Name of the Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Q1.

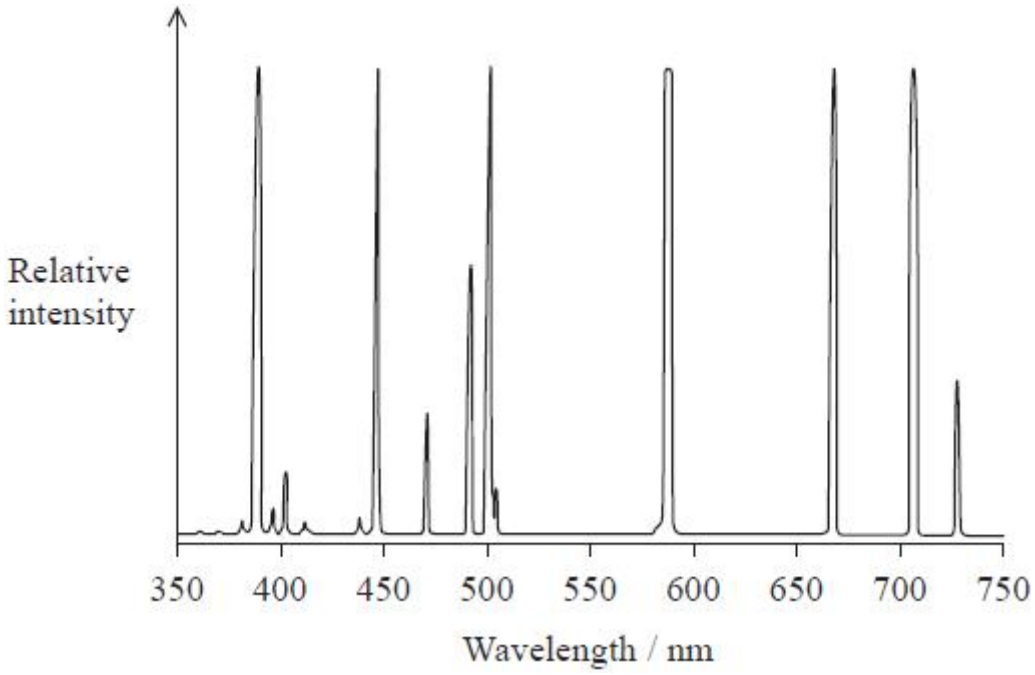
When a large potential difference is applied to a discharge tube, the gas in the discharge tube emits coloured light. When this light is passed through a diffraction grating, an emission spectrum which is made up of a series of lines of different wavelengths may be seen.

The photographs show the spectra produced from a tube containing hydrogen and a tube containing helium.

Hydrogen:

Helium:

The graph shows the relative intensities of different wavelengths of light in the spectrum of a sample of helium.



The graph shows that the lines are not at a single wavelength. This effect is known as thermal Doppler broadening and occurs because of the random motion of the helium atoms.

(i) Explain why the thermal motion of the helium atoms causes the broadening of the spectral lines.

(2)

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(ii) The width of a line may be used to determine the speed of the atoms in the gas and hence the temperature of the gas.

The spectral line with wavelength 587 nm for a particular tube containing helium has a width of 6×10^{-3} nm.

(1) Show that this corresponds to a speed, for a helium atom, of about 1500 m s^{-1}.

(2)

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(2) Assuming that this is the root mean square speed for the helium (He 4) atoms in the tube, calculate the temperature of the gas in the tube.

(3)

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Temperature = ...

(Total for question = 7 marks)

Q2.

* Cepheid variable stars have long been seen as examples of standard candles. Recent measurements have indicated that the movement of the star through the interstellar material might result in the formation of a layer of dust around the star. This affects how bright the star appears.
Explain how standard candles are used in astronomy, and suggest how the existence of a layer of dust around a Cepheid variable star might affect the conclusions drawn by astronomers.

(6)

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(Total for question = 6 marks)

Q3.

Describe the characteristics of a main sequence star.

(2)

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(Total for question = 2 marks)