Gleniffer High School

National 5

"A – Team"

Past Papers

Prelim Revision Homework

DATA SHEET

Speed of light in materials

Material	Speed in m s^{-1}
Air	3.0×10^8
Carbon dioxide	3.0×10^8
Diamond	1.2×10^8
Glass	2.0×10^8
Glycerol	2.1×10^8
Water	2.3×10^8

Gravitational field strengths

	Gravitational field strength on the surface in N kg^{-1}
Earth	9.8
Jupiter	23
Mars	3.7
Mercury	3.7
Moon	1.6
Neptune	11
Saturn	9.0
Sun	270
Uranus	8.7
Venus	8.9

Specific latent heat of fusion of materials

Material	Specific latent heat of fusion in J kg^{-1}
Alcohol	0.99×10^5
Aluminium	3.95×10^5
Carbon Dioxide	1.80×10^5
Copper	2.05×10^5
Iron	2.67×10^5
Lead	0.25×10^5
Water	3.34×10^5

Specific latent heat of vaporisation of materials

Material	Specific latent heat of vaporisation in J kg^{-1}
Alcohol	11.2×10^5
Carbon Dioxide	3.77×10^5
Glycerol	8.30×10^5
Turpentine	2.90×10^5
Water	22.6×10^5

Speed of sound in materials

Material	Speed in m s^{-1}
Aluminium	5200
Air	340
Bone	4100
Carbon dioxide	270
Glycerol	1900
Muscle	1600
Steel	5200
Tissue	1500
Water	1500

Specific heat capacity of materials

Material	Specific heat capacity in J kg^{-1} °C^{-1}
Alcohol	2350
Aluminium	902
Copper	386
Glass	500
Ice	2100
Iron	480
Lead	128
Oil	2130
Water	4180

Melting and boiling points of materials

Material	Melting point in °C	Boiling point in °C
Alcohol	−98	65
Aluminium	660	2470
Copper	1077	2567
Glycerol	18	290
Lead	328	1737
Iron	1537	2737

Radiation weighting factors

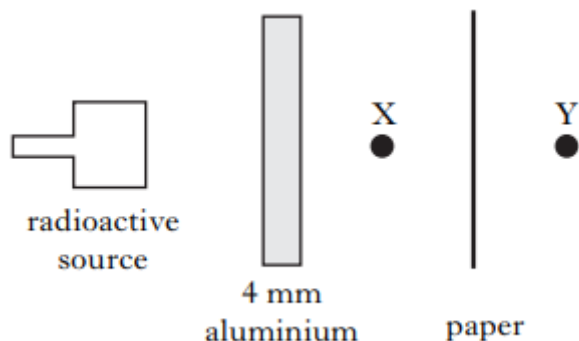| Type of radiation	Radiation weighting factor
alpha	20
beta	1
fast neutrons	10
gamma	1
slow neutrons	3

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Prelim Revision One

1.   A student makes the following statements about the members of the electromagnetic spectrum.

I   Gamma rays have a longer wavelength than X-rays.

II   Ultraviolet rays have a longer wavelength than infrared rays.

III Radio waves have a longer wavelength than microwaves.

Which of the statements is/are correct?

A   I only

B   II only

C   III only

D   I and II only

E   II and III only

2.   A radioactive source emits alpha (α), beta (β), and gamma (γ) radiation. Sheets of aluminium and paper are placed close to the source as shown.

Which row in the table shows the radiation(s) detected at points X and Y?

	Radiation(s) at X	Radiation(s) at Y
A	α, γ	γ
B	β, γ	α
C	α	β
D	β	γ
E	γ	γ

3. Which of the following statements is/are true about fission?

I A large nucleus is split into two smaller nuclei.

II Two smaller nuclei join together to form a larger nucleus.

III Fission can result in a chain reaction.

A I only

B II only

C III only

D I and III only

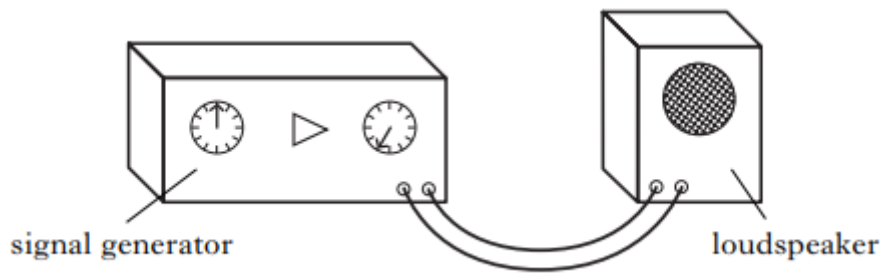E II and III only

4. a) Two types of waveform are shown.

i) Which waveform represents a longitudinal wave?

