

Name of the Student: _____

Max. Marks : 18 Marks

Time : 18 Minutes

Q1.

- (a) Brown dwarf stars are thought to have been formed in the same way as other stars. They are too small for nuclear fusion reactions to take place in them. Brown dwarf stars emit infrared radiation but are not hot enough to emit visible light.

- (i) Describe how a star is formed.

(2)

- (ii) Describe the process of nuclear fusion.

(1)

- (iii) Scientists predicted that brown dwarf stars existed before the first one was discovered in 1995.

Suggest **one** reason why scientists are now able to observe and identify brown dwarf stars.

(1)

- (b) In the 18th century some scientists suggested a theory about how the planets formed in the Solar System. The theory was that after the Sun formed, there were cool discs of matter rotating around the Sun. These cool discs of matter formed the planets. The scientists thought this must have happened around other stars too.

- (i) Thinking about this theory, what would the scientists have predicted to have been formed in other parts of the Universe?

(1)

- (ii) Since the 1980s scientists studying young stars have shown the stars to be surrounded by cool discs of rotating matter.

What was the importance of these observations to the theory the scientists suggested in the 18th century?

(1)

- (c) The Earth contains elements heavier than iron.

Why is the presence of elements heavier than iron in the Earth evidence that the Solar System was formed from material produced after a massive star exploded?

(1)

(Total 7 marks)

Q2.

- (a) There are many isotopes of the element molybdenum (Mo).

What do the nuclei of different molybdenum isotopes have in common?

(1)

- (b) The isotope molybdenum-99 is produced inside some nuclear power stations from the nuclear fission of uranium-235.

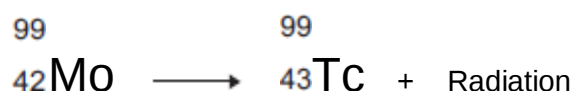
- (i) What happens during the process of nuclear fission?

(1)

- (ii) Inside which part of a nuclear power station would molybdenum be produced?

(1)

- (c) When the nucleus of a molybdenum-99 atom decays, it emits radiation and changes into a nucleus of technetium-99.



What type of radiation is emitted by molybdenum-99?

Give a reason for your answer.

(2)

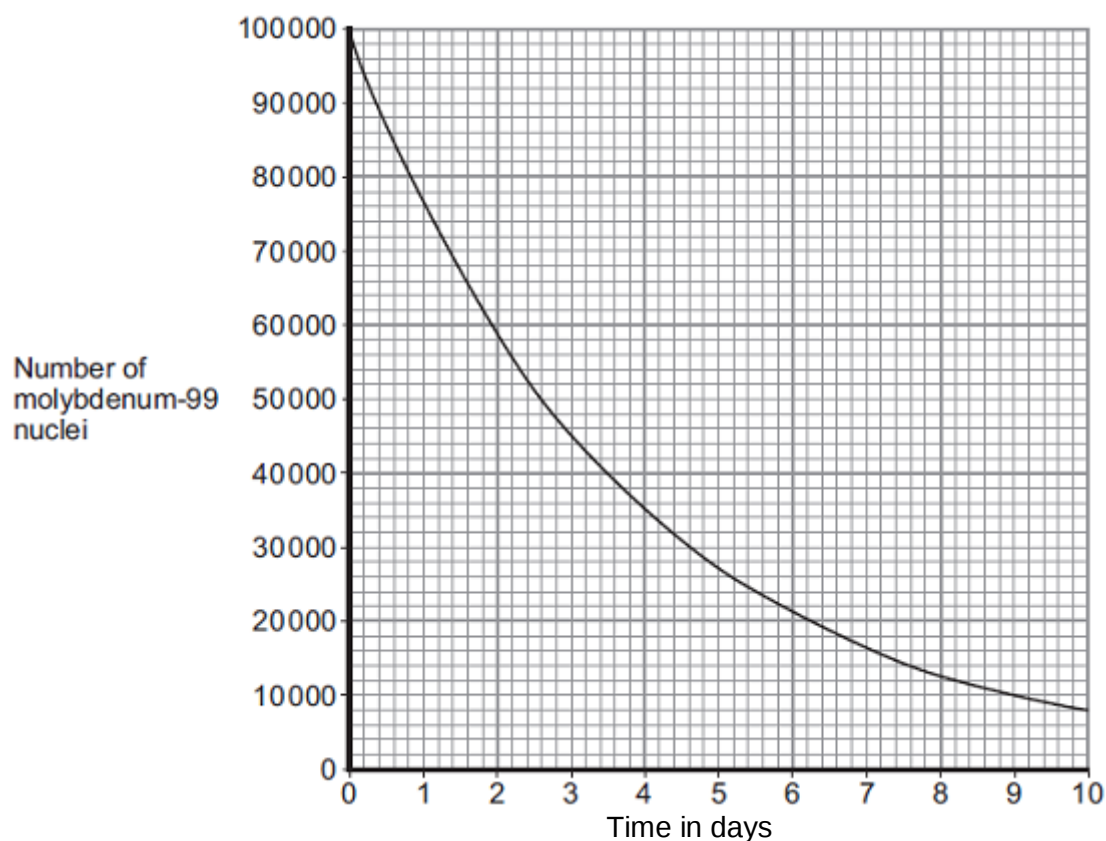
- (d) Technetium-99 has a short half-life and emits gamma radiation.

What is meant by the term 'half-life'?

(1)

- (e) Technetium-99 is used by doctors as a medical tracer. In hospitals it is produced inside a technetium generator by the decay of molybdenum-99 nuclei.

- (i) The figure below shows how the number of nuclei in a sample of molybdenum-99 changes with time as the nuclei decay.



A technetium generator will continue to produce sufficient technetium-99 until 80% of the original molybdenum nuclei have decayed.

After how many days will a source of molybdenum-99 inside a technetium-99 generator need replacing?

Show clearly your calculation and how you use the graph to obtain your answer.

Number of days = _____

(2)

- (ii) Medical tracers are injected into a patient's body; this involves some risk to the patient's health.

Explain the risk to the patient of using a radioactive substance as a medical tracer.

(2)

- (iii) Even though there may be a risk, doctors frequently use radioactive substances for medical diagnosis and treatments.

Suggest why.

(1)

(Total 11 marks)