Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

General Certificate of Secondary Education
Foundation Tier and Higher Tier
November 2011

Science A

Unit Physics P1b (Radiation and the Universe)

Physics

Unit Physics P1b (Radiation and the Universe)

PHY1BP

F&H

Tuesday 15 November 2011 Morning Session

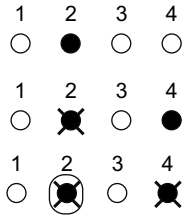
For this paper you must have:
- a black ball-point pen
- an objective test answer sheet.

You may use a calculator.

Time allowed
- 30 minutes

Instructions
- Fill in the boxes at the top of this page.
- Check that your name, candidate number and centre number are printed on the separate answer sheet.
- Check that the separate answer sheet has the title 'Physics Unit 1b' printed on it.
- Attempt **one Tier only**, **either** the Foundation Tier **or** the Higher Tier.
- Make sure that you use the correct side of the separate answer sheet; the Foundation Tier is printed on one side and the Higher Tier on the other.
- Answer **all** the questions for the Tier you are attempting.
- Record your answers on the separate answer sheet only.
- Do all rough work in this book, **not** on your answer sheet.

Instructions for recording answers
- Use a **black ball-point pen**.
- For each answer **completely fill in the circle** as shown.
- Do **not** extend beyond the circles.
- If you want to change your answer, **you must** cross out your original answer, as shown.
- If you change your mind about an answer you have crossed out and now want to choose it, draw a ring around the cross as shown.



Information
- The maximum mark for this paper is 36.

Advice
- Do **not** choose more responses than you are asked to. You will lose marks if you do.
- Make sure that you hand in both your answer sheet and this question paper at the end of the test.
- If you start to answer on the wrong side of the answer sheet by mistake, make sure that you cross out **completely** the work that is not to be marked.

You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.
The Higher Tier starts on page 16 of this booklet.

FOUNDATION TIER

Section One

Questions **ONE** to **FIVE**.

In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1**–**4**.

Use **each** answer only **once**.

Mark your choices on the answer sheet.

QUESTION ONE

Different types of electromagnetic waves are used in hospitals.

Match types of electromagnetic wave, **A**, **B**, **C** and **D**, with the numbers **1**–**4** in the sentences.

A gamma rays

B infra red rays

C radio waves

D visible light

Surgical instruments are sterilised using . . . **1** . . . .

Laser eye surgery uses . . . **2** . . . .

Damaged muscles are given heat treatment using . . . **3** . . . .

A doctor can be contacted by a bleeper that uses . . . **4** . . . .

QUESTION TWO

This question is about nuclear and electromagnetic radiation.

Match words, **A**, **B**, **C** and **D**, with the statements **1**–**4** in the table.

A alpha particle

B beta particle

C gamma ray

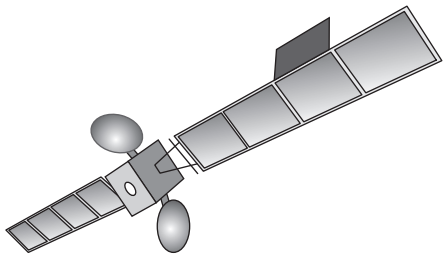
D X-rays

1	an electromagnetic wave emitted from the nucleus of an atom
2	an electron from the nucleus of an atom
3	absorbed by bone but not absorbed by soft tissue
4	very good at ionising the atoms of a gas

Turn over for the next question

QUESTION THREE

The drawing shows a satellite that carries a telescope used to look at objects in space.



Match words, **A**, **B**, **C** and **D**, with the numbers **1**–**4** in the sentences.

A a distant galaxy

B a satellite

C the Earth

D the Universe

Observations of space using visible light are better made from . . . **1** . . . because clouds may block observations made from . . . **2** . . . .