1

ii) Which waveform represents a radio wave?

1

4, b)   A signal generator is connected to a loudspeaker which produces a sound wave of frequency 2 kHz.

signal generator   loudspeaker

i)   If the speed of a sound wave in air is 340 ms-1, calculate the wavelength of the sound wave in air.

3

ii)   The loudspeaker is placed a distance of 10.2 m from a wall. Calculate the time taken for the sound wave to return to the loudspeaker.
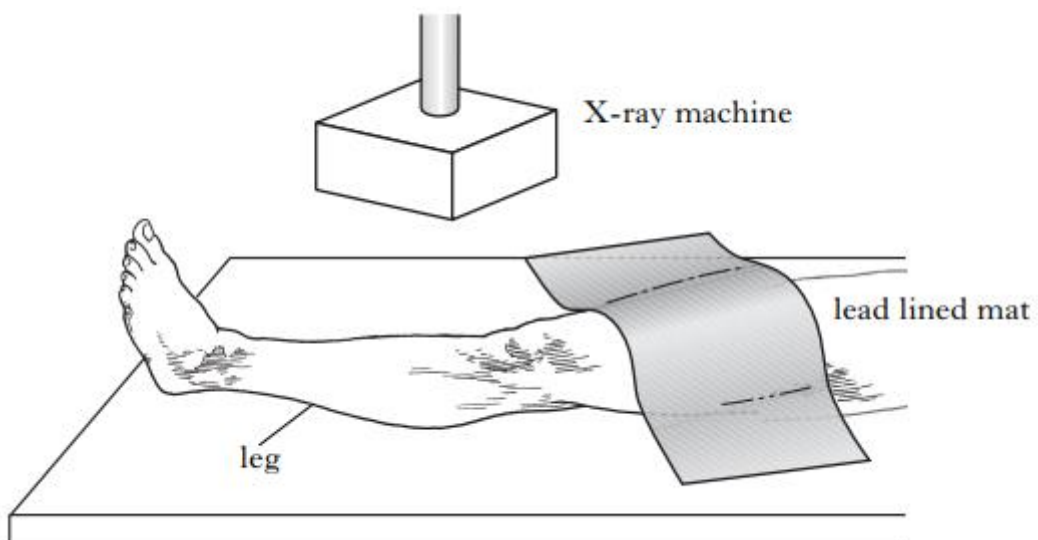
4

c)   The loudspeaker is now placed in a tank of carbon dioxide gas. The frequency remains at 2 kHz.

What effect does this have on the wavelength of the sound?

Explain your answer.

2

5.   A football player injuries their leg while playing in a match.

X-ray machine

lead lined mat

leg

In hospital the player has **three X-rays**, each producing an absorbed dose of 50 µGy.
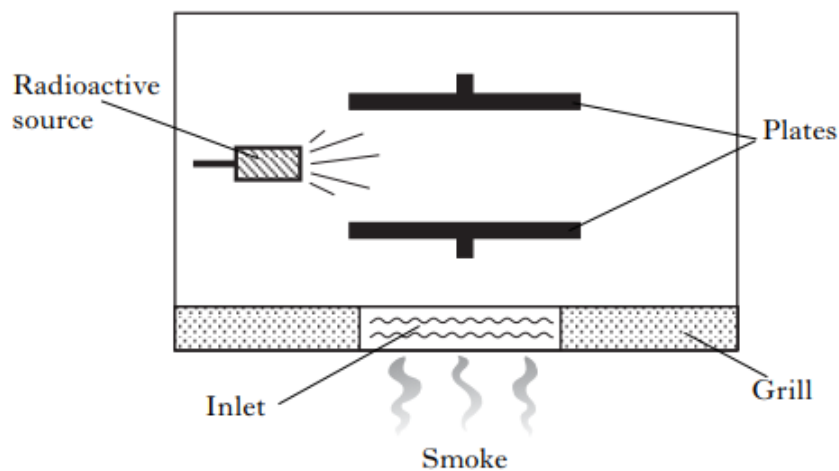
a)   The mass of the player's leg is 6 kg. Calculate the energy absorbed by the leg from the X-rays.

