6. Space physics

6.2 Stars and the Universe

Paper 3 and 4

Question Paper

Paper 3

Questions are applicable for both core and extended candidates

1 **(b)** Describe how the planets in the Solar System were formed.
Use your ideas about the accretion model. You may draw a diagram as part of your answer.

.....

.....

.....

.....

.....

..... [4]

[Total: 6]

2 **(a)** The Sun is the star in our Solar System. Eight planets orbit the Sun.

State the names of **two** other categories of bodies in the Solar System.

1 .....

2 .....

[2]

(b) State the name of the galaxy that includes our Solar System.

..... [1]

(c) Describe how the light from distant galaxies gives evidence to support the Big Bang Theory.

.....

.....

.....

.....

..... [3]

[Total: 6]

3 Fig. 11.1 shows the Sun and the four innermost planets, A, B, C, and D, of the Solar System.

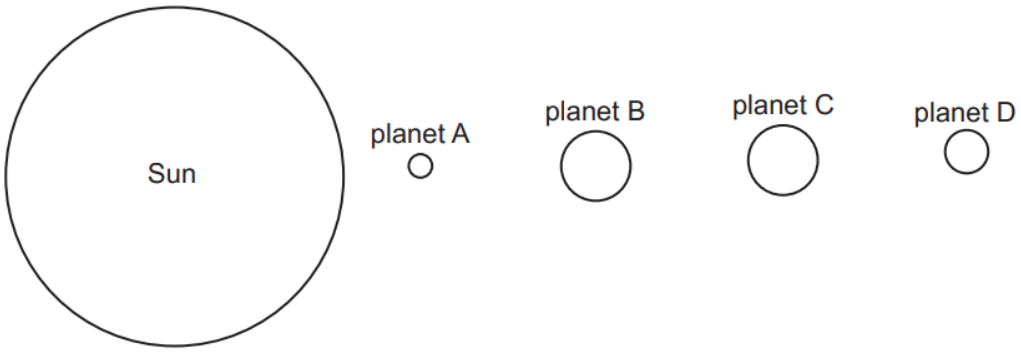

Fig. 11.1 (not to scale)

(b) Describe how the four innermost planets of the Solar System were formed.

.....

.....

.....

..... [4]

[Total: 6]

Paper 4

Questions are applicable for both core and extended candidates unless indicated in the question

4 The Sun is one of many billions of stars in the Milky Way. The Sun emits a very large quantity of energy as electromagnetic radiation.

(a) State the **three** regions of the electromagnetic spectrum in which the Sun emits the most energy.

1 .....

2 .....

3 .....

[2]

(b) Electromagnetic radiation from the Sun travels at a speed of 3.0×10^8 m/s. The radiation takes 500 s to reach the Earth.

Calculate the distance from the Sun to the Earth.

distance = ... [2]

(c) Approximately 4.6 billion years ago, the Sun formed from an interstellar cloud of gas and became a stable star.

(i) Describe and explain what happens as an interstellar cloud of gas forms a protostar.
(extended only)

.....

.....

..... [2]

(ii) Describe and explain what happens as a protostar becomes a stable star.
(extended only)

.....

.....

.....

..... [3]

[Total: 9]

5 **(a)** Name the galaxy that contains the Sun.

..... [1]

(b) Light observed from distant galaxies is redshifted.

State the theory of the Universe that this observation supports.

..... [1]

(c) Cosmic microwave background radiation (CMBR) is observed at all points in space.

(i) State when this radiation was produced. **(extended only)**

..... [1]

(ii) Explain why this radiation is now in the microwave region of the electromagnetic spectrum. **(extended only)**

.....

..... [2]

[Total: 5]

6 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. **(extended only)**

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. **(extended only)**

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

age of the Universe = ... years [2]

[Total: 10]

7 Complete the sentences about the life cycle of stars.

(a) Protostars are formed from ..... (extended only)

..... [1]

(b) A protostar becomes a stable star when ..... (extended only)

.....

is balanced by .....

.....

[2]

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

(d) Stars that are approximately the same size as the Sun become red giant stars which then form a ..... (extended only)

with a white dwarf star at its centre. [1]

[Total: 5]

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

.....

..... [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. **(extended only)**

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. **(extended only)**
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]

[Total: 9]

9 The Milky Way is the galaxy in which the Solar System is located.

(a) State what a galaxy is.

.....

..... [1]

(b) The Milky Way has a diameter that is approximately equal to 100 000 light-years.

Determine this distance in kilometres (km).

distance = ... km [2]

(c) Astronomers determine the speed and distance from the Earth of a far galaxy that is moving away from the Earth.

(i) State **one** observation that allows the speed at which a galaxy is moving away to be determined. **(extended only)**

.....

..... [1]

(ii) State **one** different observation that is used to determine the distance to a far galaxy. **(extended only)**

.....

..... [1]

(iii) State how the speeds of galaxies and their distances from the Earth are related. **(extended only)**

.....

..... [1]

(iv) The best estimate for the Hubble constant H_0 is 2.2×10^{-18} per second.

Use this value to calculate an estimate for the age of the Universe. **(extended only)**

age of the Universe = ... s [2]

[Total: 8]