Q1. *To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

Explain briefly how stars like the Sun are thought to have been formed.

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(Total 2 marks)

Q2. The table gives information about the three types of particle that make up an atom.

Particle	**Relative mass**	**Relative charge**
Proton		+1
Neutron	1	
Electron	very small	–1

(a) Complete the table by adding the **two** missing values.

(2)

(b) Use the information in the table to explain why an atom has no overall electrical charge.

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(2)

(c) Uranium has two natural isotopes, uranium-235 and uranium-238.
Uranium-235 is used as a fuel inside a nuclear reactor.
Inside the reactor, atoms of uranium-235 are split and energy is released.

(i) How is the structure of an atom of uranium-235 different from the structure of an atom of uranium-238?

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(1)

(ii) The nucleus of a uranium-235 atom must absorb a particle before the atom is able to split.

What type of particle is absorbed?

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(1)

(iii) The nucleus of an atom splits into smaller parts in a reactor.

What name is given to this process?

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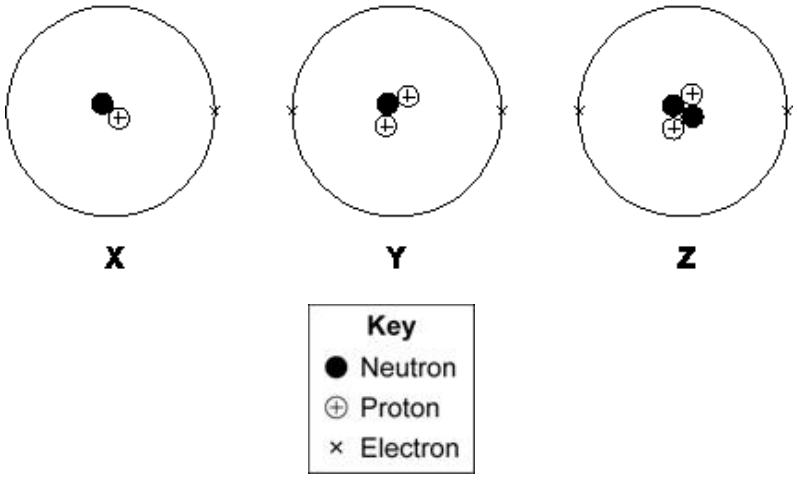
(1)

(Total 7 marks)

Q3. (a) The diagrams represent three atoms, **X**, **Y** and **Z**.



Which of these atoms are isotopes of the same element?

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Give a reason for your answer.

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(2)

(b) In a star, nuclei of atom **X** join to form nuclei of atom **Y**.

Complete the sentences.

The process by which nuclei join to form a larger nucleus is called

nuclear ..... .

This is the process by which a star releases ..... .

(2)

(c) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate*.

A star goes through a lifecycle.

Describe the lifecycle of a star like the Sun.

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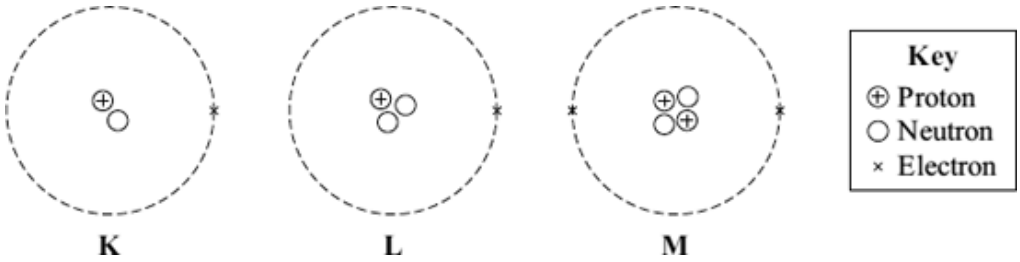
(6)
(Total 10 marks)

Q4. (a) The diagram represents 3 atoms, **K**, **L** and **M**.



(i) Which **two** of the atoms are isotopes of the same element?