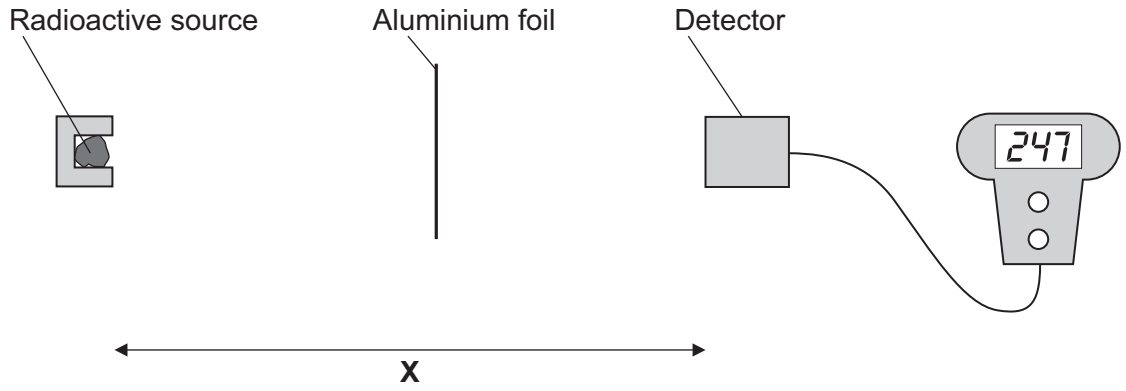
The red-shift in light from . . . **3** . . . provides evidence of the 'big bang' theory of the start of . . . **4** . . . .

QUESTION FOUR

A student investigated how much beta radiation was absorbed by aluminium foil.

He used several different thicknesses of aluminium foil.

He plotted a graph of his results.



Match words, **A**, **B**, **C** and **D**, with the statements **1**–**4** in the table.

A conclusion

B control variable

C independent variable

D prediction

1	He thought that the amount of radiation absorbed would decrease with increasing thickness.
2	From his graph, he decided that the amount of radiation absorbed increased with increasing thickness.
3	He changed the thickness of the aluminium foil.
4	He kept the distance **X** the same.

Turn over for the next question

QUESTION FIVE

The frequencies of the waves in the electromagnetic spectrum can be grouped into types.

Match types, **A**, **B**, **C** and **D**, with the descriptions **1**–**4** in the table.

A gamma rays

B infra red rays

C radio waves

D ultraviolet rays

1	They have a higher frequency than X-rays.
2	They have a lower frequency than microwaves.
3	They have a lower frequency than visible light but a higher frequency than microwaves.
4	They have a lower frequency than X-rays but a higher frequency than visible light.

Turn over for the next question

Section Two

Questions **SIX** to **NINE**.

Each of these questions has four parts.

In each part choose only **one** answer.

Mark your choices on the answer sheet.

QUESTION SIX

This question is about visible light and infra red rays.

6A Which statement is true for both visible light and infra red rays?

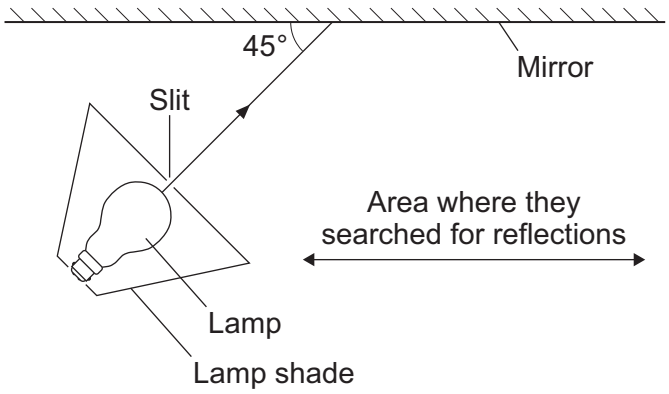
1 They have the same wavelength.

2 They have the same speed in a vacuum.

3 Only visible light can travel along an optical fibre.

4 Only infra red rays can be absorbed.

Some students wanted to see if visible light and infra red rays reflect at the same angle from a mirror. They set up a lamp pointing at 45° to a mirror. They then searched for reflections in the area shown in the diagram. Their investigation was carried out in a dark room.



6B The students carried out their investigation in a dark room because . . .

1 visible light travels faster in the dark.

2 it cuts out any other sources of visible light.

3 it allows them to do their investigation safely.

4 you can only see visible light in a dark room.

6C To minimise random errors, the students should have . . .

1 used a curved mirror.

2 plotted a graph of the angles they measured.

3 repeated the measurements several times and calculated the average.

4 carried out the investigation in a room with the lights on.

6D When a household lamp was used, the students saw a reflection of the light at 45° to the mirror.

When an infra red source was used, they could not see the rays. Using an infra red detector, they did find a reflection at 45°.

This is because . . .

1 infra red rays are not reflected by a mirror.

2 infra red rays are absorbed by the mirror.

