GCSE BITESIZE Examinations

General Certificate of Secondary Education

AQA SCIENCE A PHY1B

Unit Physics P1b (Radiation and the Universe)

AQA Physics

Unit Physics P1b (Radiation and the Universe)

HIGHER TIER

Specimen Paper

Time allowed: 30 minutes

Maximum marks: 36

Instructions
- Answer **all** of the questions for the Tier you are attempting.
- Record your answers on a separate answer sheet only.
- Do all rough work in this book **- not** on your answer sheet.

Advice
- Do **not** choose more responses than you are asked to. You will lose marks if you do.

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 choice on the answer sheet.

QUESTION ONE

The diagram below shows a representation of the electromagnetic spectrum.

Increasing wavelength ⟶

1	**2**		**Visible light**		**3**	**4**

⟵ Increasing frequency

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

A X-rays

B radio waves

C gamma rays

D microwaves

Turn over ▶

QUESTION TWO

Read the article below.

Wireless networking (Wi-fi) fears are 'unproven'

Wi-fi technology uses electromagnetic radiation to communicate from devices such as laptops. More and more schools are now installing wireless networks, but some people have reported suffering from ill-health as a result.

A scientist from Powerwatch, an organisation promoting the dangers of radiation, measured electromagnetic radiation levels. He measured radiation levels 100m from a mobile phone mast and 1m from a school laptop computer. The scientist reported that measurements of radiation levels near the laptop were three times higher than those 100m from the phone mast, although they were still 600 times less than the government's safety limits.

But other scientists have criticised the findings, saying they are "grossly unscientific".

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

A reliable

B related

C controlled

D biased

Scientists criticised the findings as being unscientific because the distances at which the measurements were taken were not …**1**…

By only sampling the radiation around only one computer, the findings were not …**2**…

Many people believe that the study should have used an independent scientist, as the scientist from Powerwatch may have presented …**3**… evidence.

The study also did not survey pupils to measure their health. This meant that scientists have no evidence to conclude whether ill-health and Wi-fi are …**4**…

SECTION TWO

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

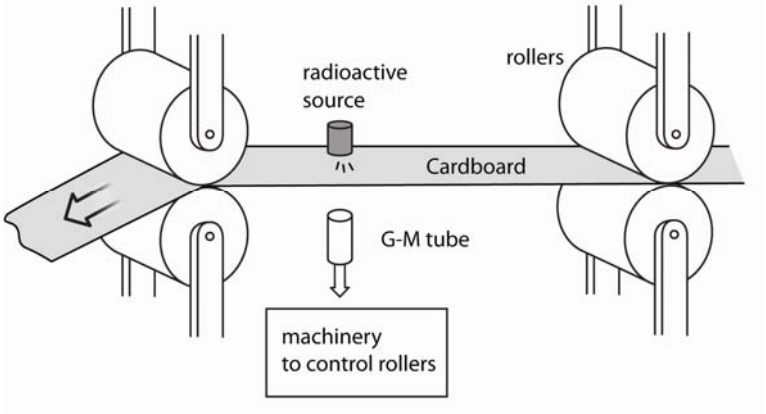
Each of these questions has four parts.

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

Mark your choices on the answer sheet.

