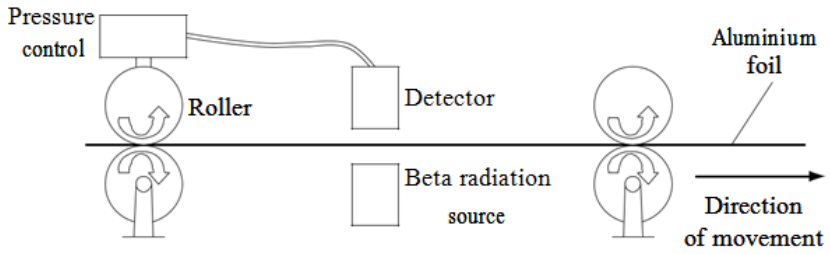
Nuclear Radiations and Isotopes MCQS

Q:1 The diagram shows how the thickness of aluminium foil is controlled during its manufacture.

The thicker the aluminium foil, the more radiation it absorbs.



A A beta particle consists of . . .

1)one electron.

2)one proton.

3)two protons.

4)two protons and two electrons.

B Starting with the most penetrating radiation, which is the correct order?

1)alpha → beta → gamma

2)beta → alpha→ gamma

3)beta→ gamma → alpha

4)gamma→ beta→ alpha

C Which sentence correctly explains why alpha and gamma radiation sources are unsuitable for use in this machine?

1)Alpha particles would be stopped by the foil but gamma rays would not be stopped.

2)Both would be stopped by the foil.

3)Gamma rays would be stopped by the foil but alpha particles would not be stopped.

4)Neither would be stopped by the foil.

D A worker accidentally receives a short exposure to the beta radiation.

A day later, this is most likely to have caused . . .

1)cancer.

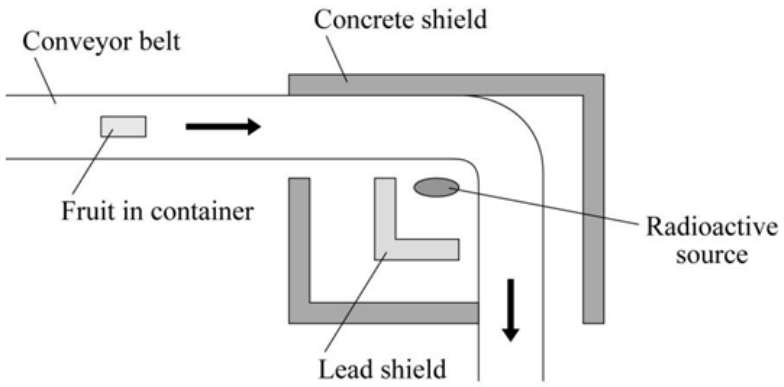
2)death.

3)hair loss.

4)skin burns.

Q:2 In some countries, fruit is passed in front of a radioactive source. The gamma radiation from the source kills bacteria. This keeps the fruit fresh for longer.

The main process is shown in the diagram.



A Gamma radiation is used because it is . . .

1)able to penetrate the container and fruit.

2)stopped by the lead shield.

3)not harmful to people.

4)the only radiation that can kill bacteria.

B The amount of radiation absorbed by the fruit can be increased by . . .

1)moving the source further from the fruit.

2)packing the fruit in thicker containers.

3)slowing down the conveyor belt.

4)speeding up the conveyor belt.

C Some fruit growers use X-ray machines instead of gamma ray sources.

The X-rays are safer to work with because . . .

1)gamma ray sources are used in hospitals.

2)X-ray machines can be switched on and off.

3)gamma rays have a lower frequency than X-rays.

4)X-rays have a shorter wavelength than gamma rays.

D Some scientists investigated the effect of radiation on the vitamin C content of fruit.

They measured the amount of radiation absorbed by some fruit.

They also measured the amount of vitamin C in the fruit before and after the radiation treatment.

Which row of the table describes the variables for a fair test?

