Practice Question Set For A-Level
Subject : Physics
Paper-2 Topic: Fields And Their Consequences(Nuclear Physics)

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

Q1.

An alpha particle is moving towards a stationary gold nucleus. The alpha particle has a kinetic energy of 9.0×10^{-13} J when it is a large distance from the gold nucleus.
The gold nucleus contains 79 protons.

What is the closest possible distance of approach of the alpha particle to the gold nucleus?

A 2.5×10^{-16} m ⬭
B 2.0×10^{-14} m ⬭
C 4.0×10^{-14} m ⬭
D 2.0×10^{-7} m ⬭

(Total 1 mark)

Q2.

After radioactive waste is removed from a cooling pond, it is often stored in underground caves.
This is to protect workers from the effects of

A alpha particles from nuclides with a large decay constant. ⬭
B alpha particles from nuclides with a small decay constant. ⬭
C gamma radiation from nuclides with a large decay constant. ⬭
D gamma radiation from nuclides with a small decay constant. ⬭

(Total 1 mark)

Q3.

Alpha particle scattering can be demonstrated using a thin gold foil.

Which statement about this demonstration is **not** true?

A The foil is thin enough to assume that alpha particles are deflected only once. ⬭
B Nuclei are more massive than alpha particles which allows the alpha particles to be deflected by more than ⬭

90°.

C The number of alpha particles deflected backwards is greater than the number that pass straight through the foil. ⬭

D Deflections of alpha particles by electrons in the foil are much smaller than deflections due to nuclei. ⬭

(Total 1 mark)

Q4.

The random nature of radioactive decay means that it is never possible to predict

A when a particular nucleus will decay. ⬭

B whether a β^- particle or a β^+ particle is emitted. ⬭

C the approximate time taken for the activity to decrease to a specified value. ⬭

D the approximate thickness of an absorber needed to reduce the count rate to a specified value. ⬭

(Total 1 mark)

Q5.

Radiation is used to measure the thickness of an aluminium sheet accurately.
The thickness of the sheet is about 0.5 mm.

Which type of radiation is most appropriate for the measurement?

A α ⬭

B β^- ⬭

C β^+ ⬭

D γ ⬭

(Total 1 mark)

Q6.

Tritium is a radioactive nuclide used in 'Exit' signs.
When a sign was manufactured the activity of the tritium in it was 37 MBq.
After 10 years the tritium in the sign has an activity of 21 MBq.

What will the activity be 15 years after it was manufactured?

A 12 MBq ⬭

B 13 MBq ⬭

C 16 MBq ⬭

D 17 MBq ⬭

(Total 1 mark)

Q7.

The mass of fuel in a nuclear reactor decreases at a rate of 4.0×10^{-6} kg per hour.

What is the rate at which energy is transferred due to nuclear fission?

