Topic 3- Radioactivity and Half Life

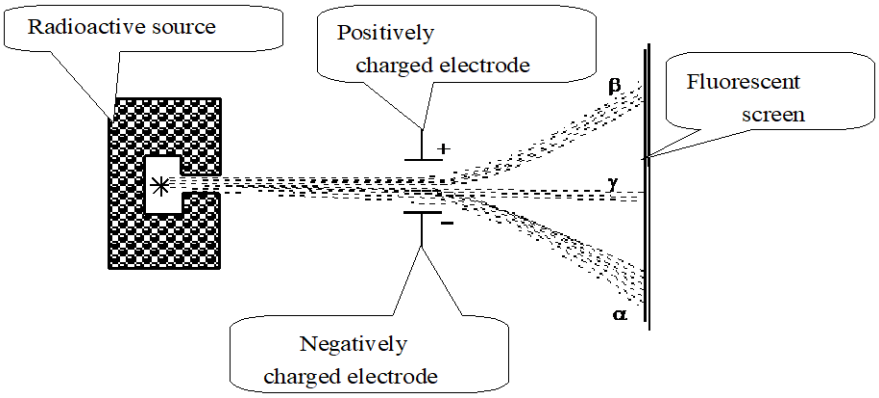
Multiple Choice

1. The following statements describe characteristics of alpha, beta, or gamma rays.
   1. They are attracted by the negative plate of an electric field.
   2. They are attracted by the positive plate of an electric field.
   3. They are associated with electrons.
   4. They are deflected by a magnetic field.

   Which of the characteristics above are associated with alpha rays?

   A) 1 and 3 B) 1 and 4 C) 2 and 3 D) 2 and 4

2. The diagram below shows the path of the alpha (α) particles, beta (β) particles and gamma (γ) rays emitted by a radioactive source during an experiment on radioactivity.



   What conclusion can you draw from this experiment?

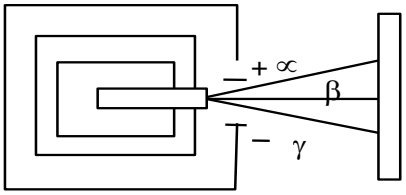
   A) The alpha (α) and beta (β) particles are positively charged.
   B) The alpha (α) particles and the gamma (γ) rays carry opposite charges.
   C) The alpha (α) particles, the beta (β) particles, and the gamma (γ) rays are negatively charged.
   D) The gamma (γ) rays carry no charges.

3. Becquerel's discovery of radioactivity led to an understanding of the properties and structure of matter. Which of the following statements best describes radioactive decay?

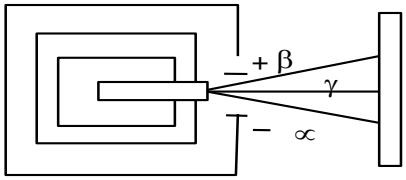
   A) Radioactive substances can emit neutral alpha particles, negatively charged beta particles, or positively charged gamma rays.
   B) Radioactive substances can emit negatively charged alpha particles, neutral beta particles, or positively charged gamma rays.
   C) Radioactive substances can emit positively charged alpha particles, neutral beta particles, or negatively charged gamma rays.
   D) Radioactive substances can emit positively charged alpha particles, negatively charged beta particles, or neutral gamma rays.

4. The following diagrams illustrate the paths of particles emitted from a radioactive source as they pass between charged plates. Which diagram shows the correct paths?

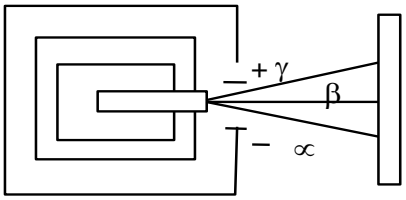
A)



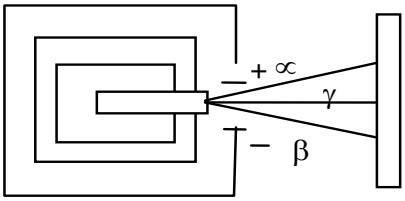
C)



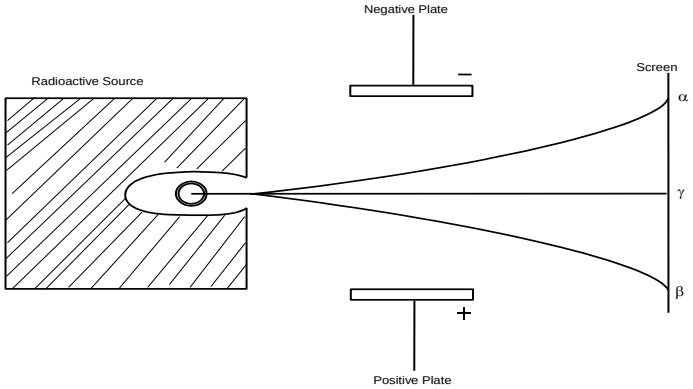
B)



D)



