

6.2 Stars and the Universe

01.0625_m23_qp_42 Q: 10

- (a) The time taken for Mars to orbit the Sun is 690 Earth days. The average orbital radius of Mars is 2.28×10^8 km. An Earth day is 24 h.

Calculate the average orbital speed of Mars in km/s.

average speed = [3]

- (b) State the shape of the orbits of the planets.

..... [1]

- (c) Light from a distant galaxy is redshifted.

- (i) Explain what is meant by redshift.

.....

..... [2]

- (ii) State the quantity that the redshift of a galaxy is used to calculate.

..... [1]

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02. 0625_s23_qp_42 Q: 10

- (a) State the equation that defines the average orbital speed v of a planet. State the meaning of any symbols you use.

.....
..... [2]

- (b) Suggest why countries that are a significant distance from the Equator experience significant temperature variation throughout the year.

.....
.....
..... [1]

- (c) Fill in the gaps in the paragraph about a star much more massive than the Sun.

The stage that follows the stable state in the life cycle of the star is the

..... stage.

It then explodes as a supernova to form a, this leaves behind a

..... or a

[4]

- (d) A galaxy is moving away from the Earth with a speed of 33 000 km/s. The value of the Hubble constant is 2.2×10^{-18} per second.

Calculate the distance from the galaxy to the Earth. Give your answer in light-years.



distance = light-years [2]

03.0625_s23_qp_43 Q: 10

(a) Show that 1 light-year = 9.5×10^{15} m.

[4]

(b) (i) State **one** measurement that is taken when determining the speed v at which a galaxy is moving away from the Earth.

.....

..... [1]

(ii) Write down an equation relating v and the distance d of a far galaxy.

..... [1]

(iii) State how the distance d of a far galaxy can be determined other than by using the equation in (ii).

.....

..... [1]

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04. 0625_w23_qp_41 Q: 10

The Milky Way is one of many billions of galaxies. Each galaxy contains many billions of stable stars.

- (a) Stable stars transfer energy into space by emitting electromagnetic radiation from their surfaces.

Describe what happens in the core of a stable star to release energy that is eventually transferred into space.

.....
.....
.....
..... [3]

- (b) On the Earth, light from a distant galaxy is observed and analysed by astronomers. This information is used to determine the speed at which the galaxy is moving away from the Earth.

- (i) Describe how the observed light is different from when it was emitted.

.....
.....
..... [2]

- (ii) State the quantity that astronomers use to determine the speed at which the galaxy is moving away.

..... [1]

- (c) The Hubble constant H_0 is equal to 2.2×10^{-18} per second.

- (i) Calculate the distance from the Earth of a galaxy that is moving away at a speed of 1.3×10^7 m/s.

distance = [2]

- (ii) Calculate an estimate for the age of the Universe. Give your answer in years.

age of the Universe = years [2]

05.0625_w23_qp_42 Q: 10

Complete the sentences about the life cycle of stars.

(a) Protostars are formed from
..... [1]

(b) A protostar becomes a stable star when
.....
is balanced by
..... [2]

(c) The initial fuel used to power nuclear reactions in stars is [1]

(d) Stars that are approximately the same size as the Sun become red giant stars which then
form a
with a white dwarf star at its centre. [1]



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06. 0625_w23_qp_43 Q: 10

(a) (i) 1. State what is represented in space physics by the symbol H_0 .
..... [1]

2. Write down the equation that defines H_0 in terms of the speed that a far galaxy is moving away from the Earth and its distance from the Earth.
..... [1]

(ii) The numerical value of H_0 is 2.2×10^{-18} . State the unit of H_0 .
..... [1]

(iii) Use this value of H_0 to determine an estimate for the age of the Universe in seconds.

age of the Universe = s [2]

(b) State when cosmic microwave background radiation (CMBR) was formed and where we detect it coming from.

.....
.....
.....
..... [2]



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