A 4.0×10^{7} W ⬭

B 1.0×10^{8} W ⬭

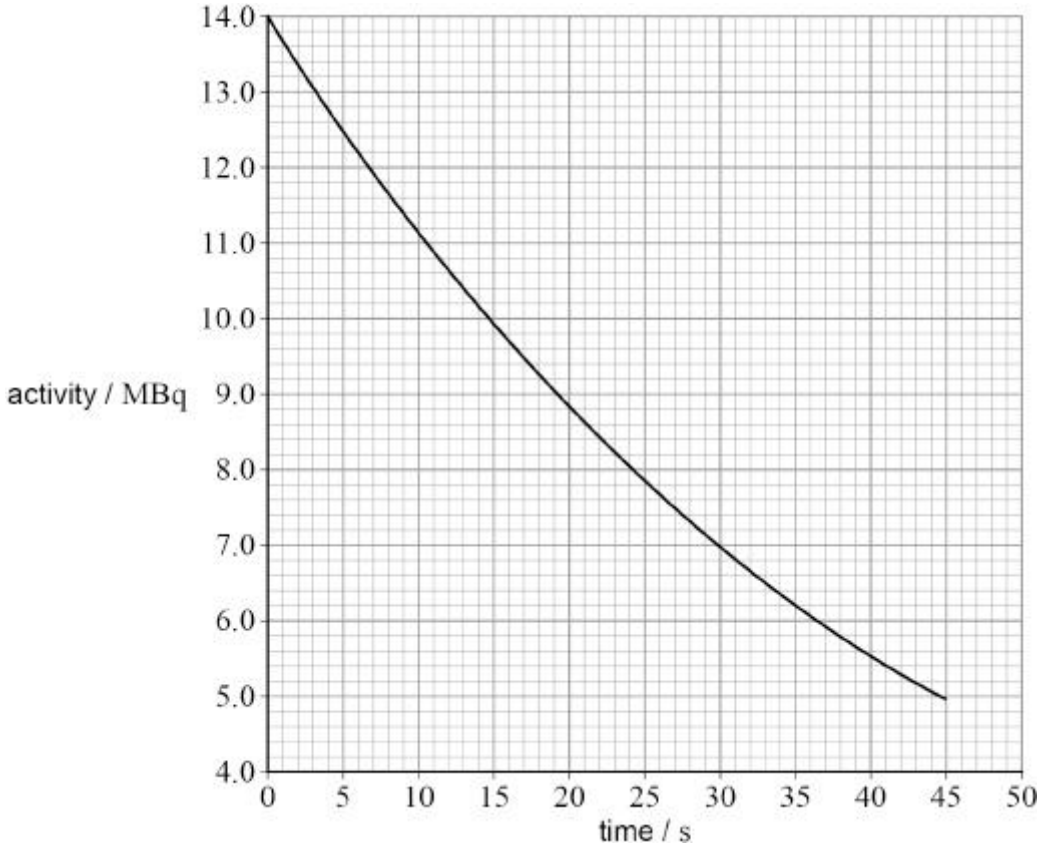
C 6.0×10^{8} W ⬭

D 3.6×10^{10} W ⬭

(Total 1 mark)

Q8.

The graph shows the variation of activity with time for a sample of a nuclide **X**.



What was the initial number of nuclei of **X** in the sample?

A 4.67×10^{5} ⬭

B 3.0×10^{8} ⬭

C 4.2×10^{8} ⬭

D 6.1×10^{8} ⬭

(Total 1 mark)

Q9.

What was deduced or observed in the Rutherford scattering experiment?

A All gold atoms are not alike. ⬭

B Alpha particles are helium nuclei. ⬭

C Some particles were deflected through angles greater than $90°$. ⬭

D The motion of most alpha particles was reversed. ⬭

(Total 1 mark)

Q10.

Which row is correct for α, β and γ radiation?

		α	β	γ	
A	Is it deflected by a magnetic field?	yes	yes	no	⬭
B	Is it deflected by an electric field?	yes	yes	yes	⬭
C	Does it have a positive charge?	yes	no	yes	⬭
D	Does it come from outside the nucleus?	no	yes	no	⬭

(Total 1 mark)

Q11.

A sample of radioactive material consists of 200 g of nuclide **P** and 100 g of nuclide **Q**.

Nuclide **P** has a half-life of 2 days and nuclide **Q** has a half-life of 4 days.

What is the total mass of nuclides **P** and **Q** after 12 days?

A 3.1 g ⬭

B 12.5 g ⬭

C 15.6 g ⬭

D 18.8 g ⬭

(Total 1 mark)

Q12.

A nuclide has a half-life of 10 ms.

The decay constant for this nuclide lies between

A $1\ s^{-1}$ and $10\ s^{-1}$. ⬭

B $10\ s^{-1}$ and $10^2\ s^{-1}$. ⬭

C $10^2\ s^{-1}$ and $10^3\ s^{-1}$. ⬭

D $10^3\ s^{-1}$ and $10^6\ s^{-1}$. ⬭

(Total 1 mark)

Q13.

Which provides evidence for the existence of energy levels in nuclei?

A the Rutherford alpha particle scattering experiment ⬭

B the existence of X-ray line spectra ⬭

C the existence of gamma radiation ⬭

D electron diffraction by crystals ⬭

(Total 1 mark)

Q14.

Which is **not** true for gamma radiation?