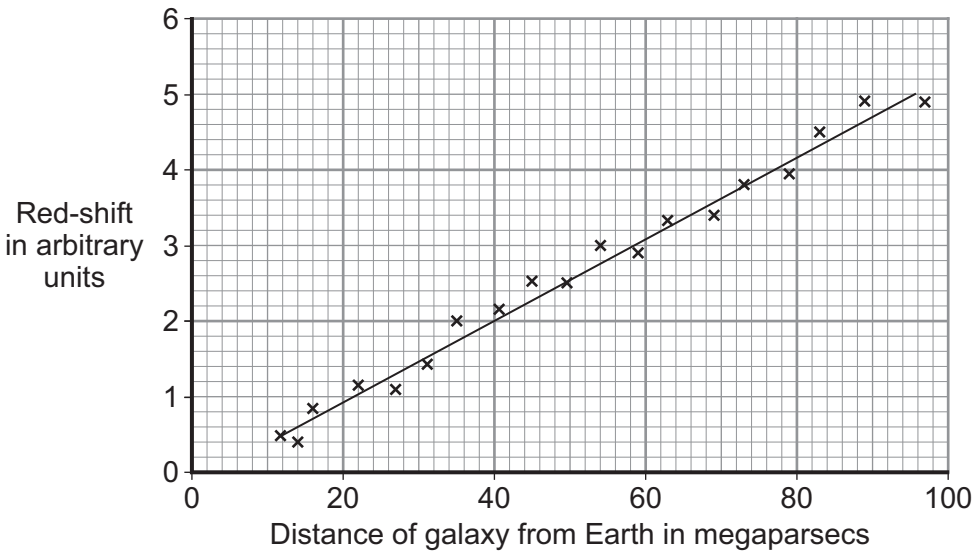
3 human eyes are not sensitive to infra red rays.

4 visible light and infra red rays reflect in different ways.

Turn over for the next question

QUESTION SEVEN

The graph shows the red-shift for a number of galaxies.



A megaparsec is a unit of distance used by astronomers.

7A The graph shows that . . .

1 the further away from Earth a galaxy is, the smaller the red-shift.

2 the further away from Earth a galaxy is, the bigger the red-shift.

3 the amount of red-shift is the same however far from Earth the galaxy is.

4 there is no relationship between red-shift and the distance from Earth**.**

7B A scientist is concerned that not all the points on the graph lie on the straight line.

How can the scientist check that the results are reliable?

1 ignore the results that do not fit on the line

2 use more precise measuring instruments

3 make the observations from space telescopes

4 compare the data with that obtained by other scientists

7C A galaxy produces a red-shift of 2 units.

How far from Earth is it?

1 20 megaparsecs

2 40 megaparsecs

3 60 megaparsecs

4 80 megaparsecs

7D Data is obtained for another distant galaxy that shows red-shift. This data does not fit the pattern of the other galaxies.

Data such as this that does not fit the pattern is called . . .

1 accurate.

2 anomalous.

3 precise.

4 sensitive.

Turn over for the next question

QUESTION EIGHT

X-rays are useful for obtaining images of internal parts of the body. However, there are dangers from exposure to X-rays.

8A Why is exposure to X-rays dangerous?

1 X-rays are poisonous.

2 X-rays can damage cells.

3 Your body can store up X-rays.

4 Your body becomes immune to X-rays.

8B There is a maximum dose of radiation from X-rays that you should not exceed each year.

The table shows the percentage of this maximum that you receive from X-ray scans of different parts of the body.

Part of the body being X-rayed	Percentage of maximum yearly allowed dose
Chest	5
Teeth	1
Pelvis	24
Spine	40

What is the best way to display the data in the table?

1 a bar chart, because one of the variables is categoric

2 a bar chart, because both of the variables are continuous

3 a line graph, because one of the variables is categoric

4 a line graph, because both of the variables are continuous

8C A patient has two chest X-rays and one spine X-ray taken in one year.

How much of the maximum yearly allowed dose has he received?

1 45 %

2 50 %

3 70 %

4 85 %

8D A dentist taking an X-ray of a patient's teeth needs to protect himself from the radiation.

He does this by . . .

1 taking no more than 1000 X-rays in a year.

2 operating the X-ray machine from outside the room.

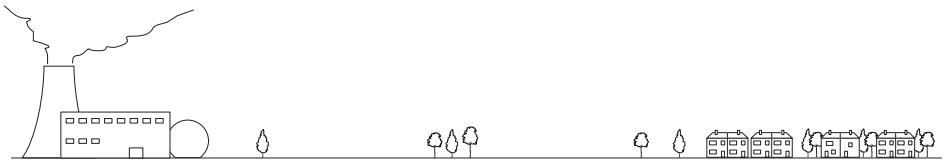
3 making sure that the patient wears a lead apron.

