GCSE Test

Physics: Atomic Structure

1.   1

Gamma radiation can be significantly reduced by…

○ Paper

○ Aluminium

○ Lead

2

What form of radiation is emitted by nuclei with too many neutrons?

○ Alpha

○ Gamma

○ Beta

3

Gamma radiation is...

○ An electromagnetic wave

○ A helium nucleus

○ An electron

4

Which form of radiation has the highest ionising power?

○ Gamma

○ Alpha

○ Beta

5

What causes an atom's nucleus to become unstable?

○

Too many or too few neutrons in the nucleus

○

More electrons than protons

○

Fewer electrons than protons

6

What is the activity of a source that emits 1,200 particles per minute?

○

1,200 Bq

○

20 Bq

○

72,000 Bq

7

Uranium 238 emits an alpha particle to become what nucleus?

○

Thorium-234

○

Thorium-239

○

Thorium-236

8

An alpha particle is…

○

An electron

○

A helium nucleus

○

An electromagnetic wave

1.

9

Which type of radiation can reach the furthest?

○

Beta

○

Gamma

○

Alpha

10

What fraction of a radioisotope has decayed after two half-lives? - Higher

○

One quarter

○

All of it

○

Three quarters

2. In 1913, Niels Bohr suggested a new model of the atom. This model has been further developed over time.

Complete the following sentences using words from the list: **[4 marks]**

In the modern model of the atom, the mass of the atom is concentrated in the _____. This central part of the atom is made up of particles called _____ and _____ and has an overall _____ charge.

nucleus	positive	electrons	protons	neutrons	negative

In the modern model of the atom, the mass of the atom is concentrated in the **nucleus**. This central part of the atom is made up of particles called **protons/neutrons** and **neutrons/protons** and has an overall **positive** charge.

For this question you need to use the words to fill in the gaps. It is recall of atomic structure that is required for this question. The mass is concentrated in the nucleus of the atom. This is made up of protons and neutrons and therefore has a positive charge.

3. Among these nuclei

234 U 92 uranium-234	235 U 92 uranium-235	238 Pu 94 plutonium-238	238 Am 95 americium-238
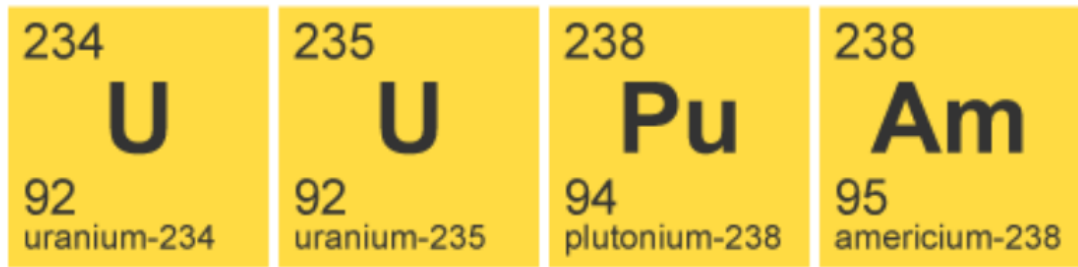
Which two nuclei have the same number of neutrons? **[1 mark]**

A	Plutonium-238 and uranium-235
B	Uranium-235 and americium-238
C	Uranium-234 and americium-238
D	Americium-238 and plutonium-238

4. Plutonium-238 is used in spacecraft to provide heat to power generators.

    One of these generators contains 925 g of plutonium-238 when it is manufactured.

    One gram of plutonium-238 has a power density of 0.54 W/g.

    Plutonium-238 has a half-life of 87.7 years.

    Calculate the average energy released per second by the generator after 263 years. **[4 marks]**

Make sure to show each step of your working clearly and include the unit in the final answer.

First, calculate the number of half lives which have passed in 263 years.

263 ÷ 87.7 = 3 half lives

Now calculate the mass of plutonium left after 87.7 years. Do this by finding 925 divided by 2, three times:

925 ÷ 2 = 462.5

462.5 ÷ 2 = 231.25

231.25 ÷ 2 = 115.625 g

Finally, calculate the total power by using the power density as 0.54 W/g.

To find the number of watts, multiply by the number of grams.

