closest approach of the α particle to the nucleus.



Which one of the following statements about the α particle on this path is correct?

A Its acceleration is zero at P.

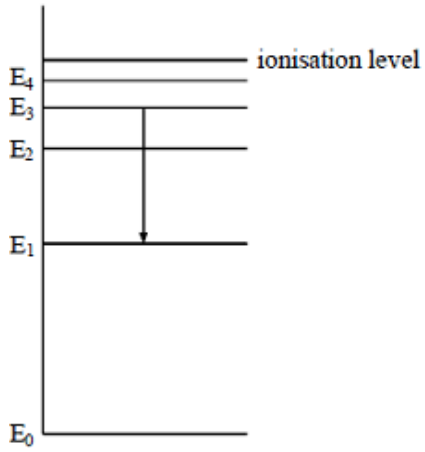
B Its kinetic energy is greatest at P.

C Its speed is least at P.

D Its potential energy is least at P.

(Total 1 mark)

Q16. The diagram shows some energy levels of an atom.



The transition E_3 to E_1 corresponds to the emission of visible light.

A transition corresponding to the emission of infrared radiation could be

A E_1 to E_0

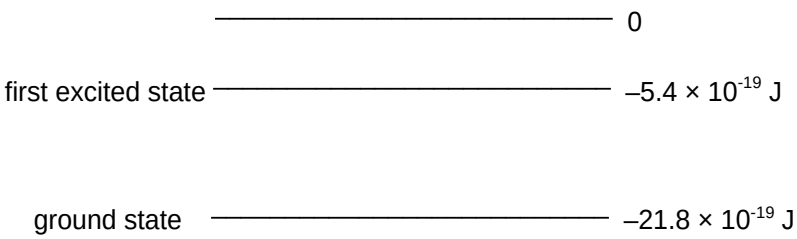
B E_4 to E_1

C E_1 to E_2

D E_3 to E_2

(Total 1 mark)

Q17. The diagram shows some of the energy levels for a hydrogen atom.



A free electron of kinetic energy 20.0×10^{-19} J collides with a hydrogen atom in its ground state. The hydrogen atom is excited from its ground state to the first excited state. The kinetic energy of the free electron after the collision is

A 1.8×10^{-19} J

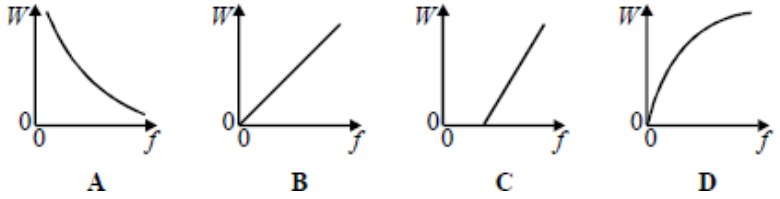
B 3.6×10^{-19} J

C 5.4×10^{-19} J

D 16.4×10^{-19} J

(Total 1 mark)

Q18. Which one of the graphs best represents the relationship between the energy W of a photon and the frequency f of the radiation?



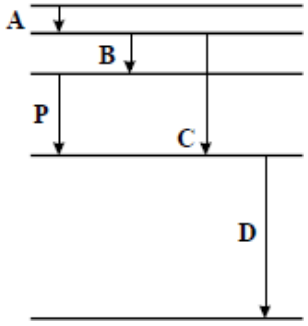
(Total 1 mark)

Q19. For which of the following relationships is the quantity y related to the quantity x by the relationship $x \propto \frac{1}{y}$?

	x	y
A	energy stored in a spring	extension of the spring
B	gravitational field strength	distance from a point mass
C	de Broglie wavelength of an electron	momentum of the electron
D	period of a mass-spring system	spring constant (stiffness) of the spring

(Total 1 mark)

Q20. The diagram **drawn to scale** shows some of the energy levels of an atom. Transition **P** results in the emission of a photon of wavelength 4×10^{-7} m.



Which one of the transitions **A**, **B**, **C**, or **D** could result in the emission of a photon of wavelength 8×10^{-7} m?

(Total 1 mark)

Q21. In a nuclear reaction $^{14}_{7}N$ is bombarded by neutrons. This results in the capture of one neutron and the emission of one proton by one nucleus of $^{14}_{7}N$. The resulting nucleus is

A $^{13}_{7}N$

B $^{14}_{6}C$

C $^{12}_{6}C$

D $^{14}_{8}O$

(Total 1 mark)

M1. A

[1]

M2. C

[1]

M3. C

[1]

M4. C

[1]

M5. C

[1]

M6. A

[1]

M7. C

[1]

M8. B

[1]

M9. C

[1]

M10. A

[1]

M11. B

[1]

M12. D

[1]

M13. C

[1]

M14. C

[1]

M15. C

[1]

M16. D

1

M17. B

[1]

M18. B

[1]

M19. C

[1]

M20. B

[1]

M21. B

[1]