19 The spectrum of light emitted by the star Chi Lupi provides evidence of mercury atoms in the outer layers of the star. The light emitted from the star is compared with light emitted from a mercury lamp on Earth.

(a) The lamp contains 1.65×10^{19} mercury atoms in a volume of $1.50 \times 10^{-5}\,m^3$. The pressure of the mercury vapour is $4.25 \times 10^{4}\,Pa$.

Calculate the mean kinetic energy of the mercury atoms.

(3)

Mean kinetic energy of mercury atoms = ...

(b) One line in the spectrum of light from Chi Lupi has a wavelength of 576.933 nm. The equivalent line in a mercury spectrum produced on Earth is 576.959 nm.

A student concluded from this data that Chi Lupi is moving towards the Earth, and that the relative velocity of Chi Lupi is about $1400\,m\,s^{-1}$.

Deduce whether the student's conclusions are correct.

(4)

(c) The surface temperature of Chi Lupi is twice the surface temperature of the Sun.
The radius of Chi Lupi is three times the radius of the Sun.

State where Chi Lupi would be located on the Hertzsprung-Russell diagram.

(1)

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(Total for Question 19 = 8 marks)