Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3440UB0-1

S18-3440UB0-1

APPLIED SCIENCE (Single Award)
UNIT 2: Science to Support our Lifestyles

HIGHER TIER

TUESDAY, 15 MAY 2018 – AFTERNOON

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**11**	
2.	**8**	
3.	**8**	
4.	**5**	
5.	**8**	
6.	**8**	
7.	**15**	
8.	**12**	
Total	**75**	

3440UB01
01

ADDITIONAL MATERIALS

A calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question **7***(c)* is a quality of extended response (QER) question where your writing skills will be assessed.

The Periodic Table is printed on the back cover of the examination paper.

Examiner only

Answer **all** *questions.*

1. *(a)* (i) State what is meant by a *catalyst*. [2]

.....

.....

(ii) Give **two** reasons why it is important to develop effective catalysts. [2]

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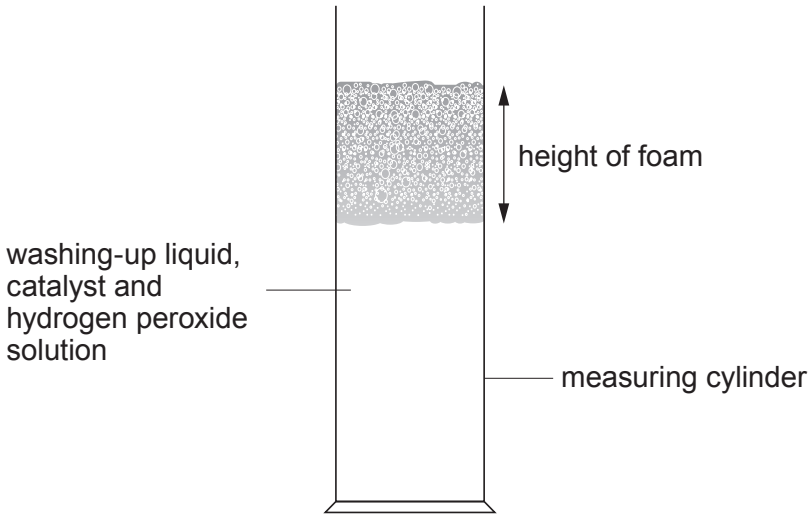
(b) A technician carried out the following experiment to find a suitable catalyst for the decomposition of hydrogen peroxide. She tested iron(III) oxide, manganese(IV) oxide and lead(IV) oxide.

One drop of washing up liquid and a spatula-full of a catalyst was added to a 10 cm^3 measuring cylinder. When hydrogen peroxide decomposes it produces oxygen which forms a foam when mixed with washing-up liquid.

Hydrogen peroxide solution at room temperature was poured into the measuring cylinder and a foam rose up the cylinder at a rate dependent on the effectiveness of the catalyst. The height of the foam above the liquid was measured every 10 seconds for each catalyst.



The following results were obtained.

Time (s)	Height of foam (mm)		
	iron(III) oxide	manganese(IV) oxide	lead(IV) oxide
0	0.0	0.0	0.0
10	0.5	4.0	2.2
20	1.1	6.8	3.6
30	1.2	9.1	5.3
40	1.2	10.2	6.3
50	1.2	10.2	6.8
60	1.3	10.2	7.1

Examiner only

(i) State the dependent variable in this experiment. [1]

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(ii) State **two** variables that need to be controlled in this experiment. [2]

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(c) Explain which catalyst is the most effective. [2]

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(d) Suggest **one** inaccuracy in the experiment and how it can be improved. [2]

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11

Turn over.

Examiner only

2. Radiographers use a range of imaging methods, to help diagnose injuries, some of which use ionising radiation.

(a) (i) State what is meant by the term *ionising radiation*. [1]

.....

(ii) State **one** difference between how a CAT scan and a standard X-ray photograph is produced. [1]

.....

The table below gives some information about different types of medical imaging methods.

Type of imaging method	Type of radiation used	Ionising radiation	Time to produce image	Type of image	Quality of images
MRI	Radio waves	no	30 min	still	high quality for soft tissue and bone
X-rays	X-rays	yes	1 min	still	High quality two dimensional (2D) images of bone
CAT	X-rays	yes	5 min	still	High quality three dimensional (3D) images of bone and soft tissues
Gamma camera	Gamma rays	yes	30 min	real-time moving image	low quality images of targeted organ
Ultra sound	High frequency sound waves	no	15 min	real-time moving image	low quality image of soft tissues

(b) Use the information in the table to answer the following.

(i) A worker was involved in a serious fall. He was rushed to an accident and emergency department where the doctors suspected damage to the internal organs.