115.625 × 0.54 = **62.4 Joules**

5. This graph shows how the power output of the nuclear reactor would change if the control rods were removed.

Draw tangent at x = 10 on the curve and find gradient.
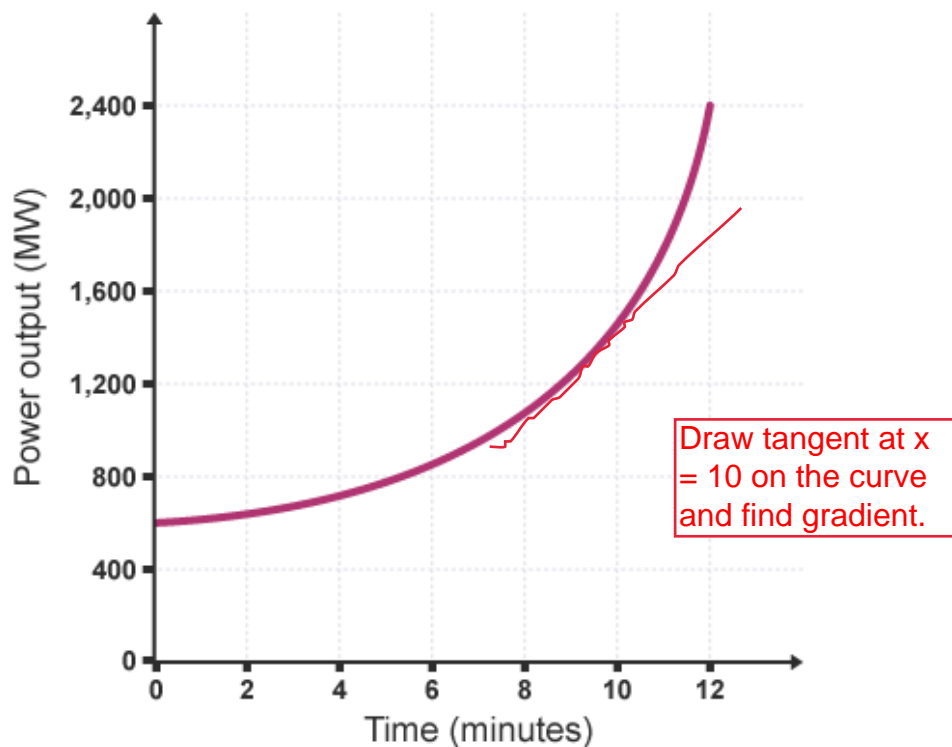
Calculate the rate of increase of power output at 10 minutes. **[2 marks]**

6. Lead-210 is a radioactive isotope that decays to an isotope of mercury by alpha decay.

    Complete the nuclear equation to show the alpha decay of lead-210.

    [3 marks]

$^{210}Pb \rightarrow_{80} Pb+$

$^{210}_{82}Pb \rightarrow^{206}_{80} Pb +^{4}_{2} He$
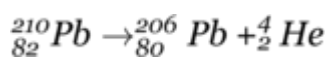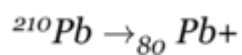
The total atomic (proton) numbers on each side of the equation should be equal. The total mass numbers on each side of the equation should be equal. You should know that an alpha particle could also be described as a Helium nucleus.

7. Scientists sometimes replace one scientific model with a different model.

   For example, in the early 20th Century the plum pudding model of the atom was replaced by the nuclear model of the atom.

   Explain what led to the plum pudding model of the atom being replaced by the nuclear model of the atom. **[6 marks]**

An experiment was carried out to direct alpha particles at a thin gold foil. The plum pudding model suggested that mass and charge were evenly spread throughout the atom. It was expected that the particles would be scattered evenly by the atoms. It was found that most alpha particles passed straight through the foil meaning most of the atom is empty space. A few alpha particles were deflected through large angles, meaning the atoms have a small, dense, positive nucleus.

The answer will need to be detailed, with scientific terms and easy for the examiner to follow.

You could include the following ideas:

- alpha particle scattering experiment
- alpha particles directed at gold foil
- most alpha particles pass straight through
- (so) most of atom is empty space
- a few alpha particles deflected through large angles
- (so) mass is concentrated at centre of atom
- (and) nucleus is (positively) charged
- plum pudding model has mass spread throughout atom
- plum pudding model has charge spread throughout atom

0 8 A student models the random nature of radioactive decay using 100 dice.

He rolls the dice and removes any that land with the number 6 facing upwards.

He rolls the remaining dice again.

The student repeats this process a number of times.

Table 1 shows his results.

Table 1

Roll number	Number of dice remaining
0	100
1	84
2	70
3	59
4	46
5	40
6	32
7	27
8	23

0 8 . 1 Give **two** reasons why this is a good model for the random nature of radioactive decay.

[2 marks]

1 _____

_____

2 _____

_____

The student's results are shown in **Figure 11**.

