Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic : 8_ Nuclear and Particle Physics

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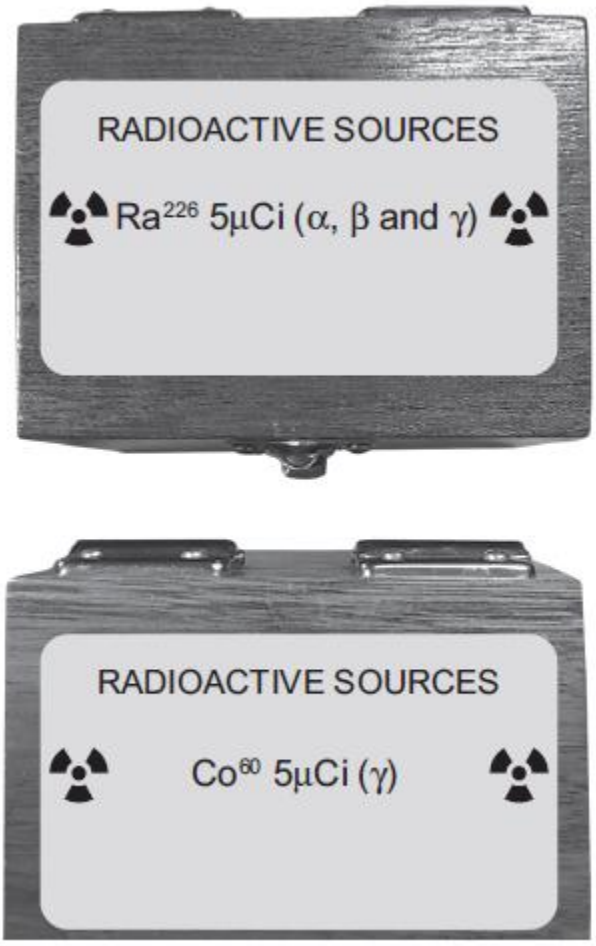
Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Q1.

The photograph shows the containers of two radioactive sources kept in a school.



The isotope Ra 226 undergoes a series of decays until it produces the stable isotope Pb 206.

Determine the number of α particles and β particles emitted during this process to complete the nuclear equation.

(3)

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$$^{226}_{88}\mathrm{Ra} \rightarrow {}^{206}_{82}\mathrm{Pb} + \underline{\quad} \times \alpha + \underline{\quad} \times \beta$$

Q2.

Tomatoes can be made into a puree.

The tomato puree has a mass of 0.444 kg and boils at 101°C. 175kJ of energy are supplied to bring it to its boiling point from a temperature of 21°C.

Determine the specific heat capacity of the puree.

(2)

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Specific heat capacity = ...

(Total for question = 2 marks)

Q3.

A high energy proton collides with a stationary proton and a π^0 particle is produced.
The equation for the reaction is

$$p + p \rightarrow p + p + \pi^0$$

(i) Explain why the proton must have a high energy in order for this reaction to occur.

(2)

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(ii) The rest mass of the π^0 is $\frac{1}{7}$ of the rest mass of a proton.
In this reaction the total kinetic energy of the particles decreases.
Calculate the minimum decrease in kinetic energy if the reaction is to occur.
rest mass of proton = 938 GeV/c^2

(2)

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Minimum decrease in kinetic energy = ...

Q4.

Phosphogypsum is a by-product in the manufacture of fertiliser. It is slightly radioactive because of the presence of radium-226, a radioisotope with a half-life of 1600 years.

It must be stored securely as long as the activity of the radium-226 it contains is greater than 0.4 Bq per gram of phosphogypsum.

Radium-226 decays to radon-222 by alpha emission.

Determine the energy released in MeV in the decay of a single nucleus of radium-226.

(5)

mass of radium-226 nucleus = 225.97713 u
mass of radon-222 nucleus = 221.97040 u
mass of α particle = 4.00151 u

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Energy released = ... MeV

(Total for question = 5 marks)

Q5.

A series of experiments was carried out in the 1970s to investigate the structure of protons using the linac at Stanford, USA.

* Explain how an electron is accelerated in a linac.

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(Total for question = 6 marks)