Higher
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Past Paper questions
1991 - 2010
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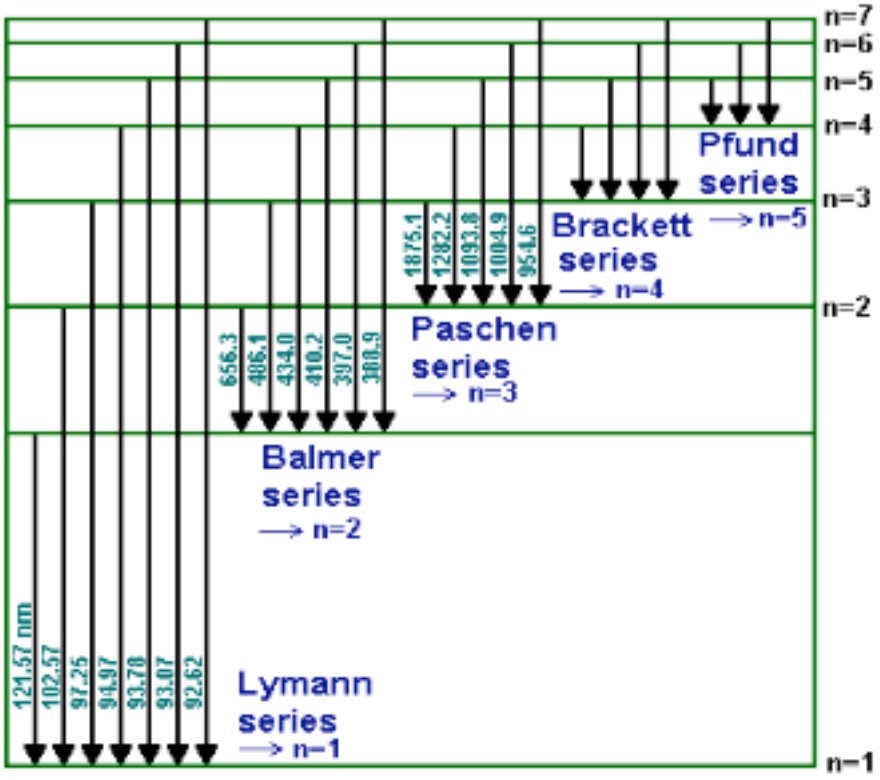
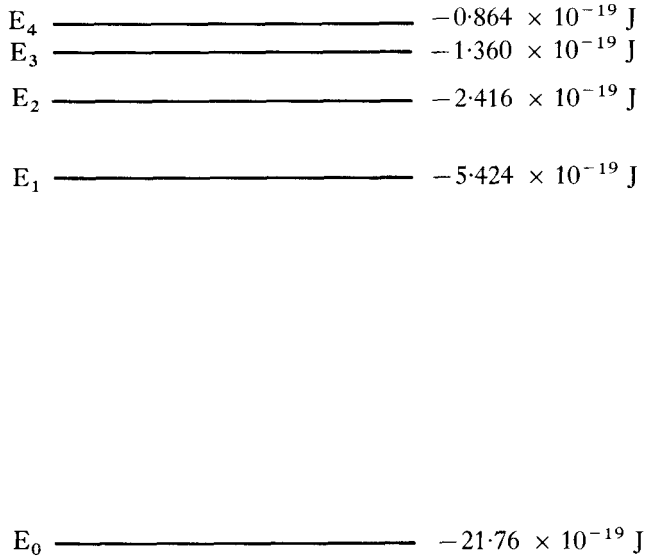
3.4 Spectra



1992 Q37

The diagram below shows the energy levels for the hydrogen atom.

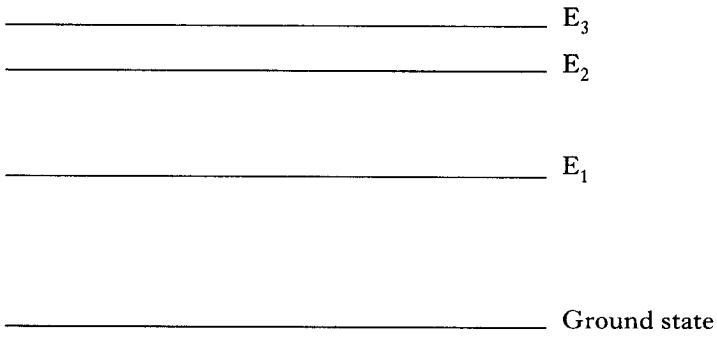


(a) Between which two energy levels would an electron transition lead to the emission of radiation of **highest** frequency?

