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

Q1.

Nuclear fusion involves small nuclei joining to make larger nuclei. Nuclear fission involves large nuclei splitting to become smaller nuclei. Both of these processes release energy.

Explain the conditions required to bring about and maintain nuclear fusion.

(3)

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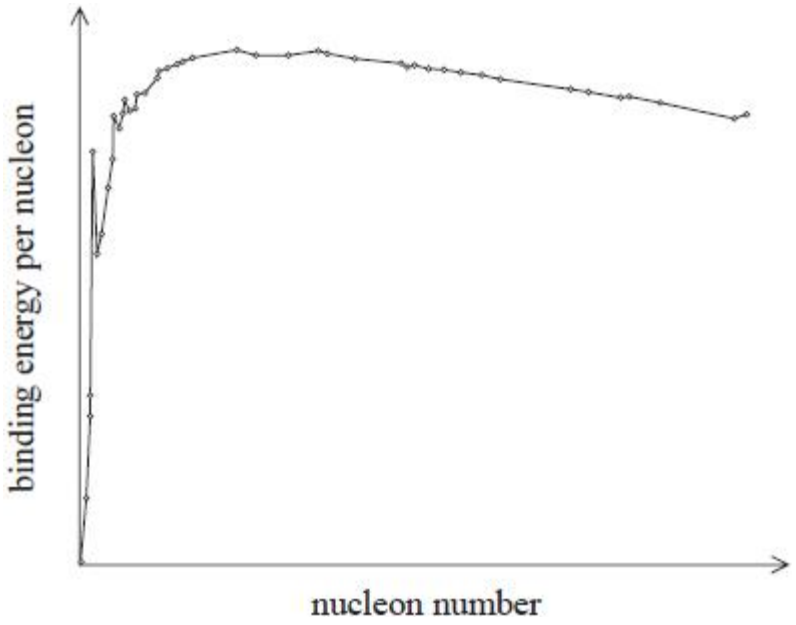
(Total for question = 3 marks)

Q2.

Nuclear fusion involves small nuclei joining to make larger nuclei. Nuclear fission involves large nuclei splitting to become smaller nuclei. Both of these processes release energy.

The graph shows how the binding energy per nucleon varies with nucleon number for a range of isotopes.



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Use the binding energy per nucleon curve to explain how fusion and fission both release energy.

(3)

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(Total for question = 3 marks)

Q3.

The photograph shows a tea cup on a saucer.

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A student notices that walking with this sort of tea cup when it is filled with tea is particularly difficult to do without spilling it.

While walking, the tea starts to oscillate from side to side in the cup, rapidly increasing in amplitude and spilling over the edge.

The student develops the hypothesis that spillage occurs most when the frequency of the steps taken by a person matches the natural frequency of oscillation of tea in the cup.

(a) Explain whether the student's hypothesis is supported by relevant physics.

(4)

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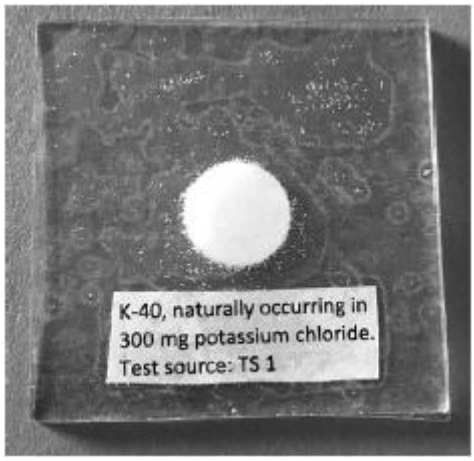
(Total for question = 4 marks)

Q4.

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.

A teacher makes some measurements using the potassium chloride test source to determine whether a Geiger-Müller tube is sufficiently efficient at detecting β radiation.

(i) The potassium chloride sample has a mass of 300 mg.

Show that the number of nuclei of potassium-40 in the sample is about 3×10^{17}.
number of potassium nuclei in 1 g of potassium chloride = 8.1×10^{21}

(2)

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(ii) Show that the activity of this sample is about 5 Bq.

half-life of potassium-40 = 1.25×10^{9} years

(3)

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(iii) With no sample in front of the Geiger-Müller tube, a count rate of 15 counts per minute is recorded. When the potassium chloride test sample is placed next to the Geiger-Müller tube 176 counts are recorded in a period of 10 minutes.

A detector is considered efficient if it detects at least 7.5% of beta emissions from the source.
Determine whether this Geiger-Müller tube can be considered efficient.

(3)

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(iv) Explain a possible reason why only a low proportion of the decays are detected.

(2)

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(Total for question = 10 marks)

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