4 wearing special gloves.

Turn over for the next question

QUESTION NINE

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.

9A 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.

9B 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.

9C 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.

9D 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.

END OF TEST

You must do **one Tier** only, **either** the Foundation Tier **or** the Higher Tier.
The Foundation Tier is earlier in this booklet.

HIGHER TIER

Section One

Questions **ONE** and **TWO**.

In these questions, match the letters, **A**, **B**, **C** and **D**, with the numbers **1–4**.

Use **each** answer only **once**.

Mark your choices on the answer sheet.

QUESTION ONE

The frequencies of the waves in the electromagnetic spectrum can be grouped into types.

Match types, **A**, **B**, **C** and **D**, with the descriptions **1**–**4** in the table.

A gamma rays

B infra red rays

C radio waves

D ultraviolet rays

1	They have a higher frequency than X-rays.
2	They have a lower frequency than microwaves.
3	They have a lower frequency than visible light but a higher frequency than microwaves.
4	They have a lower frequency than X-rays but a higher frequency than visible light.

QUESTION TWO

Communication signals may be either analogue or digital.

Between a signal transmitter and a signal receiver, interference occurs. The interference distorts both types of signal.

Match the descriptions of the signals, **A**, **B**, **C** and **D**, with the visual displays **1**–**4**.

A analogue signal reaching a receiver

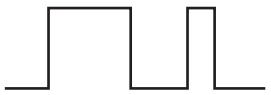
B analogue signal sent from a transmitter

C digital signal reaching a receiver

D digital signal sent from a transmitter

1

2



3

4

Turn over for the next question

Section Two

Questions **THREE** to **NINE**.

Each of these questions has four parts.

In each part choose only **one** answer.

Mark your choices on the answer sheet.

QUESTION THREE

X-rays are useful for obtaining images of internal parts of the body. However, there are dangers from exposure to X-rays.

3A Why is exposure to X-rays dangerous?

1 X-rays are poisonous.

2 X-rays can damage cells.

3 Your body can store up X-rays.

4 Your body becomes immune to X-rays.

3B There is a maximum dose of radiation from X-rays that you should not exceed each year.

The table shows the percentage of this maximum that you receive from X-ray scans of different parts of the body.

Part of the body being X-rayed	Percentage of maximum yearly allowed dose
Chest	5
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What is the best way to display the data in the table?

1 a bar chart, because one of the variables is categoric

2 a bar chart, because both of the variables are continuous

3 a line graph, because one of the variables is categoric

4 a line graph, because both of the variables are continuous

3C A patient has two chest X-rays and one spine X-ray taken in one year.

How much of the maximum yearly allowed dose has he received?

1 45 %

2 50 %

3 70 %

4 85 %

3D A dentist taking an X-ray of a patient's teeth needs to protect himself from the radiation.

He does this by . . .

1 taking no more than 1000 X-rays in a year.

2 operating the X-ray machine from outside the room.

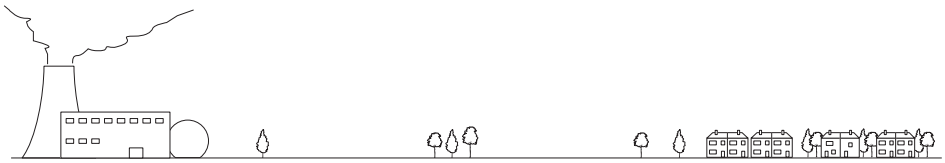
3 making sure that the patient wears a lead apron.

4 wearing special gloves.

Turn over for the next question

QUESTION FOUR

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.

4A 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.

4B 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.

4C 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.

4D 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.

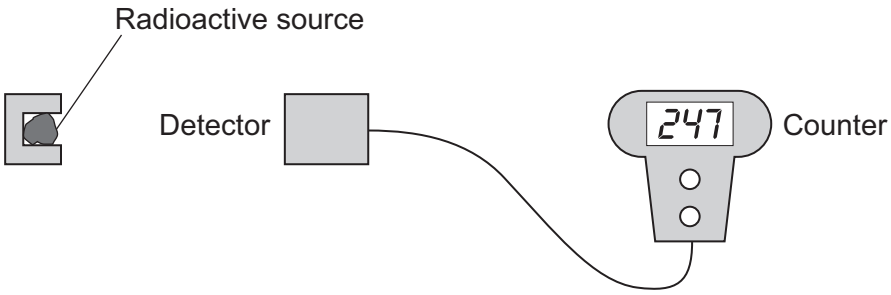
3 lead.

