Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Q1.

A student used a Geiger-Müller (GM) tube to determine the activity of a radium source. Radium emits α, β, and γ radiation.

He positioned the source 20 cm from the GM tube, as shown, and recorded the count for 1 minute. He repeated the measurement and calculated a mean count.



The student recorded the following results.

Count 1	Count 2	Mean count
183	178	181

From his results the student determined that the activity of the source was 3.0 Bq.

Comment on his value for the activity of the source.

(5)

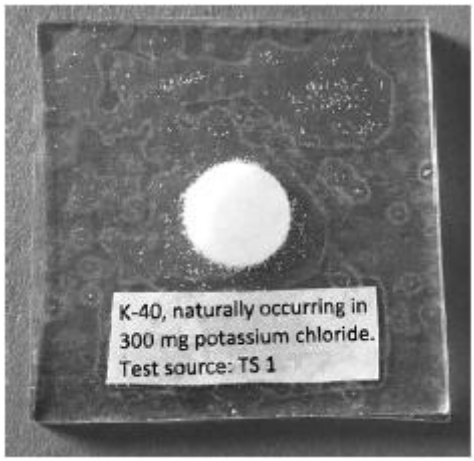
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(Total for question = 5 marks)

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Q2.

A school science department keeps a sample of potassium chloride to use as a test source for Geiger-Müller tubes.



Potassium contains 0.012% of the unstable isotope potassium-40.

The science department also has a sample of strontium-90. This undergoes beta decay with a half-life of 29 years.

State why the half-life of potassium-40 makes the potassium chloride a more suitable material than strontium-90 for the test.

(1)

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(Total for question = 1 mark)

Q3.

In a nuclear fission reaction in power station, a slow-moving neutron is absorbed by a nucleus of U-235
The fission reaction produces nuclei of barium-141 and krypton-92

The equation for the reaction is:

$$^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{141}_{56}\mathrm{Ba} + {}^{92}_{36}\mathrm{Kr} + 3 \times {}^{1}_{0}\mathrm{n}$$

Use the data in the table to calculate the energy, in joules, released in this fission reaction.

(3)

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	Mass/u
neutron	1.008665
uranium-235	235.0439
barium-141	140.9144
krypton-92	91.9262

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Energy = ... J

(Total for question = 5 marks)

Q4.

(a) In 1939 Hans Bethe published a paper describing the fusion processes in stars.

In the proton-proton cycle, hydrogen is converted to helium in stages. The nuclear equation below represents one of the stages.

$$^{7}_{3}\mathrm{Li} + \,^{\cdots\cdots}_{\cdots\cdots}\mathrm{X} \rightarrow 2 \times {}^{4}_{2}\mathrm{He}$$

(i) Complete the equation and identify X.

(2)

X is .....

(ii) Calculate, in joules, the energy emitted in this stage of the cycle.

(3)

	Mass / MeV/c^2
Proton	938.3
Neutron	939.6
Helium	3727.4
Lithium	6533.8

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Energy = ... J

(b) In 1967 Bethe received a Nobel Prize in Physics for his work on understanding the fusion processes in stars. Explain why sustainable fusion has not yet been achieved for the generation of electrical power.

(4)

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(Total for question = 9 marks)

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