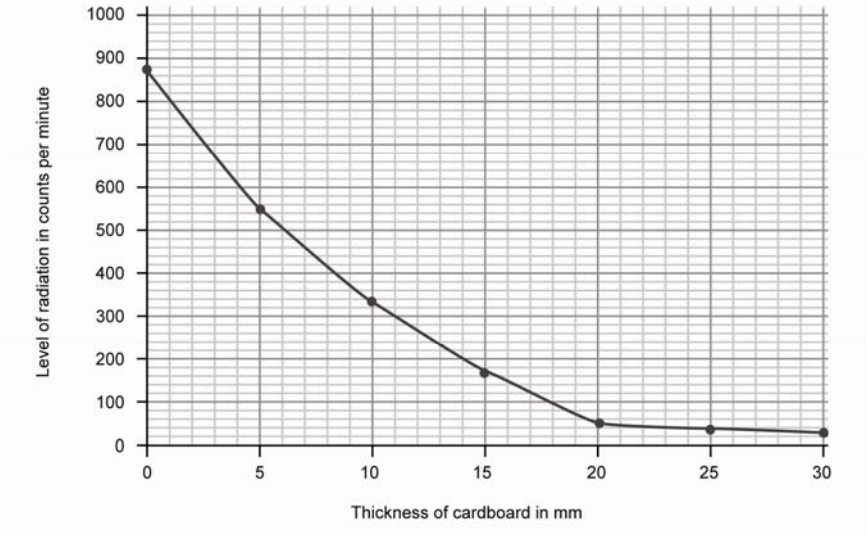
QUESTION THREE

A paper mill wanted to use Strontium-90 as a source of beta radiation to allow it to measure and control the thickness of the cardboard it was producing. The thicker the cardboard, the less radiation passes through to the Geiger-Müller tube.



Before the mill could set up the roller machinery, it first had to work out the levels of radiation which penetrated different thicknesses of cardboard. To do this, it set up a controlled laboratory investigation to establish the levels of radiation which penetrated different thicknesses of paper.

The results are shown below:



3A In this investigation, the thickness of the paper was the independent variable. Thickness of paper is a...

1 discrete variable.

2 continuous variable.

3 categoric variable.

4 ordered variable.

3B The decay of the Strontium-90 was not constant - rather it fluctuated. When the experiment was repeated, this produced variation between repeats. This is known as…

1 random error.

2 systematic error.

3 human error.

4 zero error.

3C The company used the known values from the pilot experiment to set up the roller machinery.

This is known as…

1 error reduction.

2 validation.

3 evaluation.

4 calibration.

3D The company decided to run one roller machine to produce 18mm cardboard continuously. What level of radiation would the machinery need to be set to?

1 90 counts per minute

2 100 counts per minute

3 120 counts per minute

4 130 counts per minute

QUESTION FOUR

On 6 August 1945, the US dropped an atomic bomb on the Japanese city of Hiroshima. This resulted in the release of radioactive material into the environment.

After the war, no reliable data was kept as to the number of cancers which the radiation caused, until 1975.

The table below shows the number of cases of a brain cancer called meningioma per 100,000 people per year for people living different distances from the site at which the bomb was detonated.

Distance from detonation site in km	Meningioma cases per 100,000 people per year, during the period 1975 to 1994			
	1975 to 1979	1980 to 1984	1985 to 1989	1990 to 1994
Less than 1 km	16	14	23.5	38
1 km to 1.5 km	5.5	4.5	10.5	14
1.5 km to 2 km	3	8	6.5	10
Not exposed	1.5	3	4	5.5

4A Why did the scientists who did the study include data for people who had not been exposed to radiation?

1 To act as a control group which other data could be compared against.

2 To prove that radiation had spread further than was originally thought.

3 To establish other causes of meningioma, other than nuclear radiation.

4 To work out how much zero error was contained within the data.

Turn over ►

4B By how many did the number of cases of meningioma per 100,000 increase between the period 1975 to 1979 and 1990 to 1994 for those living less than 1km from the detonation site?

1 8.5

2 22

3 24

4 32.5

4C Which of these is a valid conclusion to draw from the study?

1 Exposure to nuclear radiation results in meningioma.

2 The number of cases of meningioma has grown year upon year.

3 Meningioma is only contracted through exposure to nuclear radiation.

4 Those who were living nearer the detonation site were generally more likely to develop meningioma.

4D There are three different types of nuclear radiation. At these distances, the cancers are likely to have been caused by…

1 …alpha, beta and gamma radiation.

2 …beta and gamma radiation.

3 …beta radiation only.

4 …gamma radiation only.

Turn over ►

QUESTION FIVE

This question is about radioactive isotopes.

5A The table below contains information about the atomic structure of four substances.

Substance	Number of protons	Number of neutrons	Number of electrons
W	84	124	84
X	85	126	85
Y	84	126	84
Z	83	126	83

Using the information in the table, which two substances are isotopes of the same element?

