Name of the Student:_____

Max. **Marks : 21 Marks**   **Time : 21 Minutes**

Q1.

One of the largest stars in our galaxy is VY Canis Majoris. This star's radius is 1420 times the radius of the Sun. The luminosity of this star is 270 000 times the luminosity of the Sun.

A student states that the surface temperature of VY Canis Majoris must be much greater than the surface temperature of the Sun.

(a) Determine whether the student's statement is correct.

   surface temperature of Sun = 5780 K
   luminosity of Sun = 3.85×10^{26} W
   radius of Sun = 6.96×10^8 m

(3)

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(b) Calculate the wavelength with maximum intensity in the black body radiation spectrum of VY Canis Majoris.
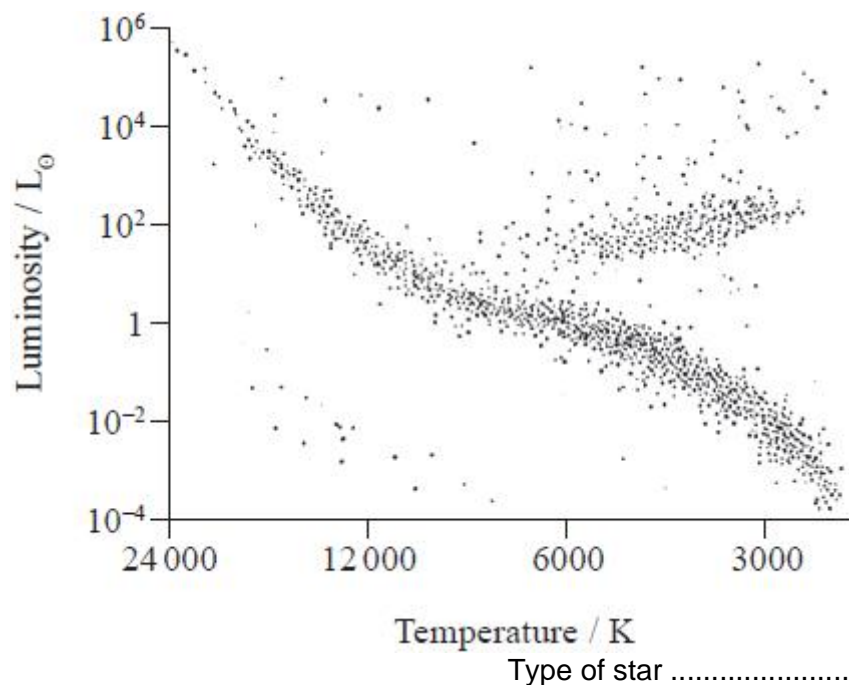
(2)

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....

                                        Wavelength = ...

(c) Add the position of VY Canis Majoris to the Hertzsprung Russell diagram to determine which type of star it is.

(2)

Type of star ....

(Total for question = 7 marks)

Q2.

The photograph below was taken by the James Webb Space Telescope (JWST) and shows a group of galaxies that formed shortly after the big bang, about 13×10^9 years ago.

(Source: © NASA, ESA, CSA, STScI)

The light from one of the galaxies, called Maisie, has a redshift z of 14.
The wavelength of light from Maisie detected at the telescope is 4.0×10^{-6} m and lies within the infrared section of the electromagnetic spectrum.

(i) Calculate the wavelength of light emitted by Maisie.

(3)

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Wavelength emitted = ...

(ii) Explain why the light emitted by Maisie arrives at the telescope as infrared.

(2)

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(Total for question = 5 marks)

Q3.

Astronomers observing stars at the centre of our galaxy have suggested that many of them are orbiting a supermassive black hole. The mass of this black hole is 9.2×10^{36} kg.

Trigonometric parallax and Hubble's law are two methods used to determine astronomical distances. Explain whether either of these methods is suitable to determine the distance to S0-2.

(3)

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(Total for question = 3 marks)

Q4.

The distance to astronomical objects relatively close to the Sun is determined using trigonometric parallax. For objects beyond a certain distance standard candles are used.

(a) State what is meant by a standard candle.

(1)

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(b) Explain why trigonometric parallax is not used beyond a certain distance.

(2)

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(c) Describe how distances too large for the use of standard candles can be determined.

(3)

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(Total for question = 6 marks)