(b) Calculate the frequency of the radiation in part (a).
[Data:- Planck's constant = 6.63×10^{-34} Js]

1996 Q36

A particular atom has energy levels as shown below.



Transitions are possible between all these levels to produce emission lines in the spectrum.

(a) How many lines are in the spectrum of this atom?

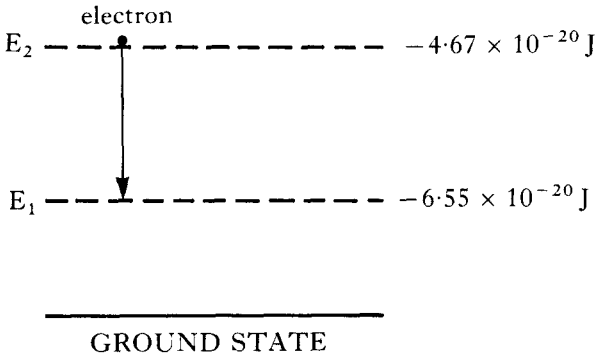
(b) Between which two energy levels would an electron transition lead to the emission of radiation of the lowest frequency?

(c) Explain why some lines in the spectrum are more intense than others.

1993 Q9

(a) Laser light is monochromatic and coherent.
Briefly explain the meaning of the terms monochromatic and coherent.

(b) A laser radiates energy when electrons are stimulated to fall from energy level E_2 to energy level E_1 as shown in the diagram.



(i) What are the frequency and wavelength of the radiation emitted?

(ii) Name the section of the electromagnetic spectrum in which the radiation occurs.

(c) The beam of light from a laser is very intense.
Give **two** reasons for this.

1994 Q10

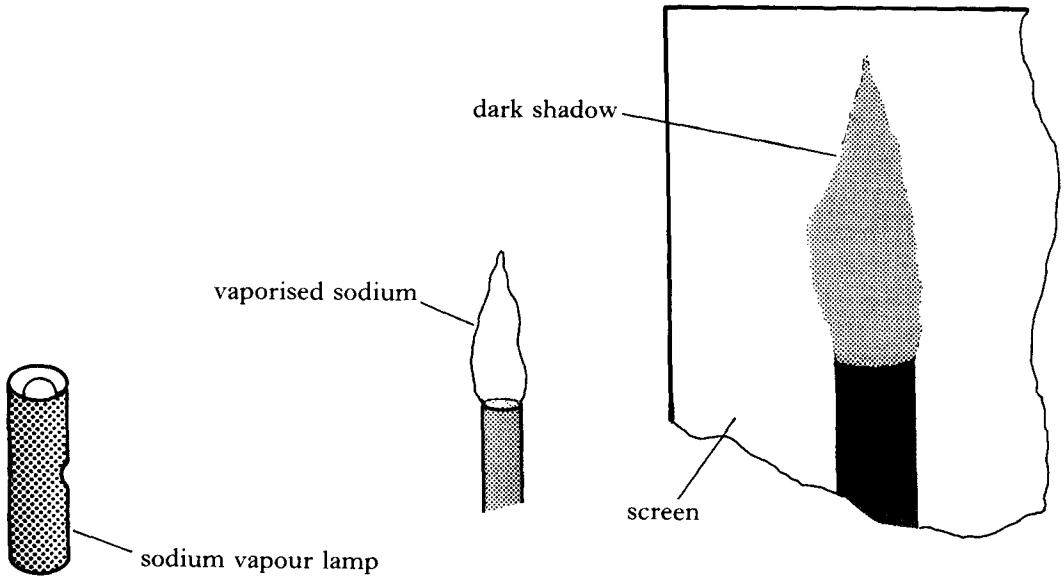
(a) A sodium vapour lamp emits bright yellow light when electrons make transitions from one energy level to another within the sodium atoms.