Figure 11
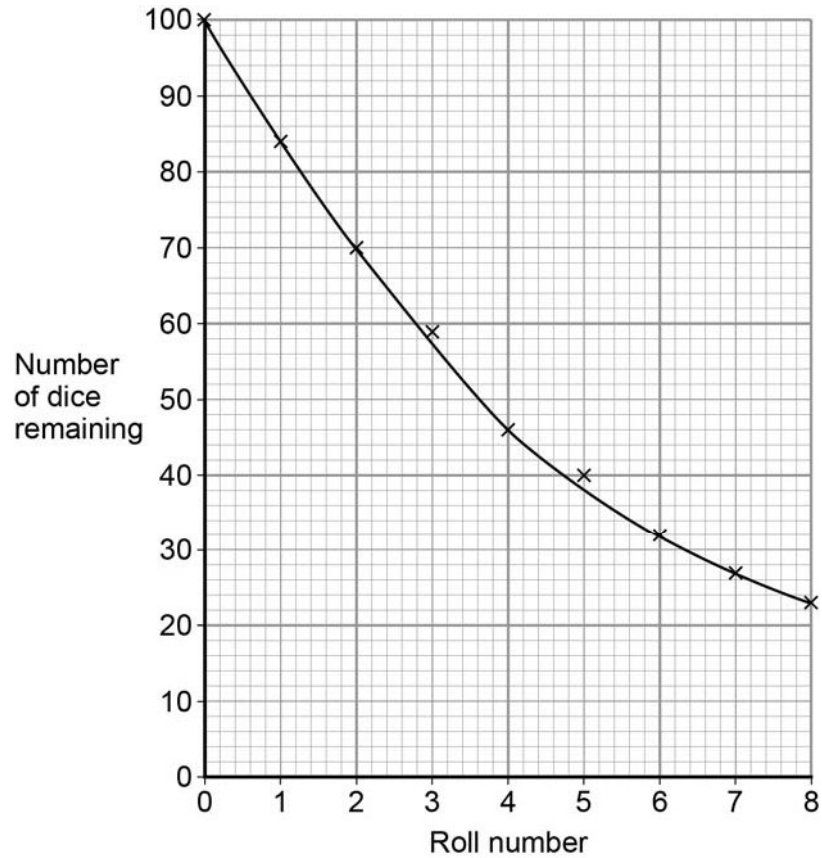
| 0 | 8 | . | 2 | Use **Figure 11** to determine the half-life for these dice using this model.

Show on **Figure 11** how you work out your answer.

[2 marks]

Half-life = _____ rolls

Question 9 continues on the next page

A teacher uses a protactinium (Pa) generator to produce a sample of radioactive material that has a half-life of 70 seconds.

In the first stage in the protactinium generator, uranium (U) decays into thorium (Th) and alpha (α) radiation is emitted.

The decay can be represented by the equation shown in **Figure 12**.

Figure 12

$$^{238}_{92}U \longrightarrow {}^{234}_{\boxed{}}Th + \alpha$$
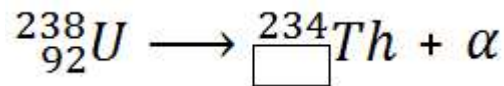
0 8 . 3   Determine the atomic number of thorium (Th) 234.

[1 mark]

Atomic number = _____

When protactinium decays, a new element is formed and radiation is emitted.

The decay can be represented by the equation shown in **Figure 13**.

Figure 13

$$^{234}_{91}Pa \rightarrow {}^{234}_{92}X + radiation$$
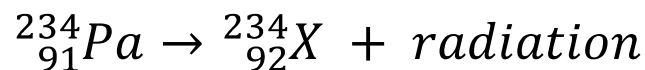
0 8 . 4   When protactinium decays, a new element, **X**, is formed.

Use information from **Figure 12** and **Figure 13** to determine the name of element **X**.

[1 mark]

0 8 . 5   Determine the type of radiation emitted as protactinium decays into a new element.

Give a reason for your answer.

[2 marks]

0 8 . 6   The teacher wears polythene gloves as a safety precaution when handling radioactive materials.

The polythene gloves do **not** stop the teacher's hands from being irradiated.

Explain why the teacher wears polythene gloves.

[2 marks]

Turn over for the next question

Turn over ▶

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	cannot predict <u>which</u> dice / atom will 'decay' cannot predict <u>when</u> a dice / atom will 'decay'	accept answers given in terms of 'roll a 6'	1 1	AO3/1b 4.4.2.3 WS1
08.2	3.6 to 3.7 (rolls)	allow **1** mark for attempt to read graph when number of dice = 50	2	AO2/2 4.4.2.3 WS3
08.3	90		1	AO2/1 4.4.2.2
08.4	uranium		1	AO2/1 4.4.1.2
08.5	beta proton number has gone up (as neutron decays to proton and e⁻)		1 1	AO1/1 AO3/2a 4.4.2.2
08.6	prevents contamination **or** prevents transfer of radioactive material to teacher's hands which would cause damage / irradiation over a longer time period.		1 1	AO1/1 AO2/1 4.4.2.4
Total			**10**	