	Amount of radiation absorbed	**Amount of vitamin C lost during irradiation**	**Size and type of fruit**
1	independent	dependent	control
2	independent	control	dependent
3	dependent	independent	control
4	control	independent	dependent

Q:3 Radium is an element with many isotopes. All of the isotopes of radium are radioactive. Natural radium emits alpha, beta and gamma radiation.

A Alpha radiation is . . .

1)a very fast electron from the nucleus.

2)an electromagnetic wave of very high frequency.

3)a particle containing protons and neutrons.

4)a particle containing only neutrons.

B Beta radiation has a longer range in air than alpha particles.

One of the reasons is that beta radiation is . . .

1)more highly ionising than alpha due to its larger electric charge.

2)more highly ionising than alpha due to its smaller electric charge.

3)less highly ionising than alpha due to its larger electric charge.

4)less highly ionising than alpha due to its smaller electric charge.

C Gamma radiation is not electrically charged.We know that it is not electrically charged because gamma radiation is . . .

1)deflected in magnetic fields but not in electric fields.

2)deflected in electric fields but not in magnetic fields.

3)deflected in both electric and magnetic fields.

4)not deflected in either electric or magnetic fields.

D A sample of natural radium contains 8 g of isotope radium-211. Radium-211 has a half-life of 13 seconds. After 26 seconds, . . .

1)half of the radium-211 atoms will have decayed.

2)all of the radium-211 atoms will have decayed.

3)only 2 g of radium-211 will remain.

4)the detected count rate from radium-211 will be zero.

Q:4 Airline pilots and people who live at high altitude have an increased exposure to radiation from space.

Scientists measured the annual radiation dose received by people who lived at different altitudes.

They repeated the experiment two more times and obtained the following results.

	Annual radiation dose in mSv		
Height above sea level in metres	**First time**	**Second time**	**Third time**
1000	2.9	3.0	2.9
2000	4.44	4.54	4.57
3000	5.90	5.78	6.01
4000	7.46	7.49	7.51

1 millisievert (mSv) is a unit of radiation dose

The scientists also investigated the exposure due to air travel. They found that pilots receive a radiation dose of 0.10 mSv for every 100 hours of flight.

A Which is the least precise set of results?

1)1000 m

2)2000 m

3)3000 m

4)4000 m

B Airline pilots should not receive an annual radiation dose of more than 6 mSv.

A pilot should restrict his flying hours because an annual exposure to radiation of more than 6 mSv produces . .
1)a reduced level of long-term concentration.

2)an increased risk of developing visual impairments.

3)reduced levels of oxygen to the brain.

4)an increased risk of damage to body tissues.

C A pilot who lives in Switzerland at a height of 2000 m should restrict his annual flying hours to about . .

1)500 hours.

2)1500 hours.

3)2500 hours.

4)6000 hours.

D A pilot averages 1000 hours of flying a year.

The maximum altitude at which he could safely live is . . .

1)1000 m.

2)2000 m.

3)3000 m.

4)4000 m.

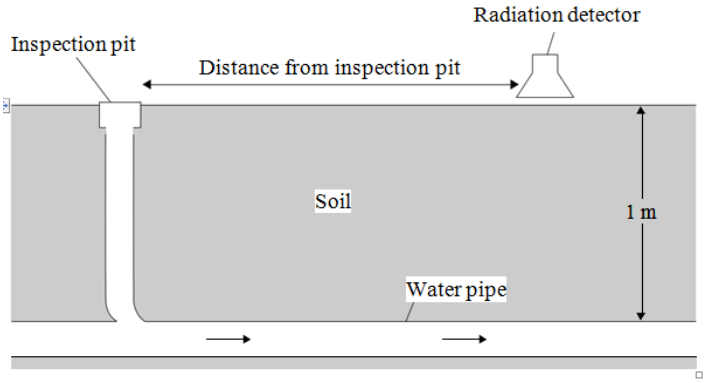
Q:5 Some engineers investigated a problem with the flow of water through an underground pipe.

The pipe was 1 metre below the ground.

The engineers put a small amount of radioactive liquid into the pipe through an inspection pit.

The radioactive liquid had a half-life of two days.

A radiation detector was used to measure the count rate at different distances from the inspection pit.



The results are shown below.

