Energy Levels & Photon Emission
TOPIC QUESTIONS

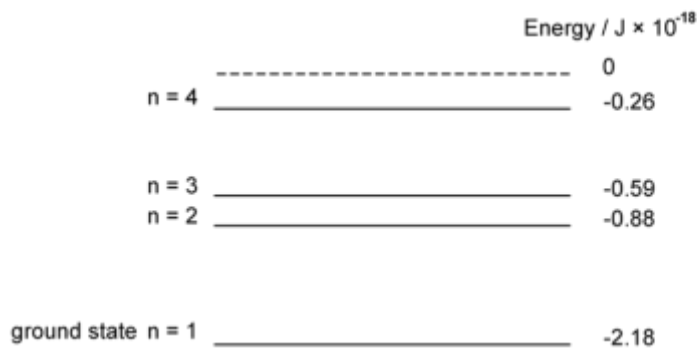| Level	A Level
Subject	Physics
Exam Board	AQA
Paper Type	Multiple Choice

Time Allowed : 30min

1. A particle has a de Broglie wavelength of 1.2 nm.What is the momentum of this particle?

  A. 5.5×10^{-31} kg m s^{-1}

  B. 5.5×10^{-22} kg m s^{-1}

  C. 5.5×10^{-28} kg m s^{-1}

  D. 5.5×10^{-25} kg m s^{-1}

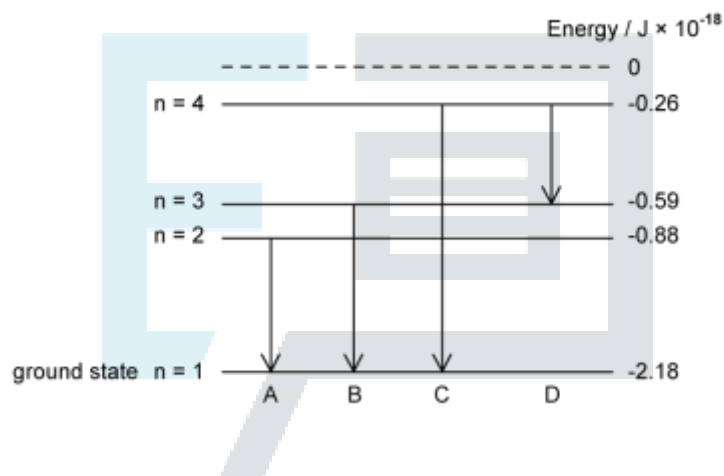2. The diagram below shows the energy levels of a mercury atom.

Energy / J × 10^{-18}

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                                                    ---------------------------   0
             n = 4  _____   -0.26

             n = 3  _____   -0.59
             n = 2  _____   -0.88

ground state n = 1  _____   -2.18
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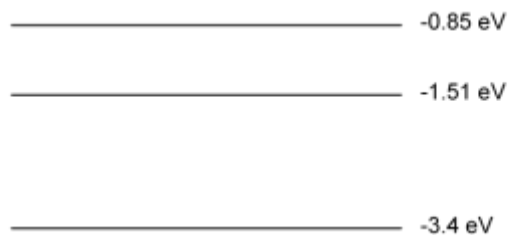
What transition produces a photon with the **longest** wavelength?

3. The diagram shows an energy-level diagram for a hydrogen atom.

————————————————— -0.85 eV

————————————————— -1.51 eV

————————————————— -3.4 eV

ground
state ————————————————— -13.6 eV

How many discrete photon energies could be produced from these energy levels?

A. 3

B. 5

C. 6

D. 9

4. The diagram shows some energy levels of an atom.
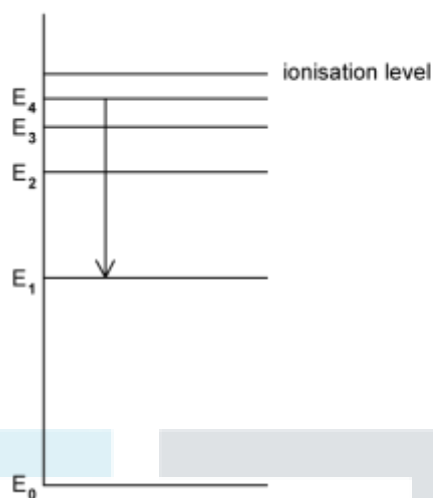
The transition E_4 to E_1 corresponds to the emission of infrared

radiation.A transition corresponding to the emission of X-rays would

be

A. E_3 to E_1

B. E_3 to E_2

C. E_4 to E_0

D. E_4 to E_2

5. The diagram below is an example of an electron diffraction pattern.

Which row correctly states how the **momentum** and therefore **wavelength** of the incident electrons

should changeto produce a pattern with a **smaller** radius?

	Momentum	Wavelength
A	Decreases	Decreases
B	Decreases	Increases
	Increases	Increases
C	Increases	Decreases
D		

6. The diagram below shoes a simplified diagram of a fluorescent tube.
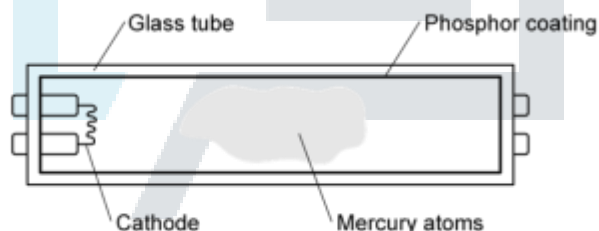
What is the purpose of the phosphor coating?