1 This apparatus can be used to obtain ethene by cracking a liquid alkane.

liquid alkane on mineral fibre

aluminium oxide

ethene

heat

water
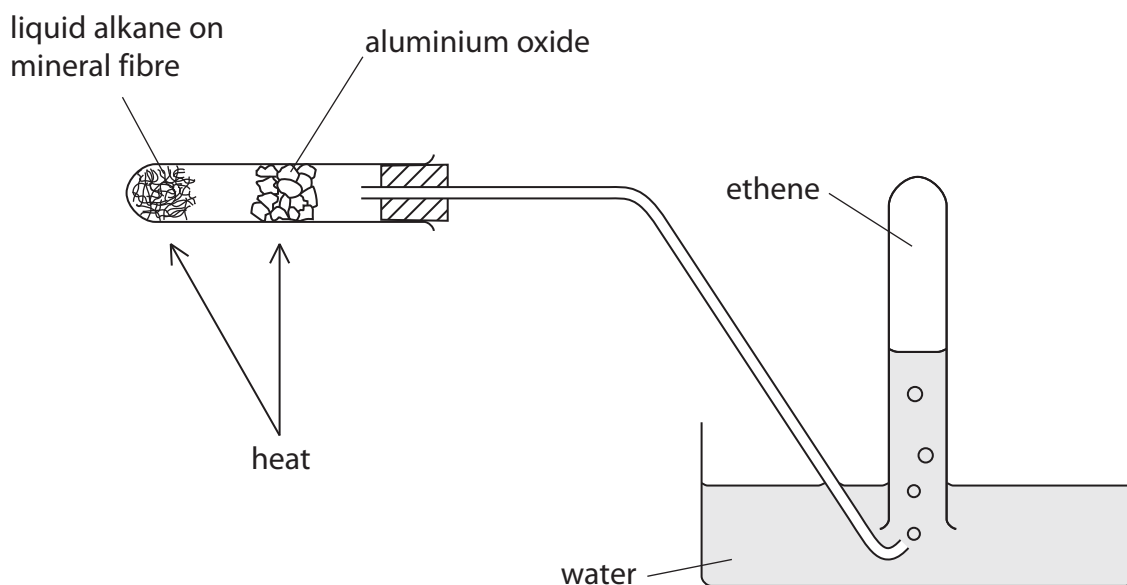
(a) What is meant by the term **cracking**?

(1)

....

....

....

(b) Give a chemical test to show that the gas collected is unsaturated.

(2)

....

....

....

(c) Cracking is also carried out in industry.

Give the name of the catalyst and the temperature used in the catalytic cracking of hydrocarbons.

(2)

catalyst...

temperature ....

(Total for Question 11 = 5 marks)

Question number	Answer	Accept	Reject	Marks
1 (a)	large hydrocarbons/alkanes/molecules become small ones IGNORE references to forming alkenes/ethene/ more useful molecules	(large) hydrocarbons or alkanes or molecules become smaller ones long chains become short chains	references to polymers	1
(b)	**M1** – (add to) bromine (water)/Br$_2$ IGNORE Br **M2** – (bromine) decolourised/turns colourless IGNORE starting colour and clear **M2** dep on **M1**, but can be scored for a near miss in **M1**,eg Br or bromide (water)	(acidified) potassium manganate(VII) decolourised/turns colourless		1 1
(c)	**M1** – (catalyst) silica / silicon dioxide / alumina / aluminium oxide **N.B.** if both name and formula given, mark the name only **M2** – 600-700 ºC	correct formula aluminosilicate / zeolite any value or range within this range equivalent temperatures in Kelvin		1 1

(Total marks for Question 11 = 5 marks)

2 (a) The table shows information about two common addition polymers.

Complete the table for these two polymers.

(4)

Name of polymer	Structure of monomer	Structure of polymer	One use for the polymer
poly(ethene)	 $\begin{array}{c} H \qquad\quad H \\ \diagdown \qquad\diagup \\ C = C \\ \diagup \qquad\diagdown \\ H \qquad\quad H \end{array}$ 		
		$\left[\begin{array}{cc} CH_3 & H \\ | & | \\ C\!-\!C \\ | & | \\ H & H \end{array}\right]_n$	water pipes

(b) State two changes that occur in the formation of an addition polymer from its monomer.

(2)

1 ....

....

2 ....

....

(c) Addition polymers such as poly(ethene) are very difficult to dispose of because they do not biodegrade easily.

(i) State a reason why addition polymers do not biodegrade easily.
(1)

....

....