Distance from the inspection pit in metres	Count rate in counts per minute
1	23
2	21
3	23
4	28
5	32
6	27
7	20
8	18
9	19
10	20

A The engineers would use a radioactive liquid that emits . . .

1)alpha radiation.

2)beta radiation.

3)gamma radiation.

4)X-radiation.

B The readings suggest that . . .

1)the pipe was clear and water was flowing normally.

2)the pipe was not level.

3)the pipe had a leak.

4)the pipe had a blockage.

C To improve the reliability of the data, the engineers should . . .

1)use a more sensitive counter.

2)re-calibrate the counter.

3)repeat their investigation and calculate the means.

4)decide whether the variables are continuous or discrete.

D To fix the problem, workmen were asked to dig a hole down to the pipe.

The best place for the workmen to dig the hole is . . .

1)3 m from the inspection pit.

2)5 m from the inspection pit.

3)7 m from the inspection pit.

4)9 m from the inspection pit

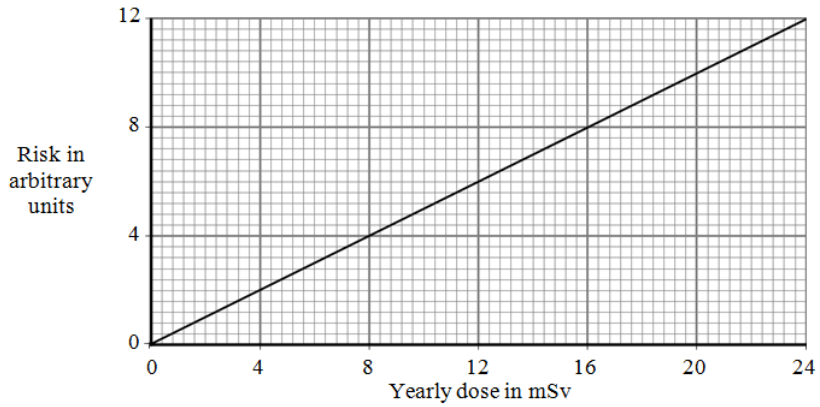
Q:6 Workers in industries that use radioactive materials have the amount of radiation they receive carefully monitored. The amount of radiation received is called the dose. The industries set dose limits.

The table shows the maximum yearly dose that is allowed for three groups of people. The higher the dose of radiation received, the greater the risk of developing cancer.

Description	**Yearly dose limit in millisieverts (mSv)**
Member of the public	1
Worker under 18 years	6
Pregnant adult worker	4

A millisievert is a unit of radiation dose.

A The graph shows how the risk changes with the yearly dose.



The graph shows that the risk . . .

1)does not depend on the yearly dose.

2)Is 2 arbitrary units for a member of the public.

3)is inversely proportional to the yearly dose.

4)is directly proportional to the yearly dose.

B The yearly dose limit for an adult worker is five times that of a pregnant adult worker. What is the risk (in arbitrary units) for an adult worker?

1)3

2)10

3)15

4)20

C Nuclear power stations produce radiation.

Which one of the following does not reduce the risk to power station workers?

1)building power stations far from centres of population

2)giving the workers protective clothing

3)monitoring the dose each worker receives to ensure that radiation limits are not exceeded

4)shielding the workers from the source of radiation

D Workers may be subjected to alpha, beta or gamma radiation.

Outside the body, alpha is less dangerous to workers than beta because alpha radiation . . .

1)cannot penetrate the skin.

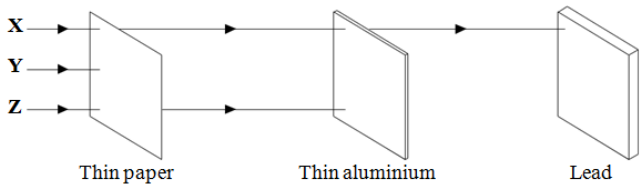
2)is deflected by electric fields.

3)is much less strongly ionising.

4)has a much longer range.

Q:7 This question is about radioactive substances and the radiation they emit.

The diagram shows how each type of radiation, X, Y and Z, is absorbed by different materials



Which row in Table 1 shows the correct radiation types?

