4 Evidence to support the Big Bang theory comes from cosmological microwave background radiation and the relative abundance of hydrogen and helium in the Universe.

(a) Explain what is meant by cosmological microwave background radiation and how its existence supports the Big Bang theory.

Cosmic microwave background radiation is microwave e/m radiaiton that comes from all parts of the universe

the has a peak in the microwave part of the spectrum at around 2.7K

though this has been red shifted to longer wavelengths suggesting that everything is moving away/expanding

It is the remnant left over from the big bang

(3)

(b) Explain how the relative abundance of hydrogen and helium supports the Big Bang theory.

When the universe was young and hot there was a brief period when fusion of hydrogen nuclei to form helium.

As universe expanded it cooled, and this fusion stopped to quickly for the formation of larger nuclei.

This explains the abundance of H/He as around 3:1

(3)

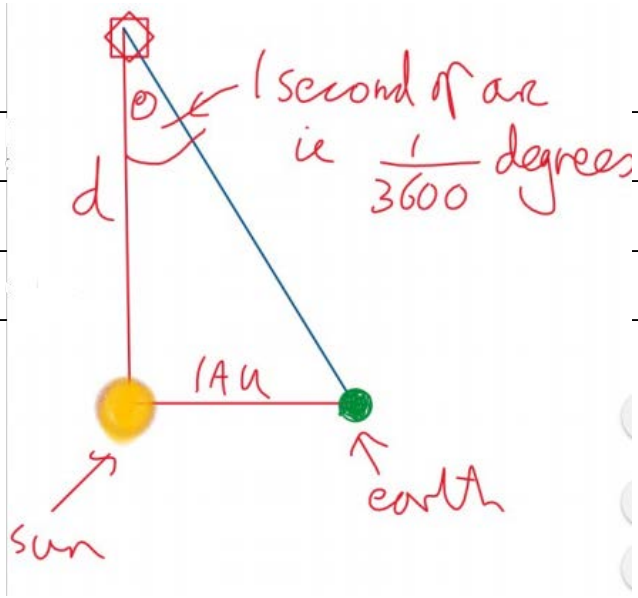
(Total 6 marks)

7 The table summarises some of the properties of four stars in the constellation Hercules.

Star	Distance/pc	Spectral class	Apparent magnitude
Kornephoros	43	G	2.8
Rasalgethi	110	M	3.0
Rutilicus	11	G	2.8
Sarin	23	A	3.1

(a) Define the parsec. You may use a diagram as part of your answer.

distyance at which 1AU (earth to sun distance) subtends 1/3600 (1 arc second) of a degree



(2)

(b) Deduce which star is larger, Kornephoros or Rutilicus.

K and R are the same spectral class meaning they one of the some temperature
They have similarapparent magnitudes despite k being a lot further away & so k mint have a greater power output/ absolute magnitude

$P = \sigma A T^4$ ← temp ⇒ $P \propto A$

Power ↑ const ↑ surface area

so as power is proportional to area (surface) K must be bigger

(3)

(c) One of the four stars has the peak in its black-body radiation curve at a wavelength of 1.0 μm.

Calculate the corresponding temperature for this curve.

$\lambda_{max} T = 2.9 \times 10^{-3}$

temperature = 2900 K

(2)

(d) Explain which star produced the black-body radiation curve described in question (c).

R ~ it is an M class star which is around 3000k on the H-R diagram

(2)

(e) Which star has the brightest absolute magnitude?

Tick (✓) the correct box.

Kornephoros	☐
Rasalgethi	☑
Rutilicus	☐
Sarin	☐

all about same apparent mag & R bit further away

(1)

(f) Determine the absolute magnitude of Sarin.

$m - M = 5 \log\left(\frac{d}{10}\right)$ 23

3.1

absolute magnitude = _____

(3)

(Total 13 marks)

$3.1 - M = 1.8$

$3.1 = 1.8 + M$ $\therefore M = 1.3$

10 Two methods involved in the detection of exoplanets are the radial velocity method and the transit method.

(a) Explain what is meant by the transit method of detection.

As planet passes in front of the star so its apparent magnitude drops.
We see a light curve which has a periodic dip in a constant value as the planet passes in front or star absorbing some of its light

(3)

(b) Explain why it is important that there is more than one method of detection.

dip could be caused by some other effect
planet can take many years to orbit star, so going to take ages to check results

(2)

(Total 5 marks)

11 (a) Sketch a Hertzsprung−Russell diagram on the axes on the graph below. Label the position of the main sequence, white dwarf and giant stars.

(3)

(b) Label the minimum and maximum values on the scale of each axis.

(2)

(c) Some of the properties of three stars are shown in the table below.

	Rigel	**Omicron 2 Eridani**	**Regulus A**
distance/light year	860	16.5	79
apparent magnitude	0.13	9.5	1.3
temperature/K	12 000	16 500	12 500

O B A F G K M

Identify the spectral class to which all three stars belong.

Tick (✓) the correct answer in the right hand column.

11,000 - 25,000 K →

	✓ if correct
A	
B	✓
F	
G	
K	
M	
O	

All temps in same group

(1)

(d) Explain your answer to part **(c)**.

All Temps are in the same band which is 11×10^3 → 25×10^3 Kelvin

(2)

(e) The three stars belong to different parts of the Hertzsprung−Russell diagram.

Deduce which star is a white dwarf.

White dwarf his lowest M
Omicron 2 has lowest m despite being the nearest so it is the WD

(3)

(Total 11 marks)

(2)