5. The diagram below illustrates the results of an experiment on radioactivity:



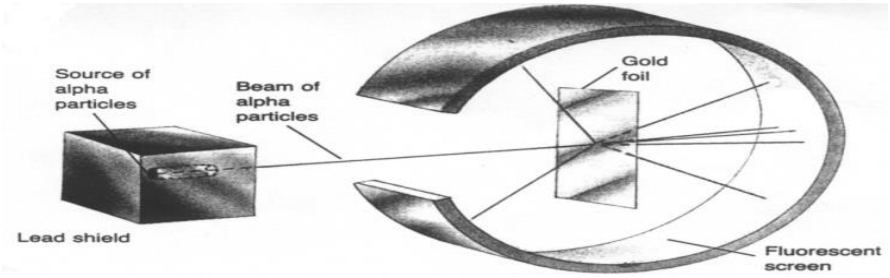
Which of the following conclusions can be drawn from this diagram?

A) The alpha and beta particles are electrically charged.
B) The atom contains a positive nucleus surrounded by negative electrons
C) The alpha and beta particles and the gamma rays can all penetrate matter.
D) The alpha and beta particles and the gamma rays all have different masses.

6. Which of the following best explains why a small number of alpha particles were weakly deflected during Rutherford's alpha scattering experiment?

A) These alpha particles collided with the positively charged nucleus.
B) These alpha particles were deflected because of electrical repulsion of the nucleus.
C) These alpha particles were deflected because they had a charge opposite to the nucleus.
D) These alpha particles were deflected because they collided with the electrons in the orbitals.

7. In Rutherford's experiment, a beam of alpha particles was directed at a very thin sheet of gold, as illustrated below.



What can be concluded from Rutherford's experiment?

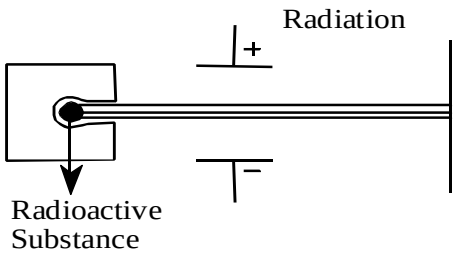
1. Electrons circulate in energy levels.
2. Atoms can lose or gain electrons.
3. An atom is mostly empty space.
4. The nucleus of an atom consists of protons.

A) 1 and 2 B) 1 and 3 C) 2 and 4 D) 3 and 4

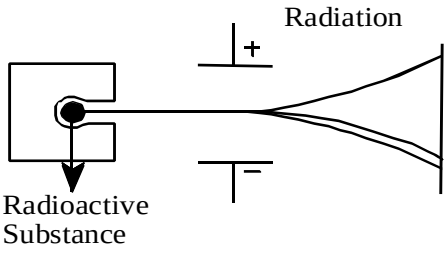
8. Radioactive substances emit three types of radiation : alpha, beta and gamma radiation. Scientists have observed that alpha radiation is attracted towards a negatively charged electrode and beta radiation is attracted towards a positive electrode. What do these observations permit us to conclude?
   A) Radioactive substances contain only radiation with a negative charge.
   B) Radioactive substances contain only radiation with a positive charge.
   C) Radioactive substances contain radiation with no charge.
   D) Radioactive substances contain radiation charged positively and radiation charged negatively

9. Which of the following diagrams accurately represents the behaviour of the different types of radioactivity?

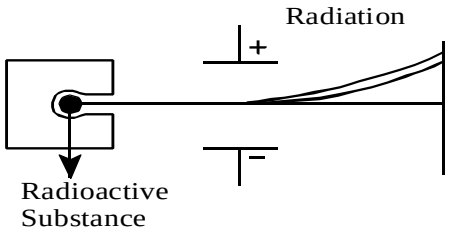
A)



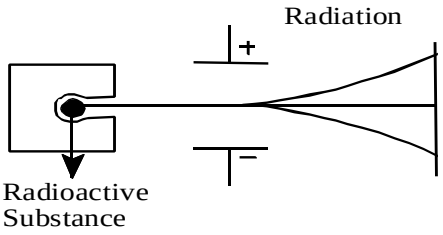
C)



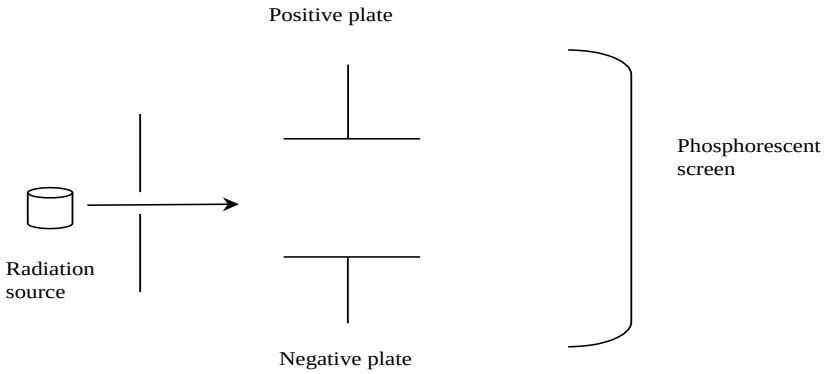
B)