1 W and X

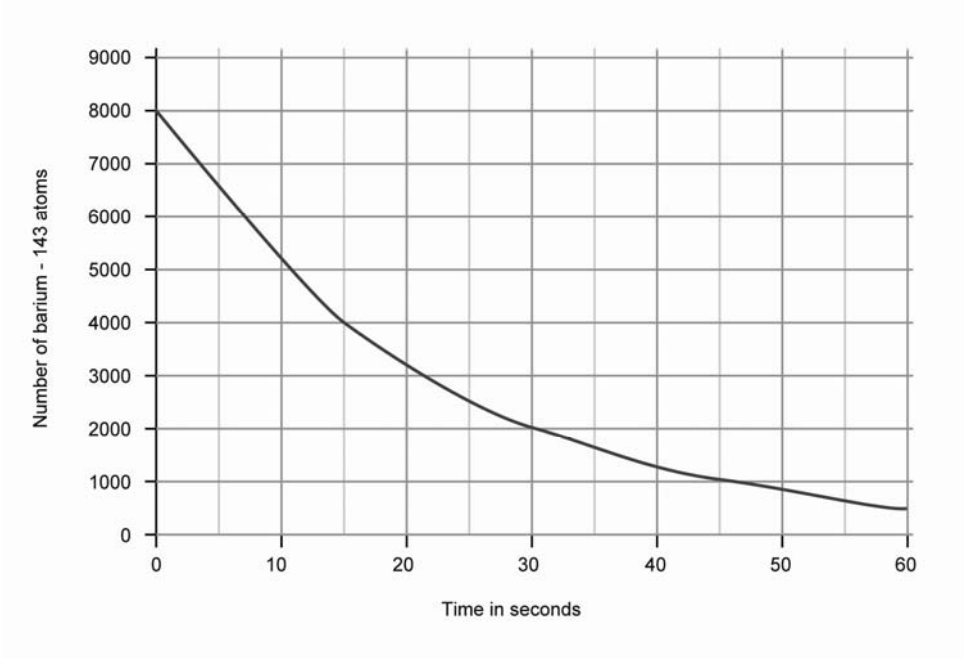
2 W and Y

3 W and Z

4 Y and Z

Radioisotopes are isotopes of elements whose nuclei decay, emitting radiation in the process.

The graph below shows the radioactive decay of the radioisotope Barium-143.



5B What is the half-life of Barium-143?

1 Five seconds

2 13 seconds

3 15 seconds

4 30 seconds

5C Using the information in the graph, calculate the number of barium-143 atoms which would be present after 90 seconds.

1 400

2 300

3 250

4 125

5D Read the statements about radiation in the box below:

> i) The speed at which radioactive substances decay cannot be altered.
>
> ii) Alpha and gamma radiation originate in the nucleus of an atom, while beta radiation originates from the electron shell of an atom.
>
> iii) Radioactive substances with a short half live are useless as they break down too quickly.

Which of the statements are correct?

1 Statement i) only

2 Statements i) and ii)

3 Statements ii) and iii)

4 None of the statements are correct.

Turn over ►

QUESTION SIX

Optical fibres are now used widely in telecommunications to carry signals over large distances. They have the advantage that they can be bundled up into cables that can be bent, and there is also less signal degeneration.

6A Which of these statements best describes how a signal can be transmitted along an optical fibre that is curved?

1 The optical fibres conduct an electrical signal along them.

2 Waves are reflected internally along the optical fibre.

3 The optical fibres absorb the signal and carry it along in the form of vibrations.

4 Electric fields are used to alter the direction of waves, so they stay in the centre of the optical fibre.

6B Infrared or visible light are used to send signals along optical fibres.

Visible light travels at 300 million m/s in a vacuum and has a typical wavelength of 0.000005 m.

wave speed (metres/second, m/s)	=	frequency (hertz, Hz)	x	wavelength (metres, m)

Calculate the frequency of the yellow light.