	X	Y	Z
1	beta	alpha	gamma
2	gamma	alpha	beta
3	beta	gamma	alpha
4	gamma	beta	alpha

B When gamma radiation is absorbed, . . .

1)the absorber increases in mass.

2)the absorber shows a rise in temperature.

3)the radiation will become helium gas.

4)the radiation will transform into light.

C Which row in Table 2 correctly describes the three types of radiation?

	Alpha	Beta	Gamma
1	an electron from outside the nucleus	a helium nucleus	a short wavelength electromagnetic wave
2	a short wavelength electromagnetic wave	an electron from outside the nucleus	a helium nucleus
3	a helium nucleus	an electron from inside the nucleus	a high frequency electromagnetic wave
4	a helium nucleus	a short wavelength electromagnetic wave	an electron from inside the nucleus

D The radioactive gas thoron, which has a half-life of 50 seconds, is used in an experiment.

At the end of the experiment, the count rate had fallen to 321 of the count rate at the beginning.

The time taken to carry out the experiment was . . .

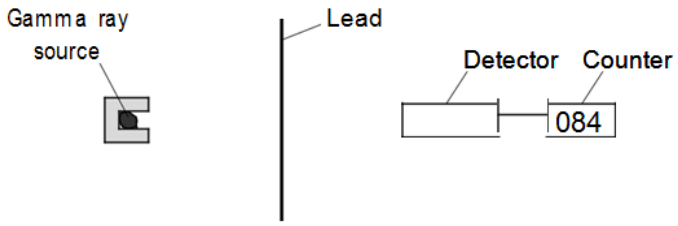
1)200 seconds.

2)250 seconds.

3)300 seconds.

4)1600 seconds.

Q:8 A student investigated the absorption of gamma rays. He used lead of different thicknesses.



He increased the thickness of the lead by 1 mm each time and measured the count rate.

His results are shown in the table.

Thickness of lead in mm	Count rate in counts per second
0	100
1	84
2	70
3	60
4	50
5	44
6	35
7	30
8	25

A What was the interval used in the thickness of the lead sheets?

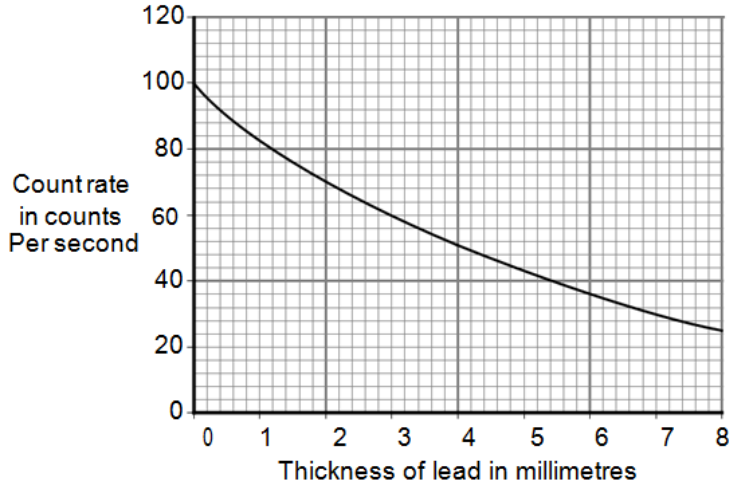
1) 1 mm

2) 2 mm

3) 5 mm

4) 10 mm

The graph shows the results.



B The graph shows that . . .

1)doubling the thickness of lead doubles the count rate.

2)there is no relationship between thickness and count rate.

3)doubling the thickness of lead makes the count rate three times bigger.

4)the thicker the lead, the lower the count rate.

C A thickness of 2 mm of lead will reduce the count rate by . . .

1)30 counts per second.

2)40 counts per second.

3)50 counts per second.

4)70 counts per second.

D What thickness of lead reduced the count rate to half of its original value?

1)1 mm

2)4 mm

3)9 mm

4)10 mm

Q:9A What is a beta particle?