4 wood.

Turn over for the next question

QUESTION FIVE

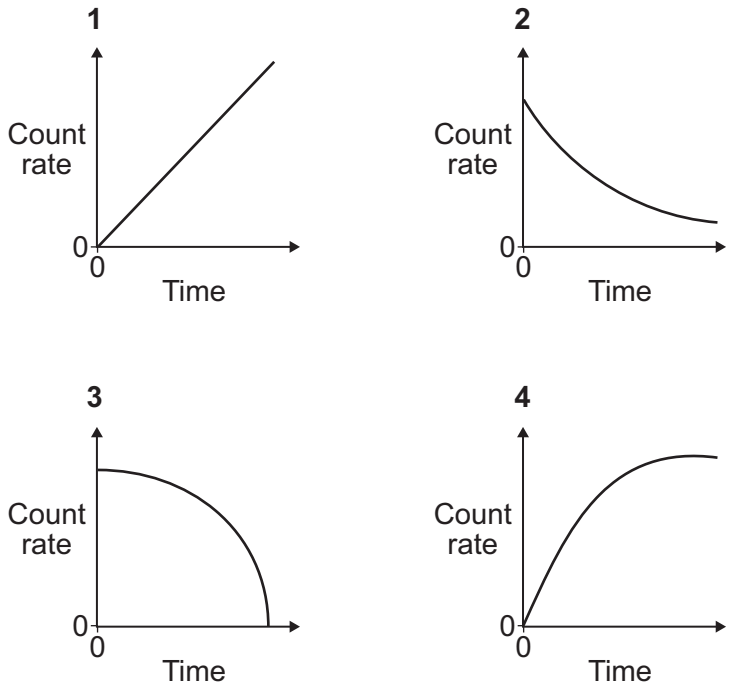
A teacher used the apparatus shown in the diagram to measure the count from a radioactive source.



She put the radioactive source near the detector. She measured the number of counts in 20 seconds. She reset the counter to zero and measured the number of counts in the next 20 seconds. She continued this for 10 minutes.

5A The teacher asked the students to plot a graph of the count rate against time.

Which of the following could be the expected shape of the graph?



5B The students can use their graphs to find the half-life of the radioactive source.

What is meant by *half-life*?

1 half the time it takes for the count rate to fall to zero

2 half the time it takes for the number of nuclei in the sample to halve

3 the time it takes for the count rate to halve

4 the time it takes for the number of nuclei in the sample to fall to zero

5C Which of the following will affect the initial count rate in the sample?

1 the pressure in the room

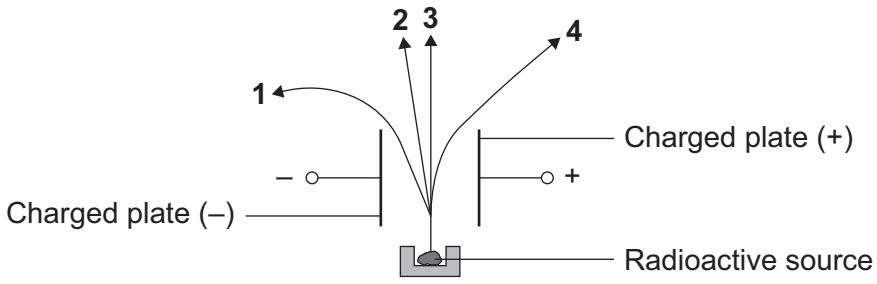
2 the original number of nuclei in the sample

3 the temperature of the room

4 the temperature of the sample

5D A radioactive source is placed close to a pair of charged parallel plates with an electric field between them.

Which of the lines, **1**, **2**, **3** or **4**, on the diagram shows the path of the beta particles emitted by the source?