4

b)   Why is the rest of the player's leg covered in a lead lined mat?

1

6.   A simplified diagram of a smoke detector is shown. Radiation from the source causes ionisation of the air molecules between the plates. This produces a small current in a circuit. When smoke particles pass between the plates, the current decreases and a buzzer sounds.

a)   What is meant by ionisation?

1

b)   Should the source be an alpha, beta or gamma emitter?

Explain your answer in terms of ionisation.

2

c)   A manufacturer is choosing a new source for its smoke detectors. From the following information, select the most suitable source to use.

Explain your answer.

3

Source	Half-life (years)	Range (metres)
W	1	0·05
X	10	2·0
Y	100	0·05
Z	1000	2·0

Prelim Revision Two

1. Which of the following is an example of a longitudinal wave?

A   Light wave

B   Infra-red wave
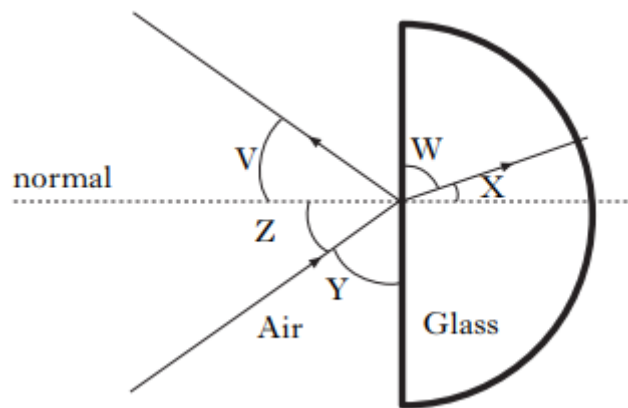
C   Radio wave

D   Sound wave

E   Water wave

2. The diagram shows a list of the members of the electromagnetic spectrum in order of increasing wavelength.

| gamma rays | **P** | ultraviolet | **Q** | infrared | **R** | TV and Radio |

Which row in the table shows the radiation represented by the letters **P, Q, and R**?

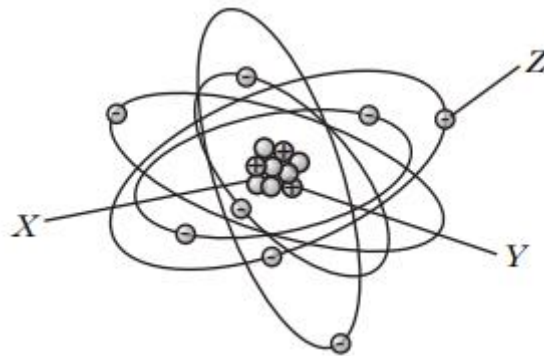|	P	Q	R
A	microwaves	visible light	x-rays
B	visible light	microwaves	x-rays
C	x-rays	visible light	microwaves
D	visible light	x-rays	microwaves
e	x-rays	microwaves	visible light

3. The diagram shows what happens to a ray of light when it strikes a glass block.

Which row in the table identifies the angle of incidence and the angle of refraction?

	Angle of incidence	Angle of refraction
A	V	W
B	Y	W
C	Y	X
D	Z	W
E	Z	X

4. The diagram below shows a simple model of an atom.

Which row in the table identifies particles **X, Y, and Z**?

	X	**Y**	**Z**
A	electron	proton	neutron
B	proton	neutron	electron
C	neutron	electron	proton
D	electron	neutron	proton
E	neutron	proton	electron

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5.   A student makes the following statements about ionising radiations.

I   Ionisation occurs when an atom loses an electron.

II   Gamma radiation produces greater ionisation (density) than alpha particles.

III   An alpha particle consists of 2 protons, 2 neutrons, and 2 electrons.
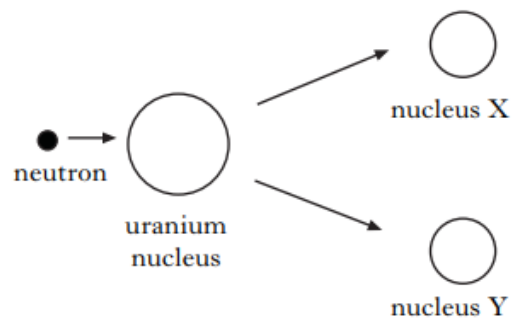
Which of the statements is/are correct?