1)an electron from outside the nucleus

2)an electron from inside the nucleus

3)a neutron from inside the nucleus

4)a proton from inside the nucleus

B Which row in the table correctly describes the properties of beta particles?

	Range in air	Penetration through materials
1)	a few centimetres	stopped by thin paper
2)	about a metre	stopped by thin paper
3)	about a metre	stopped by thin aluminium
4)	several kilometres	stopped by thick lead

C Beta particles cause ionisation.What does this mean?

1)They make non-radioactive sources become radioactive.

2)They produce charged particles when they collide with atoms.

3)They remove charged particles from the air.

4)They stop other radioactive sources from emitting radiation.

D How is a beta particle different from an alpha particle?

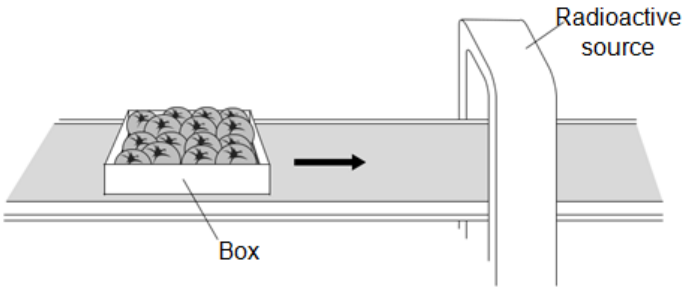
1)Alpha particles do not cause ionisation but beta particles do.

2)Alpha particles are deflected by magnetic fields and beta particles are not.

3)Beta particles are deflected by electric fields and alpha particles are not.

4)Beta particles have a much smaller mass than alpha particles.

Q:10 The shelf-life of fruit can be increased by exposing the fruit to radiation emitted by a radioactive source. The radiation kills the microbes in the fruit. These microbes would make the fruit decay.



The diagram shows some fruit in a box.

A To penetrate all the way through the box of fruit, the best type of radiation to use would be . . .

1)alpha radiation only.

2)beta radiation only.

3)gamma radiation only.

4)either alpha or beta radiation.

B Each box of fruit is exposed to radiation for 20 minutes.

The radioactive source should have a half-life of about . . .

1)2 minutes.

2)20 minutes.

3)2 days.

4)20 years.

C The workers at the fruit processing factory need to be protected from exposure to the radiation.

Which of the following would not reduce the exposure of the workers to radiation?

1)wearing lead-lined clothing

2)working remotely from behind a shield

3)wearing a radiation film badge

4)working near the radioactive source for a shorter time

D The governments of some countries do not allow any food to be exposed to radiation to increase its shelf-life. These governments are concerned that there would be a negative response from the public if this were allowed.

What sort of decision have these governments made?

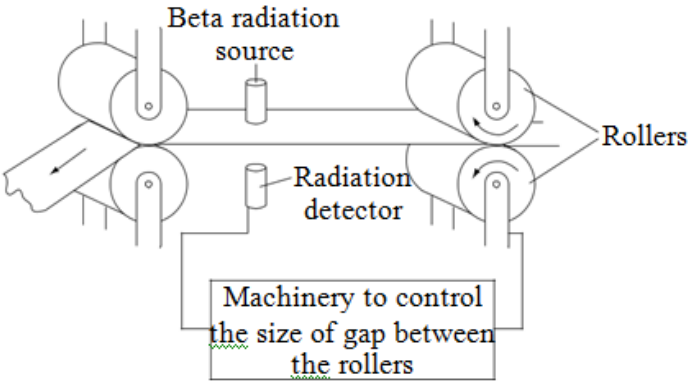
1)economic

2)ethical

3)political

4)scientific

Q:11 The diagram shows a system used in a paper mill to control the thickness of the paper.



The paper passes through a narrow gap between a beta (β) radiation source and a detector.

A Beta radiation passes through the paper more easily than alpha radiation because beta radiation . . .

1)consists of smaller particles than alpha radiation.

2)has a negative charge.

3)has a shorter frequency than alpha radiation.

4)has a longer wavelength than alpha radiation.

B A radioactive source producing only gamma rays would be unsuitable because . . .