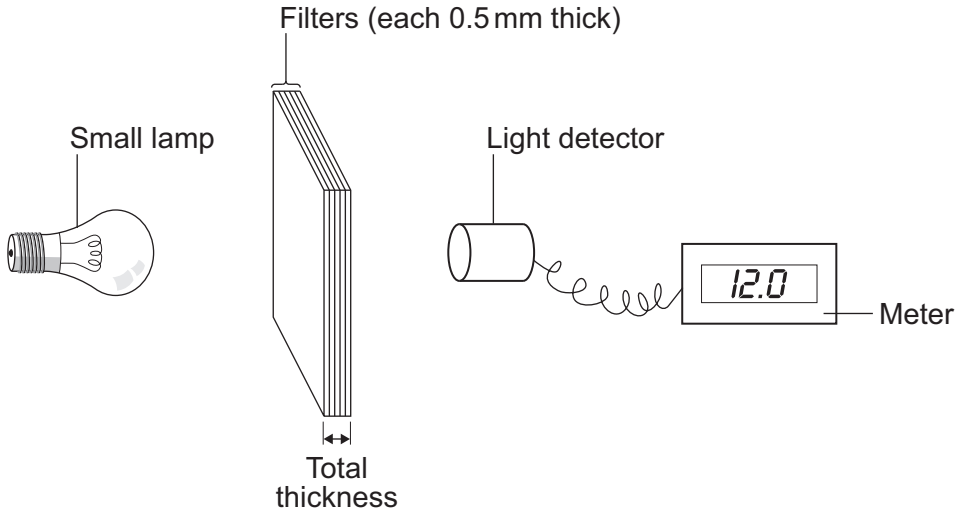


Turn over for the next question

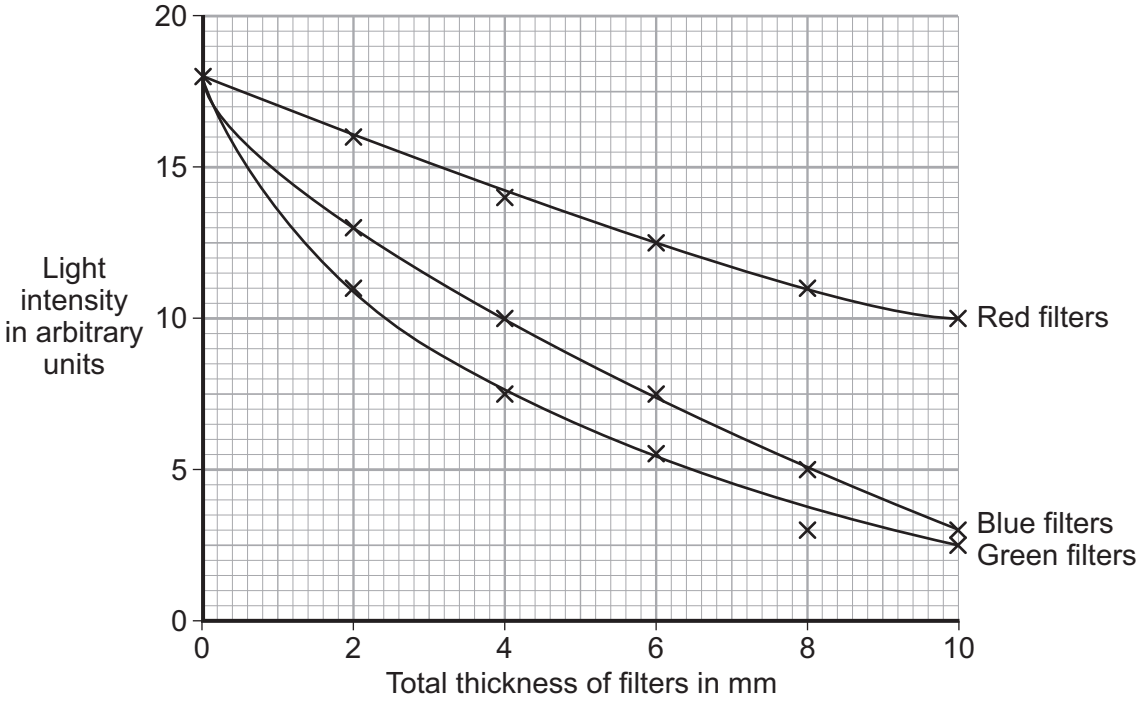
QUESTION SIX

Different numbers of coloured filters were placed between a small lamp and a light detector. Each filter was 0.5 mm thick.

The meter showed the intensity of the light reaching the detector.



The graph shows how the light intensity changes as the thickness of the filters changes.



6A Which is the best description of the pattern shown by the graph considering all the coloured filters?

1 The light intensity transmitted is directly proportional to the total thickness of the filters.

2 The light intensity transmitted is inversely proportional to the total thickness of the filters.

3 As the total thickness of the filters increases, the light intensity transmitted increases.

4 As the total thickness of the filters increases, the light intensity transmitted decreases.

6B What is the light intensity reading when 14 blue filters are used?