(ii) Burning and landfill (burying in the ground) are two methods used to dispose of addition polymers.

Suggest a problem with each method of disposal.
(2)

burning...

....

landfill...

....

(Total for Question 14 = 9 marks)

Question number	Answer	Accept	Reject	Marks
2 (a)	**M1 –** $\left(\begin{array}{cc} H & H \\ -C-C- \\ H & H \end{array} \right)_n$ **M2** – any suitable use, eg: • plastic bags • buckets/bowls • storage bottles (for food, drinks, chemicals) • garden furniture • gas pipes • rubbish bins • storage tanks for fuel • cling film • packaging • clothing • insulation (for electric cables) Please research any unfamiliar use **M3 –** poly(propene) **M4** - $\begin{array}{cc} H & CH_3 \\ C=C \\ H & H \end{array}$ IGNORE bond angles	continuation bonds not going through brackets polypropene polypropylene methyl group attached to any carbon methyl group displayed	just plastic	1 1 1 1

(b)		Any two from **M1** – (many) small molecules/monomers join up **M2** - double bond becomes single bond/ it becomes saturated **M3** – increase in mass/chain length/size	OWTTE double bond breaks and single bond forms		2
(c)	(i)	inert(ness) IGNORE strong bonds / long chains	unreactive/non-polar		1
	(ii)	**M1** – produces greenhouse gases/toxic gases/poisonous gases	carbon dioxide		1
		M2 – (landfill) uses up land / takes up space			1
		OR new sites hard to find			

(Total marks for Question 14 = 9 marks)

3 Crude oil is an important source of organic compounds.

(a) The diagram shows how crude oil is separated into fractions in the oil industry.
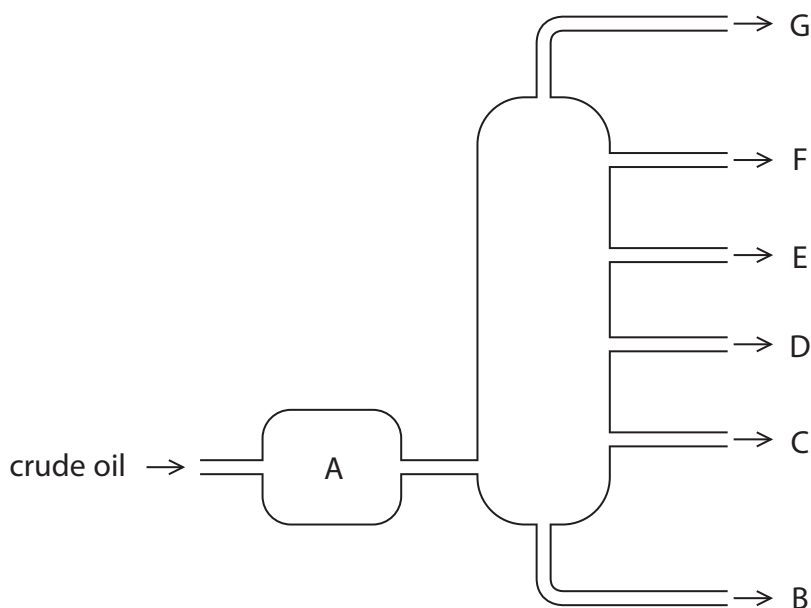
(i) What happens to the crude oil in A?

(1)

....

....

....

(ii) Most of the compounds in crude oil are hydrocarbons.

What is meant by the term **hydrocarbons**?

(2)

....

....

(iii) Compare the hydrocarbons in fractions D and F in terms of

- boiling point
- size of molecules
- viscosity

(3)

....

....

....

....

....

....

....

....

....

(b) Some of the fractions are catalytically cracked. The general equation for some reactions in this process is

$$alkane \rightarrow alkane + alkene$$

(i) State two conditions used in catalytic cracking.

(2)

1 ....

....

2 ....

....

(ii) How does the bonding in an alkene molecule differ from the bonding in an alkane molecule?

(1)

....

....

(iii) The chemical equation for one cracking reaction is

$$C_{16}H_{34} \rightarrow C_8H_{18} + 2C_3H_6 + compound\ Q$$
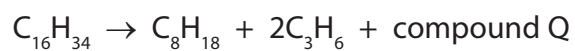
Deduce the molecular formula of Q.

(1)

....

(c) The compound with molecular formula C_3H_6 can be used to make a polymer.

(i) Give the name of the compound C_3H_6

(1)

....

(ii) Complete the table of information about this compound.

