Space physics – 2023 June O Level 5054

1. June/2023/Paper_ 5054/11/No.39
   It takes 27 days for the Moon to orbit the Earth.

   The average value of the radius of the Moon's orbit is 3.8×10^8 m.

   What is the average orbital speed of the Moon?

   A 160 m/s

   B 1000 m/s

   C 1.4×10^8 m/s

   D 8.8×10^8 m/s

2. June/2023/Paper_ 5054/11/No.40
   What is the nuclear reaction that takes place in stable stars?

   A   fission of helium to produce hydrogen

   B   fission of hydrogen to produce helium

   C   fusion of helium into hydrogen

   D   fusion of hydrogen into helium

3. June/2023/Paper_ 5054/12/No.39
   In which region of the electromagnetic spectrum does the Sun radiate the most energy?

   A   infrared region

   B   microwave region

   C   radio wave region

   D   X-ray region

4. June/2023/Paper_ 5054/12/No.40

Four of the stages in the life cycle of a star, until it becomes a red giant, are shown.

W   Inward force of gravitational attraction is balanced by an outward force from its centre.

X   Internal gravitational collapse produces an increase in temperature.

Y   It expands.

Z   Most of the hydrogen has been converted to helium.

In which order do these stages occur, starting with the earliest?

A   W → X → Y → Z

B   W → X → Z → Y

C   X → W → Y → Z

D   X → W → Z → Y

5. June/2023/Paper_ 5054/21/No.11

Table 11.1 shows details about eight planets in the solar system, their average distance from the Sun, their orbital period and their average surface temperature.

Table 11.1

planet	distance from the Sun/km	orbital period/s	average surface temperature/°C
....	5.8×10^7	7.6×10^6	167
Venus	1.1×10^8	1.9×10^7	464
Earth	1.5×10^8	3.2×10^7	15
Mars	2.3×10^8	5.9×10^7	−65
....	7.8×10^8	3.7×10^8	−110
Saturn	1.4×10^9	9.3×10^8	−140
....	2.9×10^9	2.6×10^9	−195
Neptune	4.5×10^9	5.2×10^9	−200

(a) Complete Table 11.1 by adding the names of the three planets that are not given. [2]

(b) Calculate the orbital speed of Mars as it travels around the Sun.

orbital speed = ... km/s [2]

(c) Describe the relationship between the distance of a planet from the Sun and its orbital period.

....

.... [1]

(d) Describe the relationship between the distance from the Sun and the average surface temperature of a planet.

In your description, include any anomalies.

....

....

.... [2]

[Total: 7]

6. June/2023/Paper_ 5054/22/No.10

   (a) Astronomical distances are measured in light-years.

      (i) State what is meant by 'a light-year'.

         ....

         .... [1]

      (ii) The Sun is one star in the Milky Way galaxy.

         State the approximate diameter of the Milky Way galaxy.

                 diameter of Milky Way = ... light-years [1]

   (b) There are several stages in the life cycle of a star.

      (i) Complete Fig. 10.1 to show the stages that a **massive** star goes through after it has used up most of the hydrogen at the centre of the star.

         Use words from the following list:

nebula   **neutron star**   **protostar**   **red giant**   **supernova**   **white dwarf**

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        ┌─────────────────────────┐
        │  massive star (much larger │
        │      than our Sun)       │
        └─────────────────────────┘
                    ▼
        ┌─────────────────────────┐
        │     red supergiant      │
        └─────────────────────────┘
                    ▼
        ┌─────────────────────────┐
        │                         │
        │  .....................  │
        └─────────────────────────┘
                    ▼
┌───────────────────────────────────────────────┐
│                                               │
│  ..................... and black hole or ..................... │
└───────────────────────────────────────────────┘
```
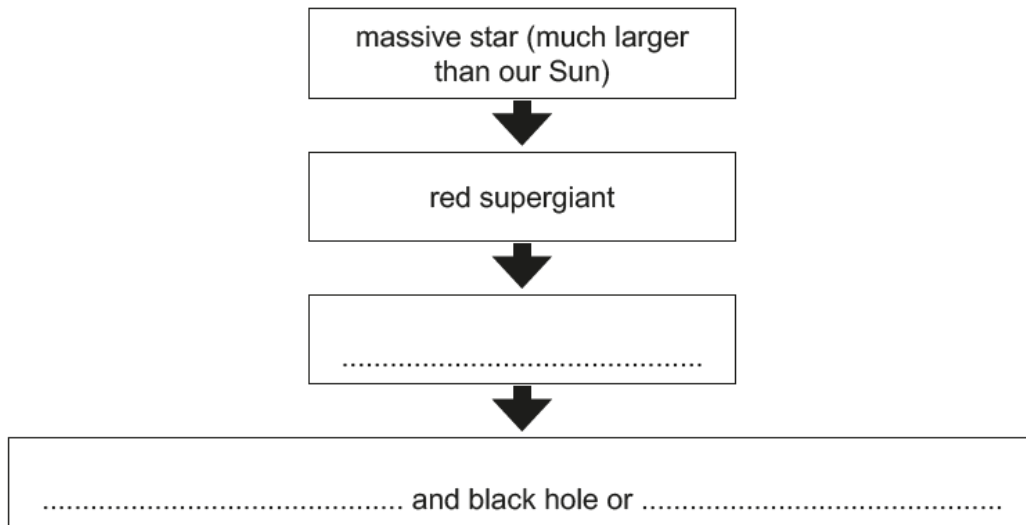
Fig. 10.1

                                                             [2]

      (ii) State the stage in the life cycle of a star where heavy elements are formed.

         .... [1]

(c) Current scientific understanding is that the universe began 14 billion years ago in an event known as the Big Bang.

Explain **one** observation that supports the Big Bang Theory.

observation ....

....

explanation ....

....

....

....

....

....

[4]

[Total: 9]