1 1,500 Hz

2 15,000 Hz

3 6,000,000,000,000 Hz

4 60,000,000,000,000 Hz

Turn over ►

6C Optical fibres can carry analogue and digital signals. Which one of these statements is **not** true about digital signals?

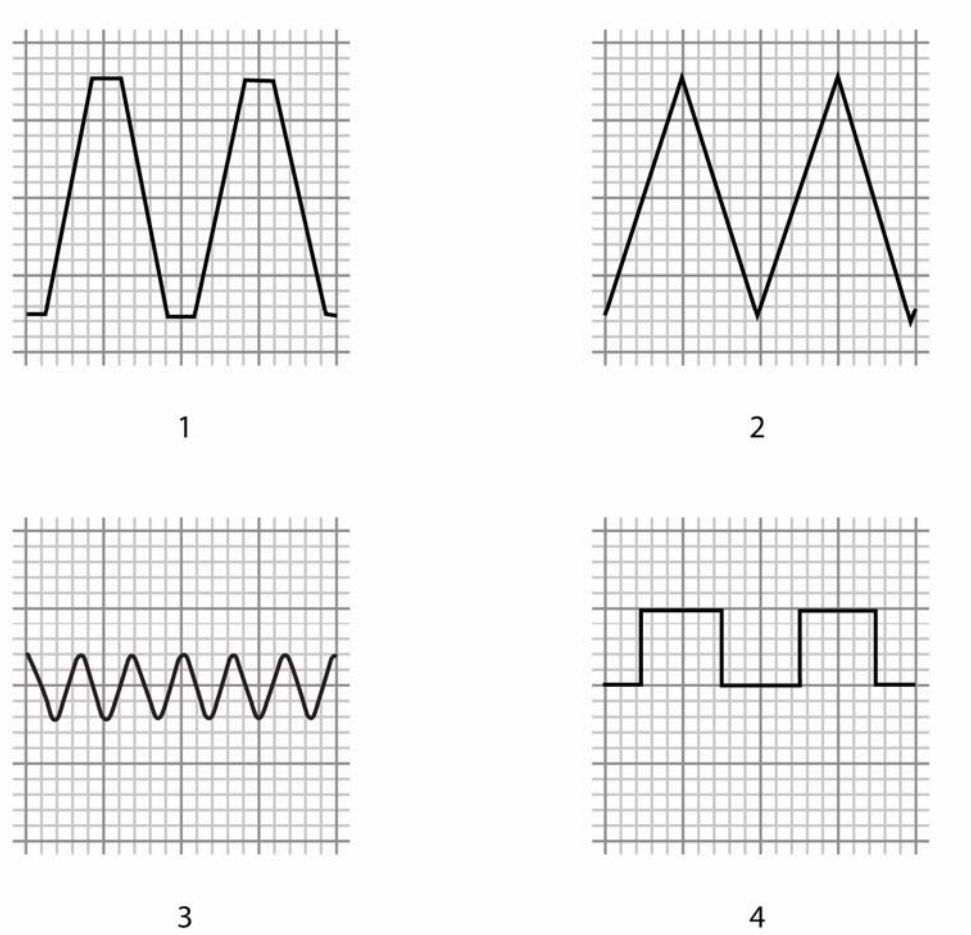
1 They are faster than analogue signals.