A   I only

B   II only

C   I and II only

D   II and III only

E   I, II, and III

6.   A sample of tissue has a mass of 0.05 kg. The tissue is exposed to radiation and absorbs 0.1 J of energy in 2 minutes.

The absorbed dose is

A   0.005 Gy

B   0.1 Gy

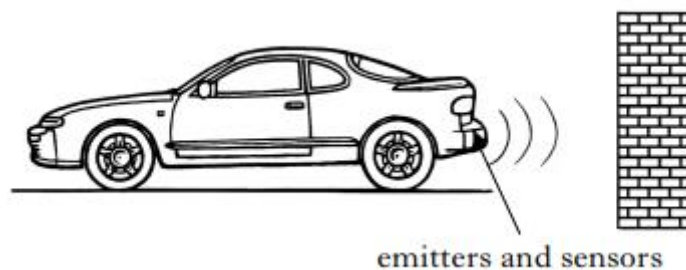C   0.5 Gy

D   2 Gy

E   6 Gy

7. During fission, a neutron splits a uranium nucleus into two nuclei, X and Y, as shown.

For a chain reaction to occur which of the following **must** also be released?

A   Protons

B   Electrons

C   Neutrons

D   Alpha particles

E   Gamma radiation

8. Parking sensors are fitted to the rear bumper of some cars. A buzzer emits audible beeps, which become more frequent as the car moves closer to an object.

emitters and sensors

High frequency pulses are emitted from the rear of the car. Objects behind the car reflect the pulses, which are detected by sensors. The pulses travel at a speed of 340 ms^{-1}.

a)   The time between these pulses being sent and received is 2 x 10^{-3} s.

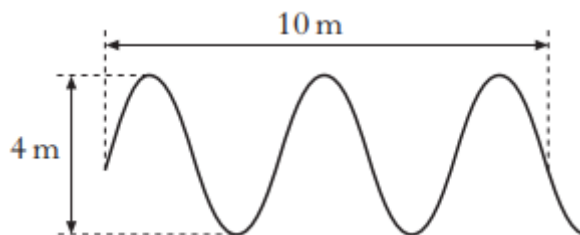Calculate the distance between the object and the rear of the car.

4

b)   At a certain distance, the buzzer beeps every 0.125 s.

Calculate the frequency of the beeps.

3

Prelim Revision Three
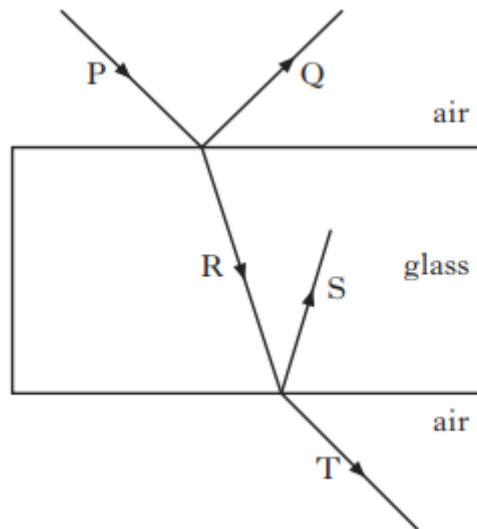
1. The following diagram gives information about a wave.

Which row shows the amplitude and wavelength of the wave?

	Amplitude (m)	Wavelength (m)
A	2	2
B	2	4
C	2	5
D	4	2
E	4	4

2. Sound is a longitudinal wave. When sound travels through the air, the particles of air

A   vibrate at random

B   vibrate along the wave direction

C   vibrate at 90o to the wave direction

D   move continuously away from the source

E   move continuously towards the source

3. The diagram shows a ray of light P incident on a rectangular glass block.

Which of the following are refracted rays?

A   Q and R

B   R and S

C   S and T

D   Q and S

E   R and T

4. Activity and absorbed dose are quantities used in Dosimetry.

Which row shows the unit of activity and the unit of absorbed dose?

	Unit of activity	Unit of absorbed dose
A	gray	becquerel
B	becquerel	sievert
C	becquerel	gray
D	gray	sievert
E	sievert	gray

5. The table shows the count rate of a radioactive source taken at regular time intervals. The count rate has been corrected for background radiation.