1)gamma radiation consists of rays rather than particles.

2)the paper would not stop any of the gamma rays reaching the radiation detector.

3)gamma rays are not affected by magnetic fields.

4)gamma rays are too dangerous to use.

C Beta particles are less dangerous to workers than alpha particles because they . . .

1)are deflected by magnetic fields.

2)are much less strongly ionising.

3)cannot penetrate skin.

4)have a much shorter range.

D The most suitable half-life for the beta source in the system is . . .

1)six hours.

2)six days.

3)six months.

4)six years.

Q:12 A former spy was poisoned with the radioactive isotope polonium-210.

A Some of the spy's friends were found to be contaminated with polonium-210. They were safe from the radiation unless they had taken some of the polonium-210 into their bodies.

This is because the radiation given off by polonium-210 is . . .

1)alpha particles.

2)beta particles.

3)gamma rays.

4)X-rays.

B It is difficult to detect the radiation given off by polonium-210 using a detector outside the body because the radiation has . . .

1)high penetrating power.

2)a long range in air.

3)low ionising power.

4)low penetrating power.

C Scientists carried out many tests at restaurants, hotels and airports. This caused much public anxiety.

Which one of the following statements is true?

1)The particles emitted by polonium-210 are radioactive.

2)Anyone too close to a polonium-210 source will become radioactive.

3)If you swallow polonium-210, it will damage cells in the body.

4)The radiation from polonium-210 makes clothes glow in the dark.

D Another isotope of polonium is polonium-208. Compared with polonium-210, polonium-208 has . . .

1)more neutrons.

2)fewer neutrons.

3)more protons.

4)fewer protons.

Q:13 Pierre and Marie Curie made many important discoveries about radioactivity.

Pierre was killed in 1906 when he slipped and fell under a horse-drawn cart. He was having dizzy spells at the time. Marie lived until 1934 when she died of leukaemia, a form of cancer.

A The most likely cause of their sickness was . . .

1)the very long hours they worked.

2)the lack of proper equipment in their laboratory.

3)the cold temperatures in which they worked.

4)the radiation emitted by the radioactive materials they worked with.

B Marie's notebooks are still so radioactive that they are kept in a lead-lined safe.

The notebooks are radioactive because they . . .

1)are made of radioactive materials.

2**)**became contaminated with the radioactive materials in her laboratory.

3)absorbed ultraviolet radiation from the radioactive materials in her laboratory.

4)absorbed ultraviolet radiation from the Sun.

C The safe is lined with thick lead because . . .

1)radioactive materials cannot pass through thick lead.

2)thick lead is needed to stop alpha radiation.

3)thick lead is needed to stop beta radiation.

4)thick lead is needed to stop gamma radiation.

D The notebooks are removed from the safe occasionally. Careful safety precautions are taken.

One safety precaution is to keep people several metres away from the notebooks.

This would provide protection from alpha radiation because alpha particles . . .

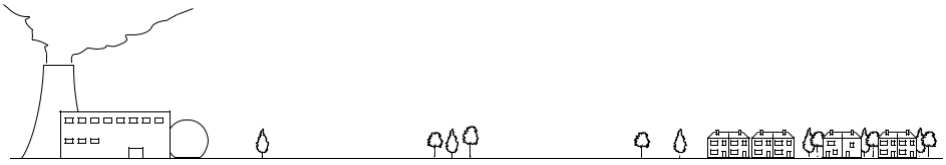
1)have a very short half-life.

2)can be stopped by a sheet of paper.

3)have a short range in air.

4)do not kill human body cells.

Q:14 A nuclear power station is built a few miles away from a village.



The nuclear power station uses radioactive uranium as its fuel. After a few years, there are more cases of cancer than usual occurring in the village. The villagers think that this is because of radiation from the power station.

A Any radiation reaching the village directly from the power station will be . . .

1)alpha radiation only.

2)beta radiation only.

3)gamma radiation only.

4)alpha, beta and gamma radiation.

B The increased number of cancer cases near the power station . . .

1)proves that the power station is the only cause of these cancers.

2)proves that the power station is one possible cause of these cancers.