(i) State whether electrons are moving to higher or lower energy levels when the light is emitted.

(ii) Using information provided in the data sheet, calculate the energy difference between these two electron energy levels in the sodium atom.

[Data:- Planck's constant = 6.63×10^{-34} Js]

(b) A Bunsen flame containing vaporised sodium is placed between a sodium vapour lamp and a screen as shown.

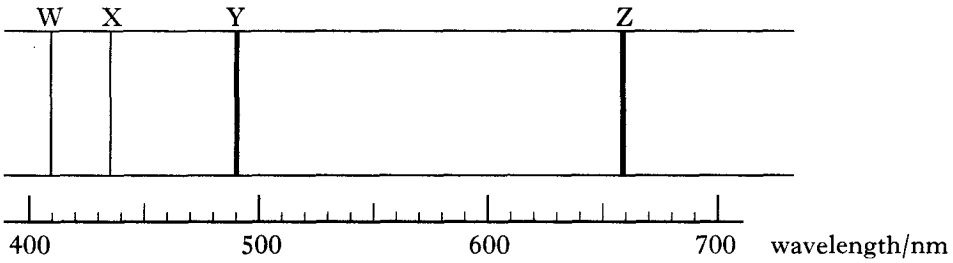


(i) Explain why a dark shadow of the flame is seen on the screen.

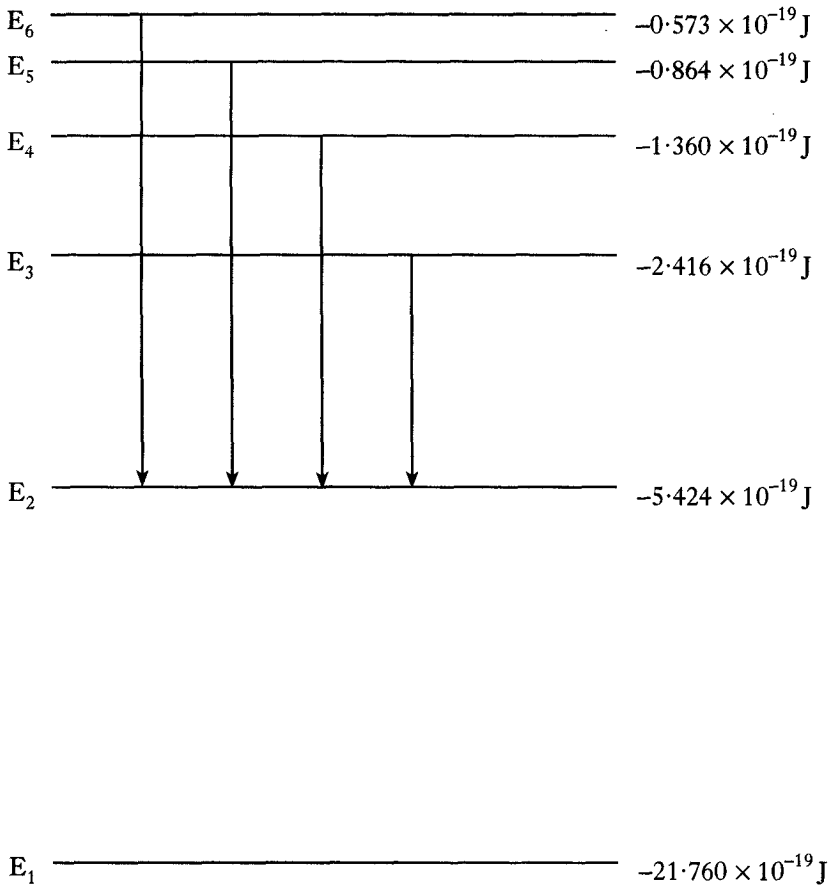
(ii) The sodium vapour lamp is replaced with a cadmium vapour lamp.
Explain why there is now no dark shadow of the flame on the screen.

1998 Q9

The line emission spectrum of hydrogen has four lines in the visible spectrum as shown in the following diagram.



These four lines are caused by electron transitions in a hydrogen atom from high energy levels to a low energy level E_2 as shown below.



(a) From the information above, state which spectral line W, X, Y or Z is produced by an electron transition from E_3 to E_2.