(3)

Type of formula	Formula
molecular	C_3H_6
	C_nH_{2n}
	CH_2
displayed	

(iii) Complete this structure to show the part of the polymer formed from two molecules of C_3H_6

(2)

$$-\!\!-C-\!\!-C-\!\!-C-\!\!-C-\!\!-$$
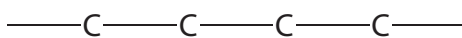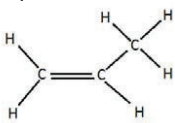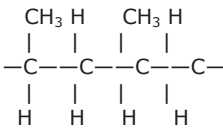
(Total for Question 6 = 16 marks)

Question number			Answer	Notes	Marks
3	a	i	heated	Accept boiled / evaporated / vaporised Reject burn Ignore melts	1
		ii	(compounds containing) hydrogen and carbon	Accept substances/molecules containing … Reject atoms/elements //mixture containing … Reject hydrogen and carbon molecules/ions	1
			only	Accept alternatives such as solely M2 needs a reference to hydrogen and carbon	1
		iii	(hydrocarbons/molecules in) D have: higher boiling point larger/bigger/heavier/longer molecules more viscous/thicker/less runny	Ignore melting point If no reference to D or F, then 0/3 Accept converse statements for F	1 1 1
6	b	i	silica / alumina (catalyst) 600 – 700 °C	Accept aluminosilicate / Al_2O_3 / SiO_2 / zeolite /broken ceramic/porous pot Accept any value or range within this range Units required Accept equivalent values in K	1 1
		ii	(alkene has) double bond (between C atoms) OR alkane has only single bonds / no double bonds / no multiple bonds	Assume it = alkenes Accept multiple bonds Reject triple bonds Reject references to ionic bonding Ignore references to intermolecular forces	1

Question number			Answer	Notes	Marks
3	b	iii	C_2H_4	Accept structural and displayed formula Penalise incorrectly shown formulae eg eg C2H4 / C_2h_4 / C_2 + H_4	1
	c	i	propene	Accept propylene / prop-1-ene Reject incorrect spellings	1
		ii	general empirical 	Accept methyl group in any position Ignore shape and bond angles	1 1 1
		iii		M1 for <u>two</u> carbon atoms both with 2 H atoms M2 for <u>two</u> carbon atoms both with 1 H atom and 1 CH_3 group No M2 if methyl groups on 1st + 2nd, or 3rd + 4th carbons in chain Do not penalise bonds to H of CH_3 Max 1 if chain extended correctly 0/2 if any double bonds shown Ignore brackets and $_n$	2

(Total for Question 6 = 15 marks)

GCSE Test

Biology: Infection and response

1) The number of people living with HIV each year is recorded by the UN. The date for recent years is shown in the table below.

Data from UNAIDS								
Year	2000	2005	2010	2011	2012	2013	2014	2015
Infected people (millions)	28.9	31.8	33.3	33.9	34.5	35.2	35.9	36.7

Plot these points on graph paper. Draw a line of best fit. **[4 marks]**
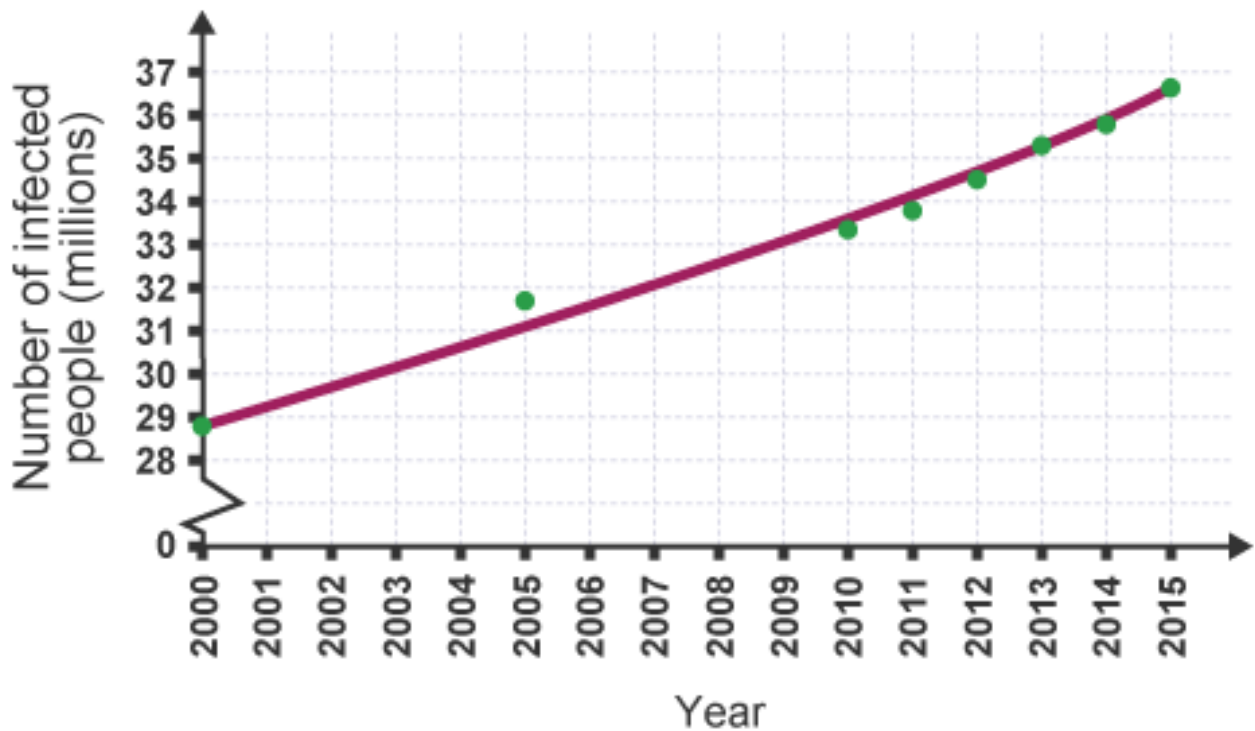
2) Doctors are now prescribing fewer antibiotics to reduce the evolution of antibiotic resistant bacteria. Describe the process of evolution of antibiotic bacteria. **[6 marks]**