3)suggests that the power station is the only cause of these cancers.

4)suggests that the power station is one possible cause of these cancers.

C Checks are to be made for any link between the power station and the increased number of cancer cases in the village.

This is most likely to be done by . . .

1)shutting down the power station to see if the number of cases decreases.

2)re-housing the villagers away from the power station to see if the number of cancer cases decreases.

3)re-housing the villagers closer to the power station to see if the number of cancer cases increases.

4)comparing the villagers' health records with those of people who do not live near nuclear power stations.

D Exposure to radiation from radioactive sources used in schools must be kept to a minimum.

The best way to do this is to store the source in a box lined with . . .

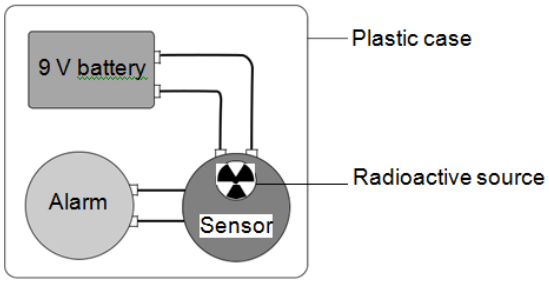
1)aluminium.

2)glass.

3)lead.

4)wood.

Q:15 The diagram shows the parts of a smoke detector. The radioactive source emits alpha particles.



The alpha particles ionise the air inside the sensor, which causes a small electric current. Any smoke getting into the sensor will absorb alpha particles. This reduces the current. The change in current sets off the alarm.

A A source that emits alpha particles will not harm people in the same room as the detector.

This is because alpha particles . . .

1)do not damage human cells.

2)are highly ionising.

3)will not pass through the plastic case.

4)are deflected by the Earth's magnetic field.

B The smoke detector would not work if a radioactive source that emitted only gamma rays was used.

This is because gamma rays . . .

1)would pass through the plastic case.

2)would not ionise the air inside the sensor sufficiently.

3)travel through the air at the same speed as light.

4)would be affected by the battery.

C An alpha particle consists of . . .

1)2 electrons and 2 neutrons.

2)2 electrons and 2 protons.

3)2 neutrons and 2 protons.

4)2 neutrons only.

Q:16 The radioactive isotope phosphorus-32 emits beta particles.

Scientists use phosphorus-32 to help them to understand how plants use phosphorus to grow.

A A material is described as radioactive if it gives out . . .

1)radio waves all the time.

2)nuclear radiation all the time.

3)radio waves when heated.

4)nuclear radiation when heated.

B Phosphorus-32 is one of the isotopes of phosphorus.

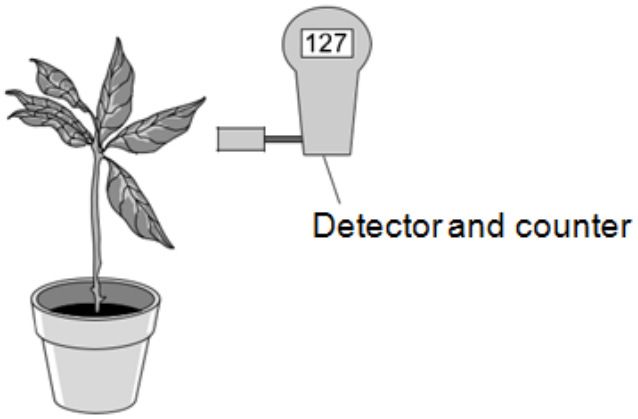
Atoms of the other isotopes of phosphorus have different numbers of . . .

1)electrons.

2)neutrons.

3)nuclei.

4)protons.



C The path of the phosphorus-32 in the plant can be traced because the detector can detect . . .

1)beta particles.

2)phosphorus atoms.

3)phosphorus nuclei.

4)ultraviolet radiation.

D Phosphorus-32 has a half-life of 14 days.

This means that the number of phosphorus-32 nuclei will . . .

1)fall to zero in 14 days.

2)halve in 14 days.

3)double in 14 days.

4)be unchanged in 14 days.

TOTAL MARKS=63