Time (minutes)	10	20	30	40	50
Count rate (counts per minute)	800	630	500	400	315

What is the half-life in minutes of the radioactive source?

A   10

B   15

C   20

D   30

E   40

6. In the following passage some words have been replaced by letters X and Y.

In a nuclear reactor, fission is caused by **X** *bombardment of a uranium nucleus. This causes the nucleus to split releasing neutrons and* **Y** *.*

Which row gives the words for X and Y?

	X	Y
A	neutron	energy
B	proton	energy
C	electron	protons
D	neutron	protons
E	electron	energy

7. It is possible to determine the age of a prehistoric wooden boat by measuring the activity of radioactive carbon-14. The activity of a piece of wood from the boat is 400 µBq.

a)   Calculate the number of atoms of carbon-14 that decay in 24 hours.

3

b)   When the boat was carved, the activity of the piece of wood was 3200 µBq due to carbon-14 atoms. The half-life of carbon-14 is 5700 years. Calculate the age of the boat.

3

c)   Carbon-14 emits beta particles. What is a beta particle?

1

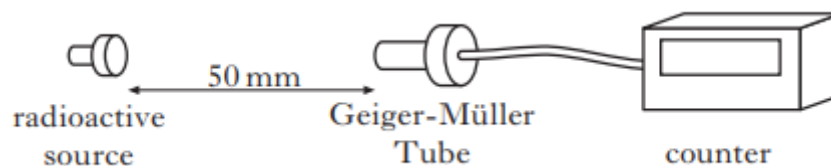8. A radioactive source emits alpha particles.

a) What is an alpha particle?

1

b) How does the ionisation density of alpha particle compare with that of beta particles?

1

c)i) A student sets up an experiment as shown.

The student places a 3 mm sheet of aluminium between the radioactive source and the Geiger-Muller Tube. The count rate is observed to decrease and the student concludes that the radioactive source is emitting beta radiation.

Suggest **one** reason why the student's conclusion may be incorrect.

1

ii) State **two** safety precautions that the student must observe when handling radioactive sources.

2

Prelim Revision Four

1. Which of the following electromagnetic waves has a higher frequency than microwaves and a lower frequency than visible light?

A   Gamma rays

B   Infrared

C   Radio

D   Ultraviolet

E   X-rays

2. A student makes the following statements.

I   The nucleus of an atom contains protons and electrons.

II Gamma radiation produces the greatest ionisation density.

III Beta particles are fast moving electrons.

Which of the statements is/are correct?

A   I only

B   II only

C   III only

D   I and III only

E   II and III only

3. Which of the following describes the term ionisation?

A   An atom losing an orbiting electron.

B   An atom losing a proton.

C   A nucleus emitting an alpha particle.

D   A nucleus emitting a neutron.

E   A nucleus emitting a gamma ray.

4. A student makes the following statements about radiation.

I   The half-life of a radioactive source is half of the time it itakes for its activity to reduce to zero.

II   The activity of a radioactive source is the number of decays per minute.

III   The risk of biological harm from radiation depends on the type of tissue exposed.

Which of the statements is/are correct?

A   I only

B   !! only

C   III only

D   II and III only

E   I, II, and III

5. A hospital radiographer calculates the equivalent dose of radiation absorbed by a patient. This is done by multiplying the absorbed dose by a radiation weighting factor.

a)   State what is meant by a radiation weighting factor.

1

b)   During a scan of the patient's brain, the absorbed dose is measured as 1.5 mGy. The mass of the brain is 1.4 kg.

Calculate the energy absorbed by the brain during the scan.

3

c)   In another medical procedure, a radioactive chemical is injected into a patient.

The chemical is prepared, by a technician, from a source which has an activity of 320 MBq.

The source has a half-life of 6 hours.

Calculate the activity of the source 18 hours later.

3

Prelim Revision Five

1.   A student makes the following statements about different types of electromagnetic waves.

I   Light waves are transverse waves.

II   Radio waves travel at 340 ms⁻¹.

III   Ultraviolet waves have a longer wavelength than infrared waves.

Which of these statements is/are correct?