Explain which type of imaging method should be used in the accident and emergency department to provide a quick diagnosis. [2]

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Examiner only

(ii) Explain which type of imaging method is preferred when studying kidney function. [2]

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(c) The recommended maximum radiation dose for adults per year is 20 millisieverts (mSv). The table below shows some typical dosages from scans.

Type of scan	Dose (mSv)
CAT scan of pelvis	20
CAT scan of spine	7
X-ray of spine	1.5
X-ray of head	0.02
Ultrasound	0
MRI scan	0

Two months ago, Ieuan was involved in a motorbike accident. At the time of the crash he was given a CAT scan of his pelvis, and X-rays of his head and spine. The doctor needs to see how his spine is healing.
Explain using information from the table which scan you would recommend. [2]

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8

Examiner only

3. Elite cyclists have special diets for training and taking part in competition. A cyclist on the Tour de France can consume 2.5 times the energy intake of an equivalent sized adult without an increase in body mass. This additional energy requirement is met by the body metabolising carbohydrates rather than fat. The body stores relatively little carbohydrate compared to body fat. After two hours of exercise the carbohydrate levels are depleted.

The table below shows how 4 diets (**A**, **B**, **C** and **D**) compare to the guideline daily amount (GDA) for a typical man.

Dietary values	GDA	Diet **A**	Diet **B**	Diet **C**	Diet **D**
Energy (kcal)	2500	4500	6250	6250	7250
carbohydrate (g)	260	400	300	700	700
of which are sugars (g)	90	120	90	120	90
fat (g)	70	100	175	75	175
fibre (g)	38	18	18	18	18
protein (g)	50	55	55	55	70
salt (g)	6	6	7	7	6

(a) Explain which diet (**A**, **B**, **C** and **D**) is most suitable for a cyclist preparing to race in the Tour de France. [2]

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(b) Cyclists are advised on the amount of salt in their diet. Explain why the correct amount of salt is important. [2]

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Examiner only

(c) A young man has a BMI of 30 and height of 1.94 m. He does not play sport or take much exercise.

Use the equation:

$$\text{BMI} = \frac{\text{mass}}{\text{height}^2}$$

to calculate how much mass the young man would need to lose to have a BMI of 24 which is within the normal range [4]

mass = ... kg

8

Turn over.

Examiner only

4. Cystic fibrosis is an inherited genetic disease caused by a recessive allele **(n)**. Individuals can undergo genetic screening and can receive counselling if they are found to be carriers.

(a) Draw a suitable genetic diagram to determine the probability of the offspring being carriers if both parents are carriers. [3]

probability = ...

(b) Discuss the ethical problems that may arise when individuals undergo genetic screening and find out they are carriers of cystic fibrosis. [2]

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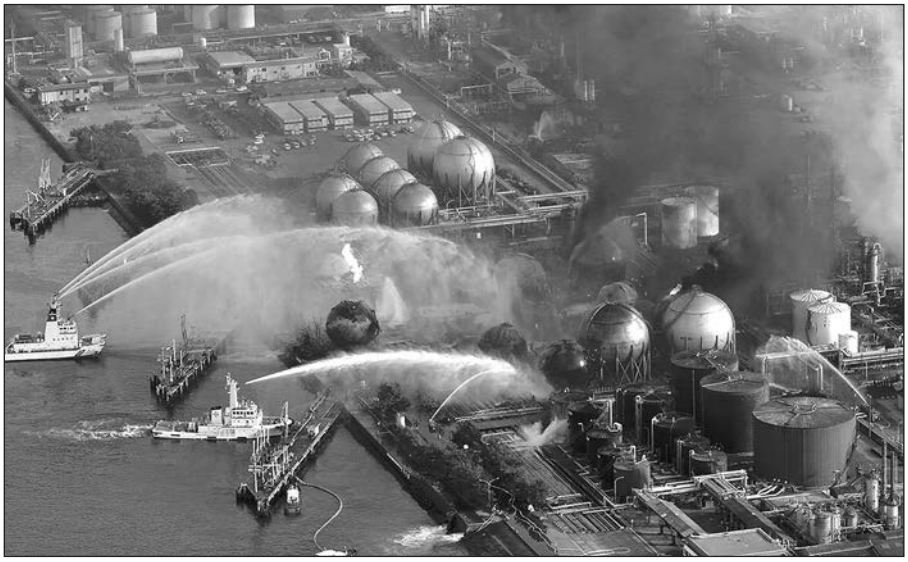
Examiner only

5. In 2011 there was an accident at the Fukushima power plant where caesium-137 (Cs-137) was released.



Cs-137 has a half-life of 28 years.

Cs-137 contamination in seabed samples near the Fukushima plant was measured in 2016 at 120 Bq/kg (becquerel per kilogram), compared to levels before 2011 of 0.3 Bq/kg. Scientists believe that it would be safe to eat the fish after the Cs-137 in the seabed has reduced its activity to 15 Bq/kg.