1 4.5 units

2 6.2 units

3 6.5 units

4 6.6 units

6C How many green filters would be needed to reduce the initial light intensity by 50 %?

1 three

2 five

3 six

4 seven

6D Which types of electromagnetic radiation are used to send signals along optical fibres?

1 infra red rays and ultraviolet rays

2 infra red rays and visible light

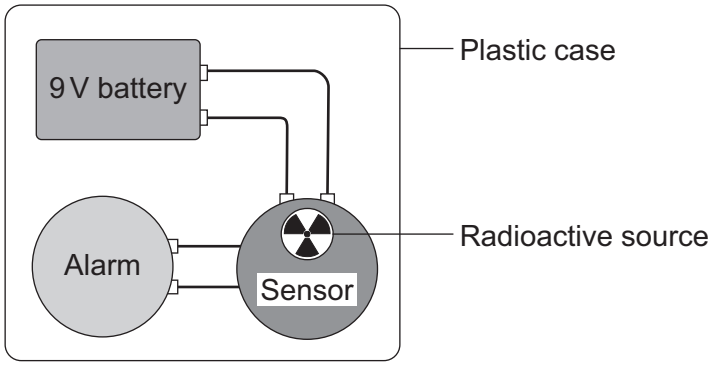
3 infra red rays, ultraviolet rays and visible light

4 visible light and ultraviolet rays

Turn over for the next question

QUESTION SEVEN

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.

7A 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.

7B 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.

7C 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.

7D The radioactive source has a half-life of about 400 years.

What fraction of the nuclei in the source will have decayed in 1200 years?

1 $\frac{1}{8}$

2 $\frac{1}{3}$

3 $\frac{2}{3}$

4 $\frac{7}{8}$

Turn over for the next question

QUESTION EIGHT

The light given out by distant galaxies has the same features as light from a very hot gas in a laboratory. However, the light from distant galaxies is shifted to longer wavelengths. This is called red-shift.

8A Red-shift occurs because . . .

1 the frequency of light increases as it travels through space.

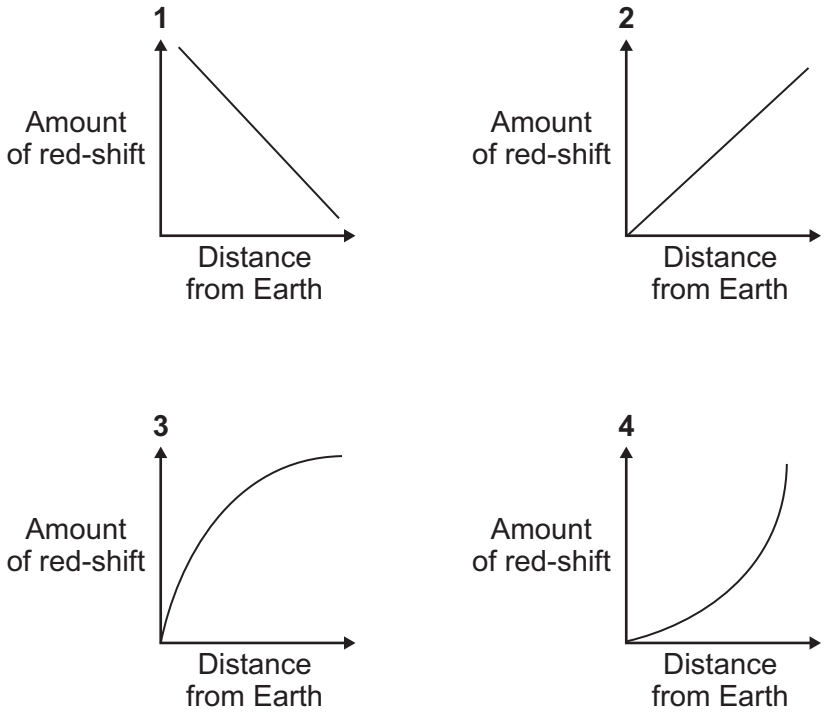
2 the speed of light from galaxies decreases as it travels through space.

3 distant galaxies have a relative movement away from the Earth.

4 distant galaxies have a relative movement towards the Earth.

8B Distant galaxies show an amount of red-shift which is directly proportional to their distance from the Earth.

Which graph shows this relationship?