D)



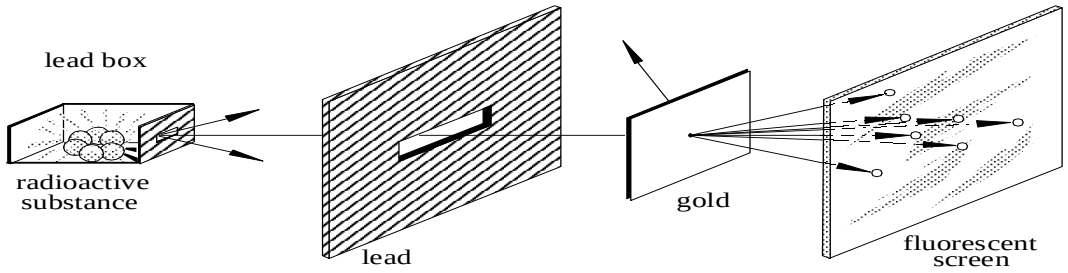
10. A radioactive source emits both beta, β, and gamma,γ, radiation. The radiation is focused into a beam and fired between two charged plates as shown in the diagram below.



What results would be expected?

A) β and γ radiation would pass straight through the plates with no deflection.
B) β and γ radiation would be deflected towards the negative plate.
C) Some radiation would be deflected towards the negative plate and some would pass straight through the plates.
D) Some radiation would be deflected towards the positive plate and some would pass straight through the plates.

11. The famous experiment that Rutherford carried out is illustrated by the following diagram



Taken from: Odyssée, Bandzuck C., Bélisle L., Valiquette P., ERPI, Montréal, 1991.

Which of the following statements is in agreement with Rutherford's results?

A) Most of the alpha particles are not deflected because the nucleus is composed of neutrons.
B) Most of the alpha particles are not deflected because the atom is composed mostly of empty space.
C) Most of the alpha particles are deflected because they are attracted to the nucleus.
D) Most of the alpha particles are deflected because they are repelled by the protons.

12. The alpha (α), beta (β) and gamma (γ) radiation emitted by radioactive matter have characteristic properties. Which of the following correctly matches the type of radiation with its charge?

A) alpha (α) = neutral
beta (β) = positive
gamma (γ) = negative

B) alpha (α) = neutral
beta (β) = negative
gamma (γ) = positive

C) alpha (α) = positive
beta (β) = negative
gamma (γ) = neutral

D) alpha (α) = negative
beta (β) = positive
gamma (γ) = neutral

13. Following a nuclear accident, environmentalists detected radiation that had the following characteristics:
    - It was attracted to a negative charge.
    - It was able to partially penetrate the walls of home.

    What is the name of this type of radiation?

    A) α rays B) β rays C) γ rays D) X rays

14. Radioactive isotopes can be used to date archaeological artefacts. Carbon 14, ^{14}C, is often used for this purpose. It was used to establish the date of the Viking artefacts found in Newfoundland. Which of the following statements best describes why ^{14}C is useful in dating historical artefacts?

A) ^{14}C is a radioactive isotope and decays over time with a predictable half-life.
B) ^{14}C is a radioactive isotope and accumulates over time with a predictable half-life.
C) ^{14}C is a radioactive isotope which is produced in artefacts as they decay.
D) ^{14}C is chemically unreactive and remains unchanged over time.

15. On April 26 1986, the Chernobyl nuclear power station in the Ukraine had a nuclear explosion. An enormous amount of cesium, a radioactive material with a half-life of 30 years was released into the atmosphere. Which statement best explains the implications of this nuclear disaster?

A) In 2016, the first half life for cesium occurred, this means that all the radioactive material was gone at this time.
B) In 2016, the first half life for cesium occurred, this means that most of the radioactive material was gone at this time.
C) In 2016, the first half life for cesium occurred, this means that half of the radioactive material was gone at this time.
D) In 2016, the first half life for cesium occurred, this means that very little radioactive material was gone at this time.

Short Answer

16. A researcher measures 200 counts per minute coming from a radioactive source at 12:00 pm (noon). At 3:00 pm, she finds that this has dropped to 50 counts per minute. Calculate the length of time for the half-life of the radioactive source.

17. 48g of P-32 decomposes until 3g remain. How much time has gone by? (half-life of P-32 is 14 days) .

18. What percent of a sample of "tritium" (H-3) remains after 60 yrs? (half-life of H-3 is 12 yrs)

19. Vicky, a breast cancer patient, was hospitalized on June 2 to receive a technetium treatment which has a half life of 6 hours. At 4:00 p.m. she received a 12-mg dose of technetium. Radiation levels around the patient are considered negligible when only 1.5 mg of the radioactive substance remains in her body. At what specific **date and time** (**include am or pm in your answer**) will Vicky be able to leave the hospital and go back home?