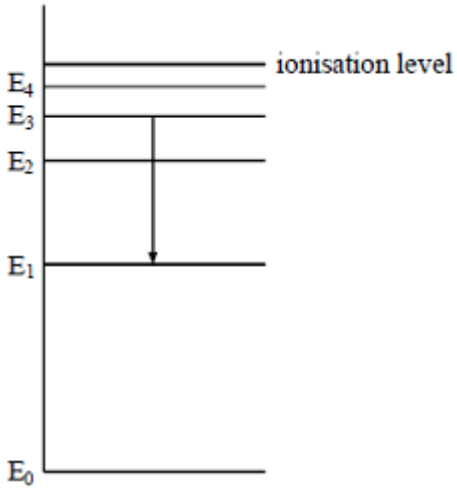
Name _ Form _ _ _ _ _ _ _ Date _ _ _ _ _ _ _ _ _ _ Time Taken _ _ _ _ _ _ _ _ _ _

Q1. 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

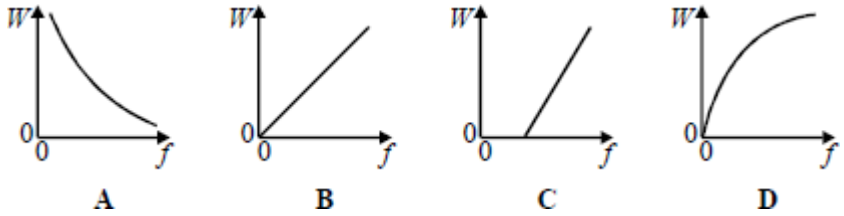
B E_4 to E_1

C E_1 to E_2

D E_3 to E_2

(Total 1 mark)

Q2. 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)

Q3. The diagram shows some of the energy levels for a hydrogen atom.

_____ 0

first excited state _____ -5.4×10^{-19} J

ground state _____ -21.8×10^{-19} J

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

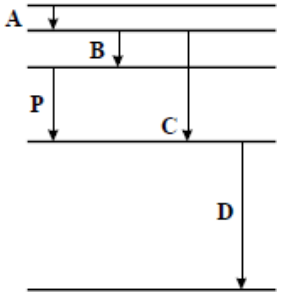
B 3.6×10^{-19} J

C 5.4×10^{-19} J

D 16.4×10^{-19} J

(Total 1 mark)

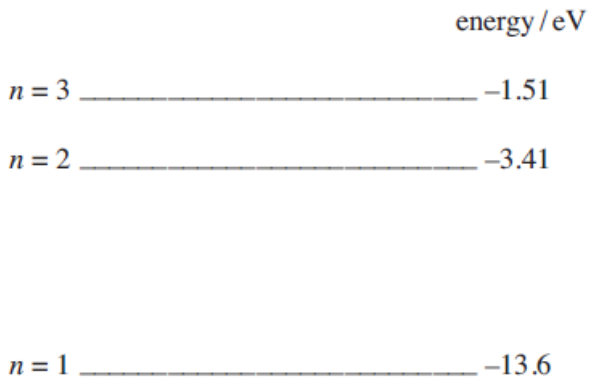
Q4. The diagram on the right **drawn to scale** shows some of the energy levels of an atom. Transition **P** results in the emission of a photon of wavelength 4×10^{-7} m.



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)

Q5. The diagram below shows the lowest three energy levels of a hydrogen atom.



(a) An electron is incident on a hydrogen atom. As a result an electron in the ground state of the hydrogen atom is excited to the $n = 2$ energy level. The atom then emits a photon of a characteristic frequency.

(i) Explain why the electron in the ground state becomes excited to the $n = 2$ energy level.

(2)

(ii) Calculate the frequency of the photon.

frequency = ... Hz

(3)

(iii) The initial kinetic energy of the incident electron is 1.70×10^{-18} J.

Calculate its kinetic energy after the collision.

kinetic energy = ... J

(2)

(iv) Show that the incident electron cannot excite the electron in the ground state to the $n = 3$ energy level.

(2)

(b) When electrons in the ground state of hydrogen atoms are excited to the $n = 3$ energy level, photons of more than one frequency are subsequently released.

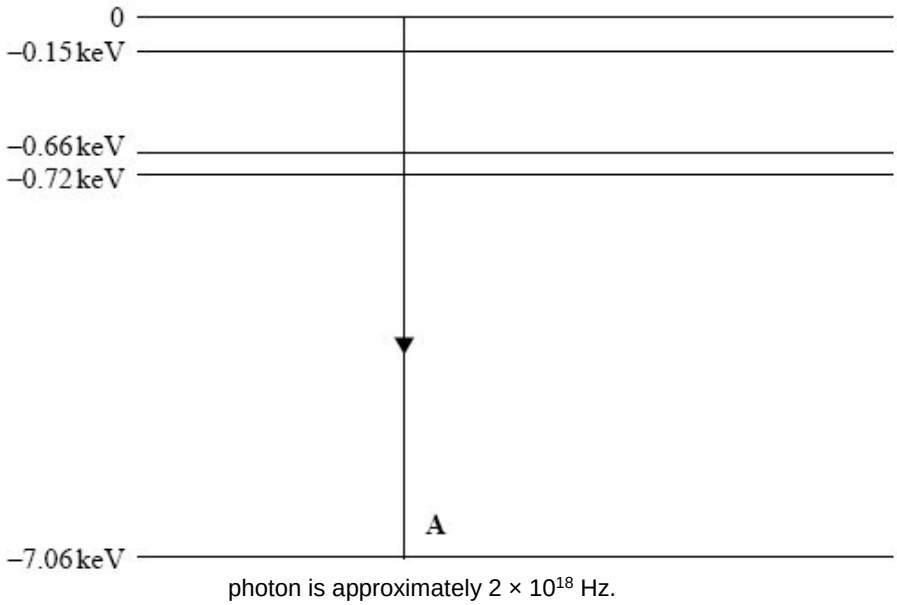
(i) Explain why different frequencies are possible.

(1)

(ii) State and explain how many possible frequencies could be produced.

(2)
(Total 12 marks)

Q5. The diagram below shows some of the energy levels for an iron atom.



(i) Draw another arrow on the diagram above to represent the smallest energy change possible for an electron moving between two of the energy levels shown.
The electron energy change selected must result in energy being emitted from the atom.
Label this arrow **B**.

(1)

(ii) In the diagram, when the energy change labelled **A** occurs an X-ray photon is emitted.
Show that the frequency of the photon is approximately 2×10^{18} Hz.

(3)

(Total 4 marks)
(20 Mark Grand Total)