8C The amount of red-shift can be used to estimate the speed of a galaxy relative to Earth.

This led to the discovery that distant galaxies are . . .

1 moving faster than nearer galaxies and the universe is contracting.

2 moving faster than nearer galaxies and the universe is expanding.

3 moving slower than nearer galaxies and the universe is contracting.

4 moving slower than nearer galaxies and the universe is expanding.

8D There are some galaxies close to the Earth that are moving towards the Earth.

Light from these galaxies has . . .

1 an observable decrease in its frequency.

2 an observable decrease in its wavelength.

3 smaller red-shifts than distant galaxies.

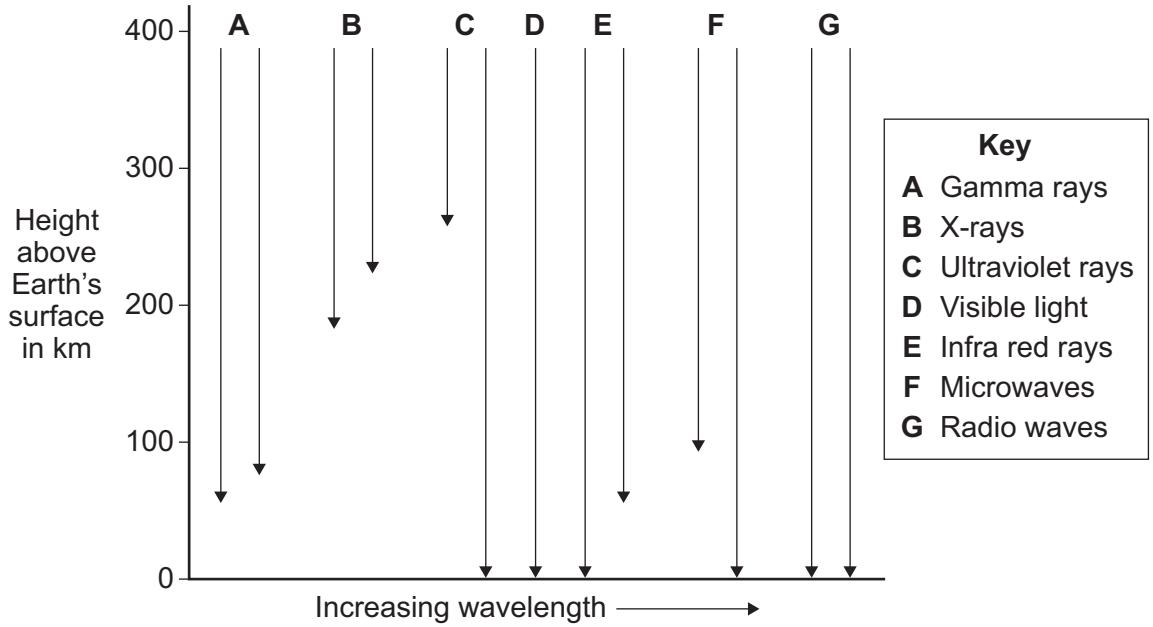
4 no change in its wavelength.

Turn over for the next question

QUESTION NINE

The diagram shows how far electromagnetic waves can penetrate the Earth's atmosphere.

Where two arrows are shown for a particular type of electromagnetic radiation, longer and shorter waves penetrate the atmosphere to different depths.



9A Which one of the following statements is true?

1 Gamma rays penetrate the atmosphere further than all other types of electromagnetic radiation.

2 All frequencies of ultraviolet radiation reach the Earth's surface.

3 No frequencies of radio waves reach the Earth's surface.

4 Higher frequencies of microwaves are completely absorbed by the atmosphere.

9B What would be the minimum height above the Earth for a satellite carrying telescopes designed to detect gamma rays, X-rays and ultraviolet radiation of all wavelengths?

1 50 km

2 70 km

3 180 km

4 260 km

9C Optical telescopes used to observe objects in space are limited because they can be used only . . .

1 as ground-based telescopes.

2 at night.

3 to observe a small region of the electromagnetic spectrum.

4 to observe one region of the sky.

9D Electromagnetic radiation from distant galaxies is very weak and is therefore very difficult to detect.

Some space telescopes use liquid helium to keep scientific instruments at a very low temperature.

Which type of weak electromagnetic radiation would best be detected by instruments kept at a very low temperature?

1 gamma rays

2 X-rays

3 infra red rays

4 ultraviolet rays

END OF TEST

There are no questions printed on this page