(b) Explain why lines Y and Z in the line emission spectrum are brighter than the other two lines.

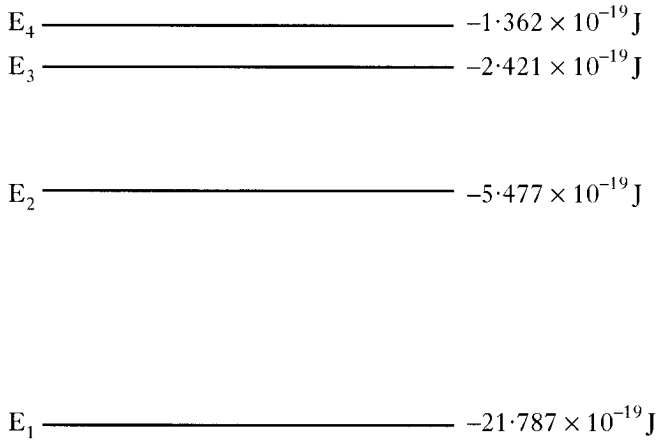
(c) Infrared radiation of frequency 7.48×10^{13} Hz is emitted from a hydrogen atom.

(i) Calculate the energy of one photon of this radiation.

(ii) Show by calculation which electron transition produces this radiation.

2001 Q11

The diagram shows some of the energy levels in an atom.



(a) For the energy levels shown, how many different wavelengths of radiation can be emitted?

(b) Which transition between the energy levels in the above diagram produces radiation with the shortest wavelength?
You must justify your answer. Numerical calculation is not required.

(c) An electron makes the transition from energy level E_3 to energy level E_2.
(i) Calculate the energy of the photon emitted.
(ii) Calculate the Wavelength of the photon emitted.
(iii) Using the data sheet, identify the element in which this transition occurs.

SPECTRAL LINES

Element	*Wavelength*/nm	*Colour*
Hydrogen	657	Red
	486	Blue-green
	434	Blue-violet
	410	Violet
	397	Ultraviolet
	389	Ultraviolet
Sodium	589	Yellow

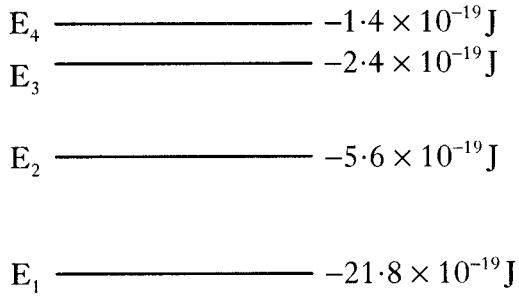
Element	*Wavelength*/nm	*Colour*
Cadmium	644	Red
	509	Green
	480	Blue

Lasers

Element	*Wavelength*/nm	*Colour*
Carbon dioxide	9550 } 10 590 }	Infrared
Helium-neon	633	Red

2003 Q27 (a)

(a) Electrons which orbit the nucleus of an atom can be considered as occupying discrete energy levels. The following diagram shows some of the energy levels for a particular atom.

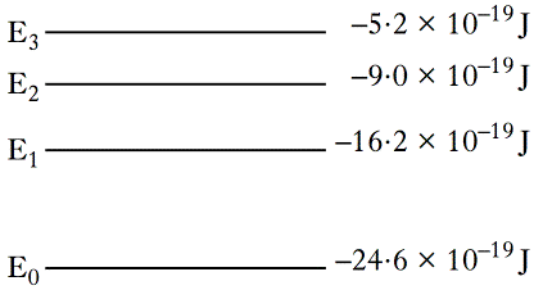


(i) The transition between which two of these energy levels produces radiation with the longest wavelength? You must justify your answer.

(ii) Calculate the frequency of the photon produced when an electron falls from E_3 to E_2.

2009 Q28.

(a) Electrons which orbit the nucleus of an atom can be considered as occupying discrete energy levels. The following diagram shows some of the energy levels for a particular atom.



(i) Radiation is produced when electrons make transitions from a higher to a lower energy level. Which transition, between these energy levels, produces radiation with the shortest wavelength? Justify your answer.

(ii) An electron is excited from energy level E_2 to E_3 by absorbing light energy. What frequency of light is used to excite this electron?