A It is more penetrating than alpha or beta radiation of the same energy through the same material. ⬭

B Its intensity is inversely proportional to the square of the distance from its source. ⬭

C It is emitted with discrete frequencies. ⬭

D When it is absorbed it makes the absorber radioactive. ⬭

(Total 1 mark)

Q15.

In a thermal reactor, induced fission occurs when a $^{235}_{92}U$ nucleus captures a neutron.

Which statement is true?

A The moderator absorbs excess neutrons. ⬭

B A large number of neutrons should be produced per fission to sustain the reaction. ⬭

C Slow neutrons are required for this induced fission. ⬭

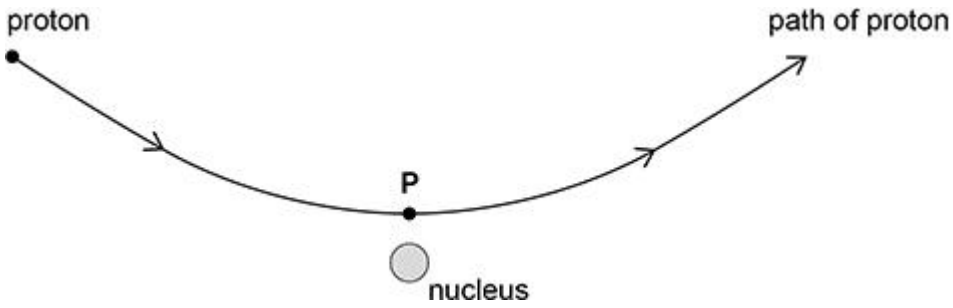
D The control rods slow down neutrons. ⬭

(Total 1 mark)

Q16.

The diagram shows the path of a proton being deflected by the nucleus of an atom.

Point **P** is the position of the proton when it is closest to the nucleus.



What is **not** true about the proton along its path at **P**?

A Its rate of change of momentum is at a minimum. ⬭

B Its kinetic energy is at a minimum. ⬭

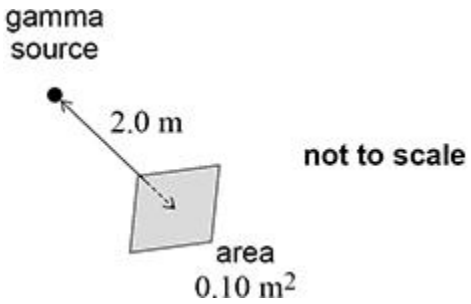
C Its potential energy is at a maximum. ⬭

D Its acceleration is at a maximum. ⬭

(Total 1 mark)

Q17.

The diagram shows an area of 0.10 m^2 normal to a line connecting it to a point source of gamma radiation. The source emits photons uniformly in all directions.
The area and the source are separated by a distance of 2.0 m.



The source emits 5000 gamma photons per second.

How many photons pass through the area every second?

A 500 ⬭

B 250 ⬭

C 10 ⬭

D 2.5 ⬭

(Total 1 mark)

Q18.

X and **Y** are two radioactive nuclides. **X** has a half-life of 3.0 minutes and **Y** has a half-life of 9.0 minutes.

Two freshly prepared samples of **X** and **Y** start decaying at the same time. After 18 minutes the

number of radioactive nuclei in both samples is the same. The sample of **Y** initially contained N radioactive nuclei.

What was the initial number of radioactive nuclei in the sample of **X**?

A $4N$ ⬭

B $16N$ ⬭

C $32N$ ⬭

D $64N$ ⬭

(Total 1 mark)

Q19.

What is the main purpose of a moderator in a thermal nuclear reactor?

A to shield the surroundings from ionising radiations ⬭

B to decrease the number of fission chain reactions ⬭

C to decrease neutron speeds ⬭

D to prevent the core from overheating ⬭

(Total 1 mark)

Q20.

In the core of a nuclear reactor, the mass of fuel decreases at a rate of 9.0×10^{-6} kg hour^{-1} due to nuclear reactions.

What is the maximum power output of the reactor?

A 2.3×10^{8} W ⬭

B 1.4×10^{11} W ⬭

C 8.1×10^{11} W ⬭

D 2.9×10^{15} W ⬭

(Total 1 mark)