2 They are more easily processed by computers than analogue signals.

3 They are less prone to interference than analogue signals.

4 Several signals can be transmitted at once, meaning that more information can be sent in a given time.

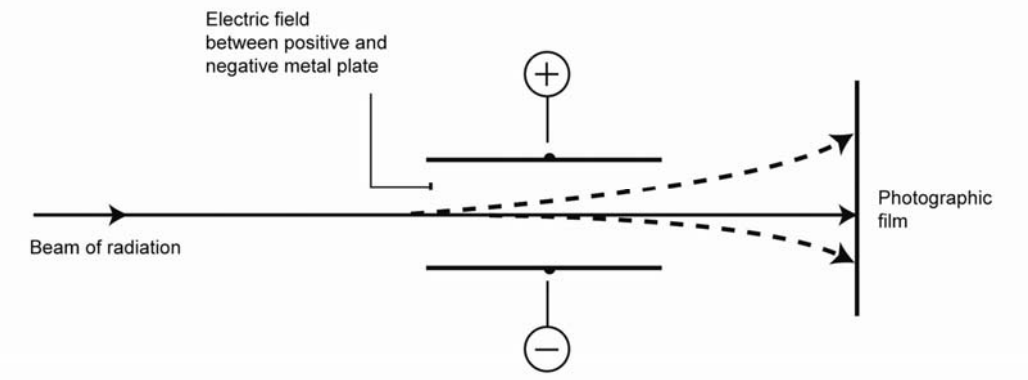
6D Which of these diagrams represents a digital wave?



Turn over ►

QUESTION SEVEN

The experiment below was first used to determine that there are three types of nuclear radiation. It involves passing radiation emitted from a radioactive source through an electric field and onto photographic film which detects where radiation lands.



7A Which row in the table is correct for the deflection that is seen in the different types of radiation?

	Attracted toward positive plate	Not affected by electromagnetic field	Attracted toward negative plate
1	alpha	gamma	beta
2	beta	gamma	alpha
3	beta	alpha	gamma
4	gamma	beta	alpha

7B The radiation which is attracted toward the positive plate is deflected more than the radiation which is attracted toward the negative plate.

This is because…

1 it has a smaller mass.

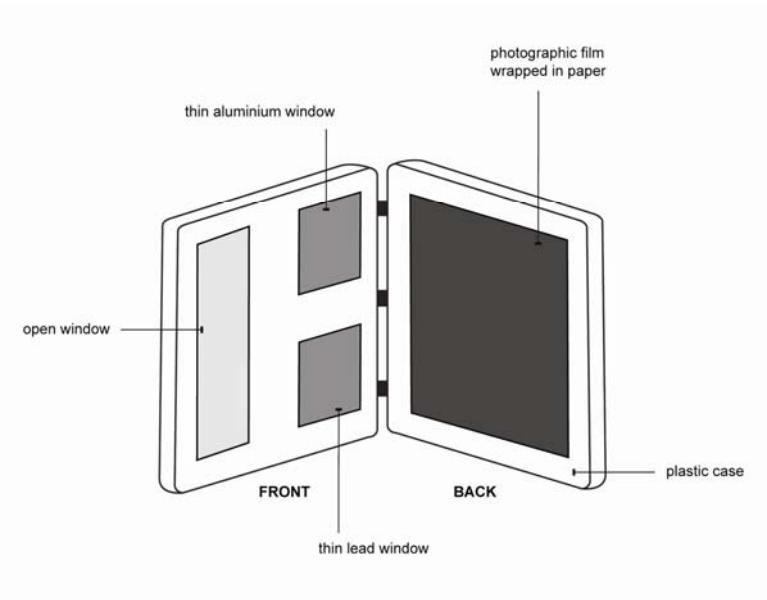
2 it has a smaller wavelength.

3 it has a greater charge.

4 it has a greater wavelength.

The diagram below shows what is inside radiation-sensitive badges that are worn by people who work with radiation to measure their level of exposure.

When closed, the back of the badge contains photographic film wrapped in paper. The radiation must pass through the front of the badge in order to affect the photographic film.



7C Which row of the table is correct for the types of radiation which would affect the wrapped photographic film behind each window?

	Open window	Thin aluminium window	Lead window
1	beta and gamma radiation	gamma radiation	gamma radiation
2	alpha, beta and gamma radiation	beta and gamma radiation	gamma radiation
3	alpha and beta radiation	gamma radiation	none
4	beta and gamma radiation	beta and gamma radiation	none

7D Nuclear workers also wear full protective suits to protect them against inhaling alpha particles.

Alpha particles are particularly dangerous inside the body because…

1 they have a strong penetrating effect.

2 they are absorbed by tissues, making the tissues become hotter.

3 they affect the electrical transmission of nerve impulses.