A   I only

B   I and II only

C   I and III only

D   II and III only

E   I, II, and III

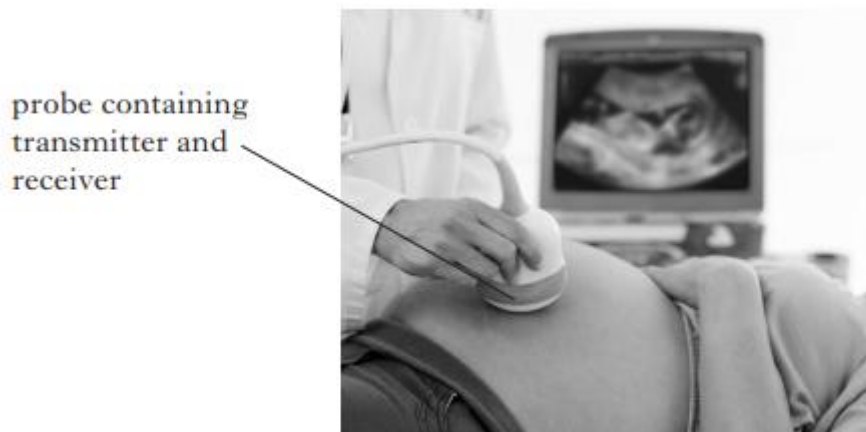2.   Alpha radiation ionises an atom. Which statement describes what happens to the atom?

A   The atom splits in half.

B   The atom releases a neutron.

C   The atom becomes positively charged.

D   The atom gives out gamma radiation.

E   The atom releases heat.

3.   A helium atom consists of electrons, neutrons, and protons.

The nucleus contains

A   electrons only

B   neutrons and electrons

C   protons and electrons

D   protons and neutrons

E   protons, neutrons, and electrons

4. High frequency sound waves, known as ultrasounds, are used to scan unborn babies.

probe containing transmitter and receiver

A probe containing a transmitter sends ultrasound pulses through tissue and water towards the baby.

The pulses reflect off the baby and travel back to a receiver in the probe.

a) By using the data sheet, state the speed of ultrasound waves durig the scan.

1

b) The time taken for one pulse to travel to the baby and back is 5.2×10^{-5} s.

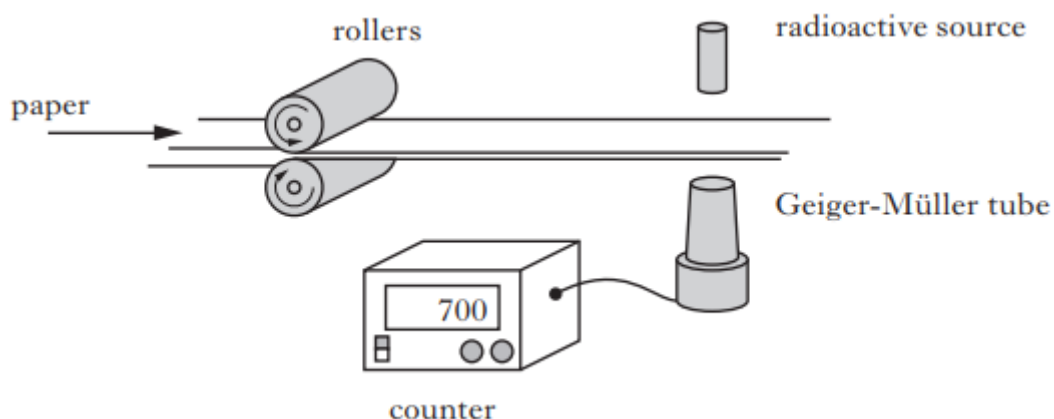Calculate the distance between the probe and the baby.

4

c) Is the wavelength of the ultrasound in the tissue longer, shorter or tha same as it is in air?

Explain your answer.

2

5. A paper mill uses a radioactive source in a system to monitor the thickness of paper.

Radiation passing through the paper is detected by the Geiger-Muller tube. The count rate is displayed on the counter as shown. The radioactive source has a half-life that allows the system to run continuously.

a) State what happens to the count rate, if the thickness of the paper decreases.

1

b) The following radioactive sources are available.

Radioactive Source	Half-life	Radiation emitted
W	600 years	alpha
X	50 years	beta
Y	4 hours	beta
Z	350 years	gamma

i) Which radioactive source should be used?

Explain your answer

3

ii) What is meant by the term half-life?

1

iii) State what is meant by a gamma ray.

1