6

White light is incident on a cloud of cool hydrogen gas, as illustrated in Fig. 6.1.

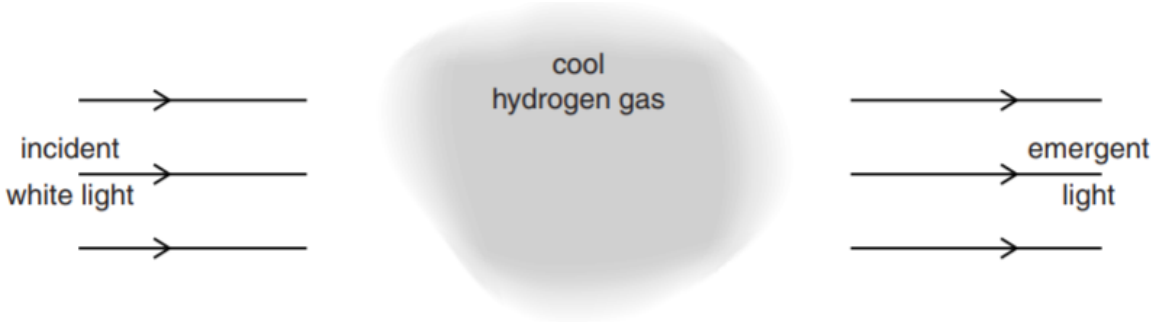

Fig. 6.1

(a)

The spectrum of the light emerging from the cloud of cool gas is viewed using a diffraction grating.

Explain why this spectrum contains a number of dark lines.

……

……

……

……[3]

(b)

The lowest electron energy levels of the gas atom are shown in Fig 6.2.

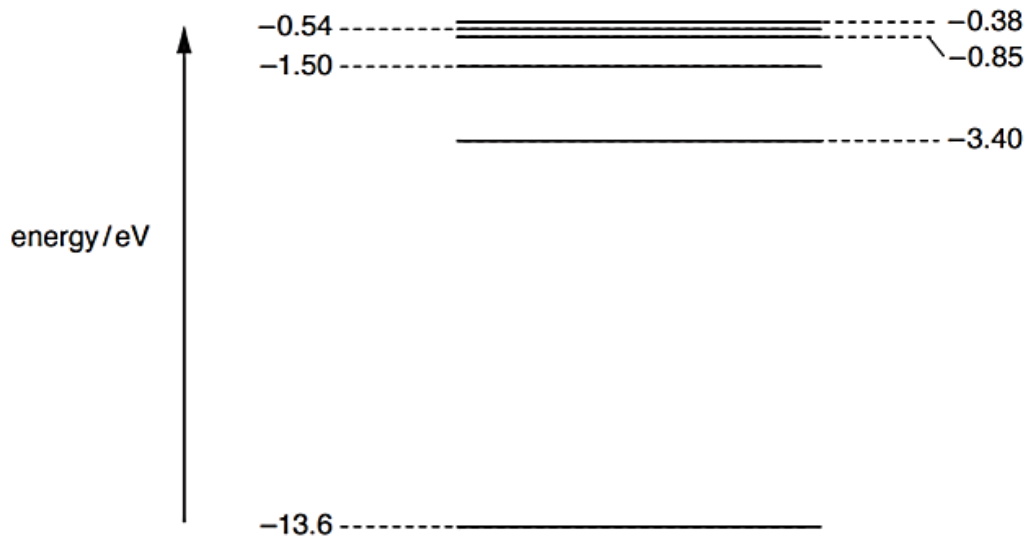

Fig. 6.2 (not to scale)

(i)

An electron is initially at the energy level –0.85 eV. State the total number of different wavelengths of photons that may be emitted as the electron de-excites.

number = ...

[1]

(ii)

Photons resulting from electron de-excitation from the –0.85 eV energy level are incident on the surface of a sample of platinum.

Platinum has a work function energy of 5.6 eV.

Determine

1.

the maximum kinetic energy, in eV, of a photoelectron emitted from the surface of the platinum,

maximum kinetic energy = ……. eV

[2]

2.

the wavelength of the photon producing the photoelectron in **(ii)1**,

wavelength = ... m

[1]

3.

the estimated uncertainty of the photoelectron's position, given that the maximum velocity of the photoelectron is measured with an uncertainty of 15%.

uncertainty of position = ... m

[3]

(c)

The photoelectrons emitted are incident on a very thin carbon film, as illustrated in Fig. 6.3.

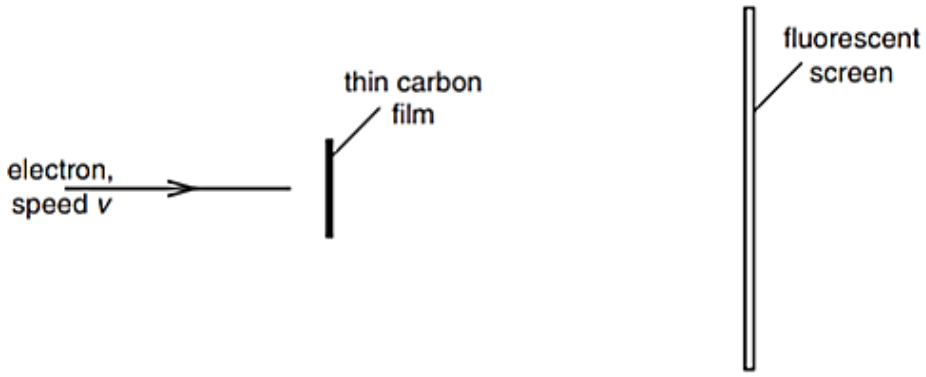

Fig. 6.3

The emergent electrons are incident on a fluorescent screen.

A series of concentric rings is observed on the screen.

(i)

Suggest how the observed rings provide evidence for the wave nature of particles.

……

……

……[2]

(ii)

The initial speed of the electrons is increased.

State and explain the effect, if any, on the radii of the rings observed on the screen.

……

……

……[2]

[Total: 14]

Section B

Answer **one** question from this Section in the spaces provided.