Name of the Student:_____

Max. **Marks : 21 Marks**

Time : 21 Minutes

Q1.

A student placed a metal block of mass 220 g in boiling water at 100 °C for several minutes.

The student then transferred the metal block into 300 g of water at 19 °C inside a glass container of mass 50 g. The final temperature of the water was 23 °C.

The table shows specific heat capacity values for copper and tin.

Metal	copper	tin
Specific heat capacity / $J\,kg^{-1}K^{-1}$	390	230

Deduce whether the metal block was made from copper or tin.

specific heat capacity of water = $4200\,Jkg^{-1}K^{-1}$
specific heat capacity of glass = $840\,Jkg^{-1}K^{-1}$

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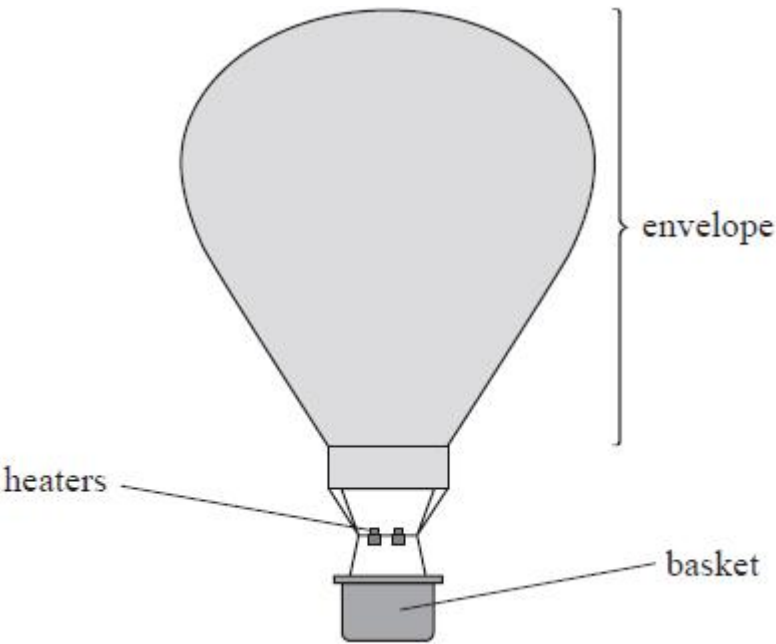
(Total for question = 5 marks)

Q2.

A hot air balloon consists of a fabric envelope, heaters and a basket, as shown.

When the balloon is set up, the envelope is partly filled with air at 20°C. The air is then heated to 120°C and expands to fill the envelope and becomes less dense.

The air pressure inside the envelope is always equal to the air pressure outside the envelope because the envelope is open at the bottom.

The balloon takes off when the upthrust is more than the total weight of the balloon, the air in the envelope and the passengers.

Deduce whether the balloon can take off.

volume of air at 120°C in inflated envelope = 2800 m^3
density of air at 20°C = 1.2 kg m^{-3}
mass of balloon = 380 kg
mass of passengers = 340 kg
upthrust when the envelope is full = 33 000 N

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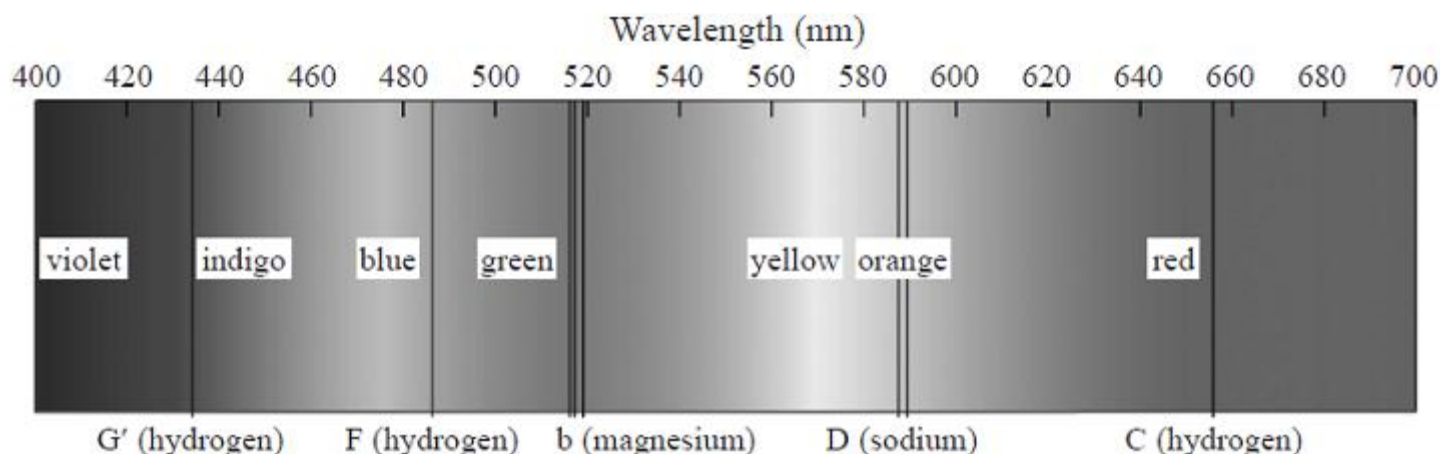
(Total for question = 6 marks)

Q3.

Scientists can analyse light from stars that has passed through a diffraction grating.

A spectrum of the visible light emitted by a particular star is shown.

Wavelength (nm)

400 420 440 460 480 500 520 540 560 580 600 620 640 660 680 700

violet   indigo   blue   green   yellow orange   red

G′ (hydrogen)   F (hydrogen)   b (magnesium)   D (sodium)   C (hydrogen)

(i) Light interacts with atoms as it passes through the atmosphere of the star.

Explain how this leads to the formation of the dark lines within the spectrum.

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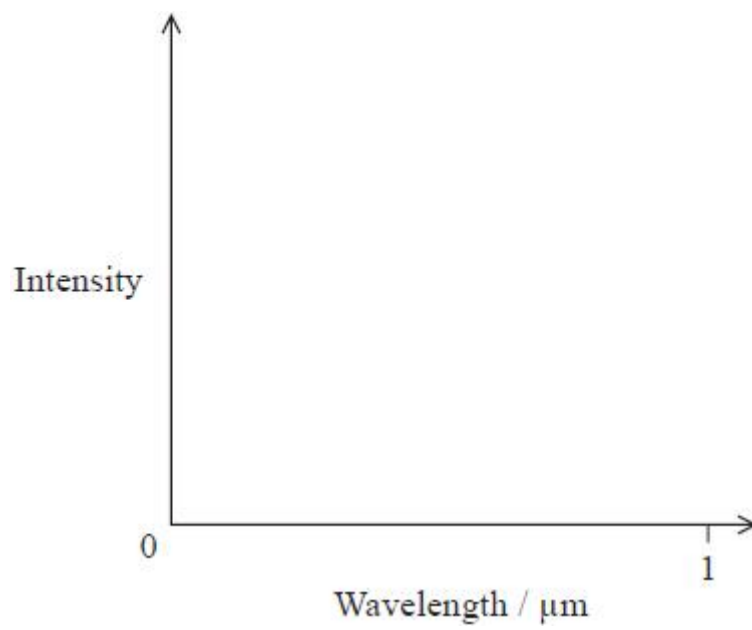
(ii) The surface temperature of the star is 5800 K.

On the axes below, sketch a graph of the intensity of radiation against the wavelength of that radiation for this star.

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(iii) This star is a main sequence star.

Explain why main sequence stars do not collapse due to gravitational forces.

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(Total for question = 10 marks)