A. This is where the electrons are ionised

B. Electrons in the phosphor coating de-excite to release visible light photons

C. Electrons in the phosphor coating de-excite to release UV light photons

D. Without the phosphor coating, the electrons in the mercury atoms would not be excited

7. When a nucleus of the radioactive isotope $^{65}_{28}Ni$ decays, a β^- particle and an electron antineutrino are emitted.

How many protons and neutrons are there in the resulting daughter nucleus?

	Number of protons	Number of neutrons
A	28	65

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B	29	65
C	29	36
D	30	35

8. What interactions are involved in the production of a strange particle and its decay intonon-strange particles?

	Production	**Decay**
A	strong	weak
B	strong	strong
C	weak	strong
D	weak	weak

9. An atom of $^{16}_{7}N$ gains 3 electrons.

What is the specific charge of the ion?

A 1.80×10^7 C kg^{-1}

B -1.80×10^7 C kg^{-1}

C 4.19×10^7 C kg^{-1}

D -4.19×10^7 C kg^{-1}

10. What is the de Broglie wavelength of an alpha particle with kinetic
energy 4.8 MeV?A. 1.5×10^{-9} m

B. 2.6×10^{-21} m

C. 3.0×10^{-15} m

D. 6.5×10^{-15} m

11. A beam of electrons **R** is accelerated from rest by a potential difference of 200 V and another beam of electrons **S**
is accelerated from rest by a potential difference of 1800 V.

When they behave like waves, what is the ratio of their respective wavelengths

$\lambda_S : \lambda_R$?A. 9 : 1

B. 1 : 9

C. 3 : 1

D. 1 : 3

12. The energy level diagram below shoes six possible transitions between the energy levels of an atom. Eachtransition between levels creates a photon of definite energy and frequency.
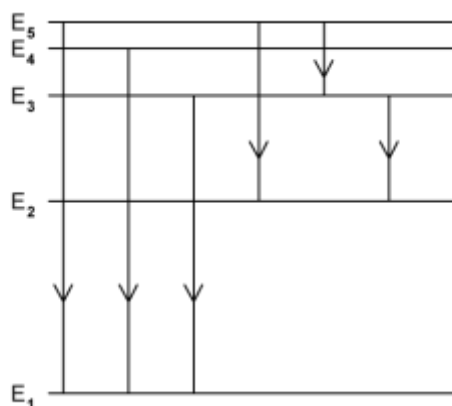
If the increase in frequency is from left to right, which of the following spectrum corresponds most closely to thetransitions?
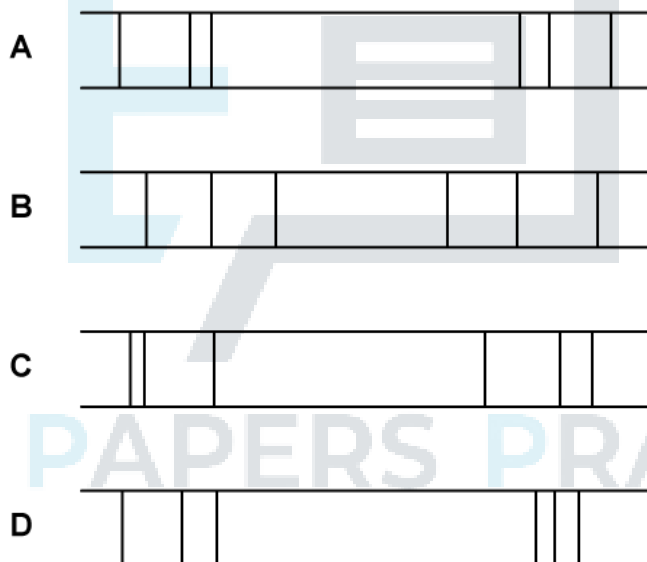
13. Transitions between three energy levels in a particular atom give rise to the three spectral lines of frequencies, indecreasing magnitude f_1, f_2 and f_3 with wavelengths λ_1, λ_2 and λ_3.

Which of the following correctly related f_1, f_2 and f_3 and λ_1, λ_2 and λ_3

	Frequency	Wavelength
A	$f_3 = f_1 + f_2$	$\dfrac{1}{\lambda_1} = \dfrac{1}{\lambda_2} + \dfrac{1}{\lambda_3}$
B	$f_3 = f_1 - f_2$	$\dfrac{1}{\lambda_1} = \dfrac{1}{\lambda_2} + \dfrac{1}{\lambda_3}$
C	$f_1 = f_2 + f_3$	$\lambda_1 = \lambda_2 + \lambda_3$
D	$\dfrac{1}{f_1} = \dfrac{1}{f_2} + \dfrac{1}{f_3}$	$\dfrac{1}{\lambda_3} = \dfrac{1}{\lambda_1} - \dfrac{1}{\lambda_2}$

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

Energy / eV

E_4 $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ -0.54

E_3 $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ -0.85

E_2 $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ -1.51

E_1 $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ -3.39

E_0 $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ $-$ -13.6

Not to scale

A free electron of kinetic energy 12.5 eV 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. 2.29 eV

B. 22.9 eV

C. 60.0 eV

D. 3.38 eV

15. The ionization energy of hydrogen is 13.6eV

What is the de Broglie wavelength of the slowest electron that can ionise a hydrogen atom when it collides withit?

A. 0.16 nm

B. 0.33 nm

C. 0.59 nm

D. 0.78 nm