..... and .....

(1)

(ii) Give a reason why the **two** atoms that you chose in part (a)(i) are:

(1) atoms of the same element .....

.....

(2) different isotopes of the same element. .....

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(2)

(b) The table gives some information about the radioactive isotope thorium-230.

mass number	230
atomic number	90

(i) How many electrons are there in an atom of thorium-230?

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(1)

(ii) How many neutrons are there in an atom of thorium-230?

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(1)

(c) When a thorium-230 nucleus decays, it emits radiation and changes into radium-226.

$$^{230}_{90}\text{Th} \longrightarrow {}^{226}_{88}\text{Ra} + \boxed{\text{Radiation}}$$

What type of radiation, alpha, beta or gamma, is emitted by thorium-230?

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Explain the reason for your answer.

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(3)
(Total 8 marks)

Q5. The process of nuclear fusion results in the release of energy.

(a) (i) Describe the process of nuclear fusion.

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(2)

(ii) Where does nuclear fusion happen naturally?

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(1)

(b) For many years, scientists have tried to produce a controlled nuclear fusion reaction that lasts long enough to be useful. However, the experimental fusion reactors use more energy than they produce.

(i) From the information given, suggest **one** reason why nuclear fusion reactors are not used to produce energy in a nuclear power station.

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(1)

(ii) Suggest **one** reason why scientists continue to try to develop a practical nuclear fusion reactor.

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(1)

(c) In 1989, two scientists claimed in a daily newspaper that they had produced nuclear fusion reactions in normal laboratory conditions. The process became known as 'cold fusion'. Other scientists thought that the evidence produced to support 'cold fusion'was unreliable.

(i) Suggest **one** reason why other scientists thought that the evidence to support 'cold fusion' was unreliable.

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(1)

(ii) In 2007, the results of a new 'cold fusion' research project were published in a respected scientific journal. This journal includes scientists such as Albert Einstein amongst its past authors.

Suggest why people may be more likely to believe an article published in a respected scientific journal than one published in a daily newspaper.

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(1)
(Total 7 marks)

Q6. (a) Nuclear fission is used in nuclear power stations to generate electricity. Nuclear fusion happens naturally in stars.

(i) Explain briefly the difference between *nuclear fission* and *nuclear fusion*.

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(2)

(ii) What is released during both nuclear fission and nuclear fusion?

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(1)

(b) Plutonium-239 is used as a fuel in some nuclear reactors.

(i) Name another substance used as a fuel in some nuclear reactors.

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(1)

(ii) There are many isotopes of plutonium.

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

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(1)
(Total 5 marks)

Q7. Stars go through a life cycle. About 90 % of all stars are in the 'main sequence' period of the life cycle.

(a) Stars are stable during the 'main sequence' period of the life cycle.

Why?

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(1)

(b) The table gives an estimated time for the number of years that three stars, **X**, **Y** and **Z**, will be in the 'main sequence' period of their life cycle.

Star	Relative mass of the star compared to the Sun	Estimated 'main sequence' period in millions of years
X	0.1	4 000 000
Y	1.0	9 000
Z	40.0	200

(i) This data suggests that there is a pattern linking the mass of a star and the number of years the star is in the 'main sequence' period of its life cycle.

What is the pattern suggested by the data?

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(1)

(ii) Scientists cannot give the exact number of years a star will be in the 'main sequence' period.

Suggest why.

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(1)

(iii) Nuclear fusion is the process by which energy is released in stars.

Which **one** of the following can be concluded from the data in the table?

Draw a ring around the correct answer in the box to complete the sentence.

The rate of nuclear fusion in a large star is

faster than
the same as
slower than

in a small star.

Explain the reason for your answer.

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(3)

(c) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate*.

Describe what happens to a star **much bigger** than the Sun, once the star reaches the end of the 'main sequence' period of its life cycle.

Your answer should include the names of the stages the star passes through.

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(6)

(Total 12 marks)