4 they have a strong ionisation effect in cells.

QUESTION EIGHT

Red-shift is a phenomenon which has been observed by astronomers in light emitted from distant galaxies. In 1929, the US astronomer Edwin Hubble discovered a linear relationship between the distance a galaxy is from us and the amount of red-shift he observed.

8A The red-shift that astronomers observe is caused by…

1 an increase in wavelength between emission and detection.

2 an increase in frequency between emission and detection.

3 a decrease in the velocity of the wave as it travels.

4 interference from other signals disrupting the quality of the wave.

8B Scientists use the red-shifting of light as evidence to support the 'Big Bang' theory.

This theory states that…

1 explosions caused the planets to be thrown into orbit around the stars.

2 all matter and energy in the Universe originated from one single point.

3 galaxies broke off from the Universe and are drifting away.

4 galaxies collide with each other, then drift apart.

Turn over ►

The sequence of colours in the visible light spectrum is:

red, orange, yellow, green, blue, indigo, violet.

Violet light from a galaxy 3 billion light years away appears green when it reaches Earth due to the red-shift effect.

8C A second galaxy is 8 billion light years away. What colour is violet light emitted from this galaxy likely to be when it reaches Earth?

1 Indigo

2 Red

3 Yellow

4 Green

8D What is likely to happen to the red light that is emitted from distant galaxies?

1 It stays red, as this is the end of the light spectrum.

2 It red-shifts into X-rays and gamma rays.

3 It shifts to the other end of the light spectrum and becomes blue.

4 It red-shifts into infrared and microwaves.

Turn over ►

QUESTION NINE

This question is about X-rays.

9A X-rays form part of the electromagnetic spectrum. Read the statements about electromagnetic radiation in the box below:

i) Different wavelengths of electromagnetic radiation may be transmitted, reflected instead, or absorbed by an object. ii) Electromagnetic radiation which is absorbed may create an alternating current with the same frequency as the electromagnetic wave. iii) Electromagnetic radiation which is absorbed may transfer energy to the object in the form of heat.

Which of the statements are correct?

1 All of the statements are correct.

2 Statement i) and ii) only.

3 Statement ii) and iii) only.

4 None of the statements are correct.

A team of scientists conducted an international study into the number of X-rays which were given to patients in hospitals and the proportion of cancers that could be linked to those X-rays.

Their findings are summarised in the table below:

Country	Number of X-rays given per 1,000 people	Percentage of cancers in men caused by exposure to X-rays	Percentage of cancers in women caused by exposure to X-rays
UK	489	0.6	0.6
Netherlands	600	0.7	0.7
Switzerland	750	1	1
Canada	892	1.1	1
Germany	1,254	1.3	1.7
Japan	1,477	2.9	3.8

Source: Berrington de Gonzalez A, Darby S. Risk of cancer from diagnostic X-rays: estimates for the UK and 14 other countries. *The Lancet* 2004; **363**:345-351

9B How much lower was the number of X-rays taken in the UK compared with the number taken in Japan?

1 33 per cent lower

2 46 per cent lower

3 59 per cent lower

4 67 per cent lower

9C Which of these conclusions is supported by the **general** trend in the results?

1 Men are more at risk from exposure to X-rays than women.

2 Cancer is caused by exposure to X-rays.

3 Increased exposure to X-rays increases the risk of developing cancers.

4 Less well developed countries have a higher cancer rate due to X-ray exposure.

9D The table below shows the results for the US in the same study:

Country	Number of X-rays given per 1,000 people	Percentage of cancers in men caused by exposure to X-rays	Percentage of cancers in women caused by exposure to X-rays
US	**962**	**0.9**	**1**

The figures from the US are lower than expected based on the trends shown in other countries.

Which of these factors would **not** explain the lower-than-expected cancer rates among US men and women?

1 The US patients may have received lower doses of X-rays.

2 The US has a larger population than other countries in the study.

3 The areas of the body not being X-rayed may have been better shielded.

4 The parts of the body commonly being X-rayed may have been different.

END OF QUESTIONS