- in every population there is variation, so some bacteria are resistant whilst others aren't [1 mark]

- the individuals (in this example, the bacteria) with the most advantageous characteristics are more likely to survive and reproduce [1 mark]

- so those that have the gene for antibiotic resistance have an advantage [1 mark]

- this is survival of the fittest [1 mark]

- because of inheritance, the offspring of those with the advantageous characteristic are more likely to have it [1 mark]

- this process is repeated over many generations until most of the bacteria are now antibiotic resistant [1 mark]

3) 1

HIV/AIDS is what type of pathogen?

◉ **A virus**

○ A fungus

○ A bacterium

2

Salmonella is what type of pathogen?

○ A protist

◉ **A bacterium**

○ A fungus

3

Black rose spot is what type of pathogen?

○ A virus

○ A protist

◉ **A fungus**

4

Malaria is caused by what type of pathogen?

◉ **A protist**

○ A fungus

○ A virus

5

What term describes an organism that transmits a disease?

○

A host

◉ A vector

○

A protist

6

How is measles often transmitted?

○

Via uncooked food

○

Via dirty water

◉ Through the air

7

In which foods is Salmonella more likely to be found?

◉ Meat, eggs and poultry

○

Vegetable and fruit

○

Seeds and nuts

8

Which of these does not prevent the spread of diseases?

○

Barrier method contraception

◉ Cancer screening

○

Sterilizing water

Which of these is a non-specific defence against disease?

○

Antibodies

○

Lymphocytes

◉

Skin

Which of these do lymphocytes not produce?

◉

Antigens

○

Antibodies

○

Antitoxins

6   The graph shows the number of people in the Caribbean who were known to be infected
    with HIV, who had AIDS and who died from AIDS, between 1982 and 2008.
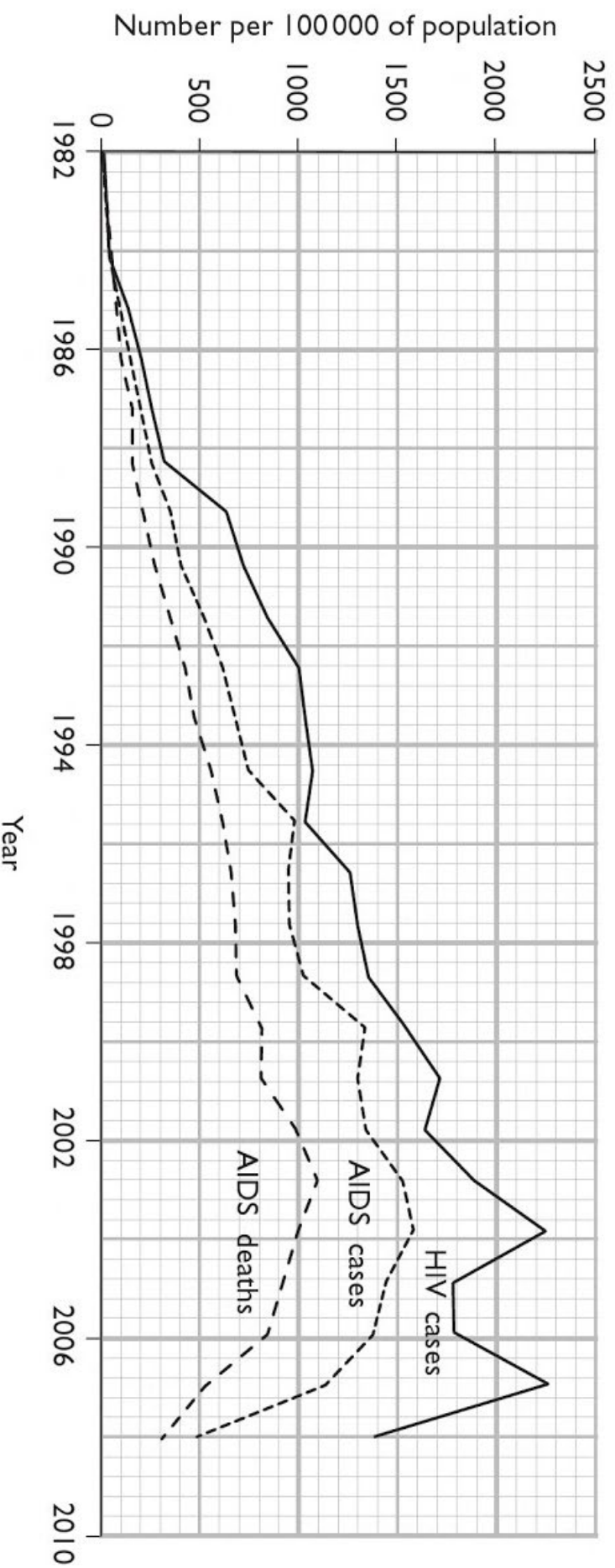
a   With reference to the graph, describe the changes in the number of people infected with
    HIV between 1982 and 2008.   [3]

b   Suggest why the actual number of people infected with HIV may be greater than the
    numbers shown on the graph.   [2]

c   Explain how infection with HIV leads to the symptoms of AIDS.   [5]

d   Suggest the reasons for the shape of the graphs between 2004 and 2008.   [4]

a) increased and then decreased;
   peaks in 2004 and 2007;
   any figure quote using both year and number of people infected read from the graph; (**3 marks**)

b) people recently infected with HIV show no symptoms;
   may not have had their blood checked; (**2 marks**)

c) HIV is a virus;
   infects lymphocytes;
   so, body cannot fight effectively against pathogens;
   or destroy its own cancerous cells;
   (so) infectious diseases can take hold / cancer can develop, much more easily; (5 **marks**)

d) more awareness of AIDS;
   people with HIV/AIDS now knew that they had it and avoided passing it on;
   people who were not HIV positive modified their behaviour to reduce the risk of becoming infected with HIV;
   example – avoided having multiple partners /used condoms / did not share contaminated needles;
   use of anti-retroviral drugs to treat AIDS;
   other valid point; (4 **marks**)

| 0 | 2 |

Tobacco mosaic virus (TMV) is a disease affecting plants.

Figure 1 shows a leaf infected with TMV.

Figure 1

Yellow patches where TMV has destroyed chloroplasts

| 0 | 2 | . | 1 |

All tools should be washed in disinfectant after using them on plants infected with TMV.

Suggest why.

[1 mark]

| 0 | 2 | . | 2 |

Scientists produced a single plant that contained a TMV-resistant gene.

Suggest how scientists can use this plant to produce **many** plants with the TMV-resistant gene.

[1 mark]

Some plants produce fruits which contain glucose.

Describe how you would test for the presence of glucose in fruit.

[2 marks]

TMV can cause plants to produce less chlorophyll.

This causes leaf discoloration.

Explain why plants with TMV have stunted growth.

[4 marks]

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	to kill virus **or** to prevent virus spreading		1	AO2/2 4.3.1.2 4.3.3.1
02.2	take (stem) cells from meristem **or** tissue culture	allow take cuttings	1	AO2/1 4.1.2.3
02.3	heat mixture and add a few drops of Benedict's solution		1	AO1/2 4.2.2.1 4.4.1.3
	glucose turns solution blue to orange		1	AO1/2 4.2.2.1 4.4.1.3

Question	Answers		Mark	AO / Spec. Ref.
02.4	**Level 2:** A clear, logical and coherent explanation which links relevant content.		3–4	AO2/1 4.3.1.2 4.3.3.1 4.4.1.3
	Level 1: Some relevant content but explanation is incomplete or insufficiently linked.		1–2	
	No relevant content		0	

	Indicative content
	
	• less photosynthesis because of lack of chlorophyll
	• therefore less glucose made
	  so
	• less energy released for growth
	• because glucose is needed for respiration
	  and /or
	• therefore less amino acids / proteins / cellulose for growth
	• because glucose is needed for making amino acids / proteins / cellulose			

| Total | | | 8 | |