(a) John claims that the fish will be safe to eat in 2080. Use the information above to determine whether John is correct. [3]

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(b) During a fission reaction a $^{235}_{92}U$ nucleus absorbs a neutron, $^{1}_{0}n$, to produce $^{137}_{55}Cs$, $^{96}_{37}Rb$ and some neutrons.

(i) Use this information to write a nuclear equation for this fission reaction. [3]

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(ii) Describe how this fission reaction could lead to an uncontrolled chain reaction. [2]

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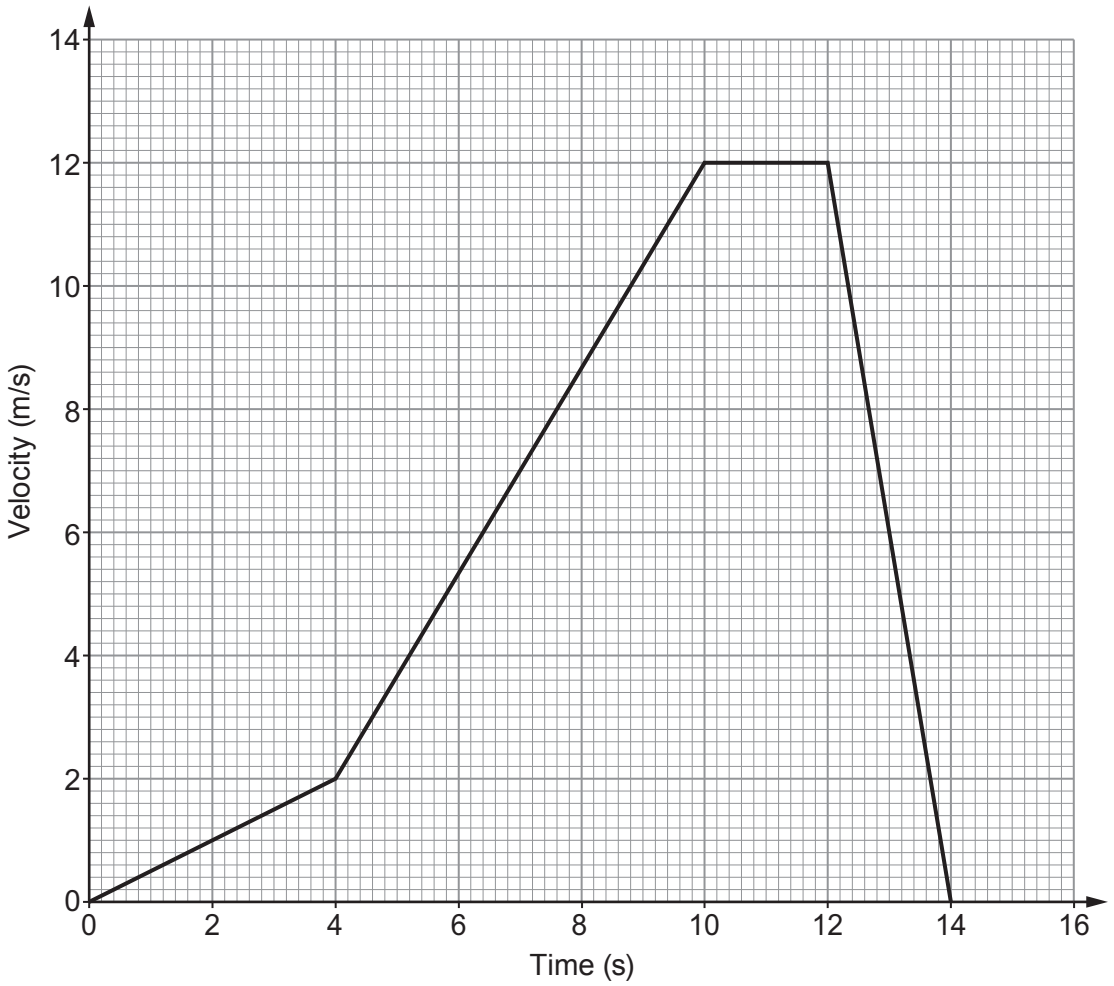
Turn over.

Examiner only

6. The velocity-time graph for an athlete in a sprint race is shown below.



Use the graph and the following information:

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time}}$$

acceleration = gradient of velocity-time graph

distance travelled = area under the line of the velocity-time graph

to answer the following questions.

(a) Calculate the mean acceleration between 0 and 10 seconds. [2]

mean acceleration = ... m/s^2

Examiner only

(b) Calculate the total distance travelled between 0 and 14 seconds. [4]

total distance = ... m

(c) Calculate the mean velocity between 0 and 14 seconds. [2]

mean velocity = ... m/s

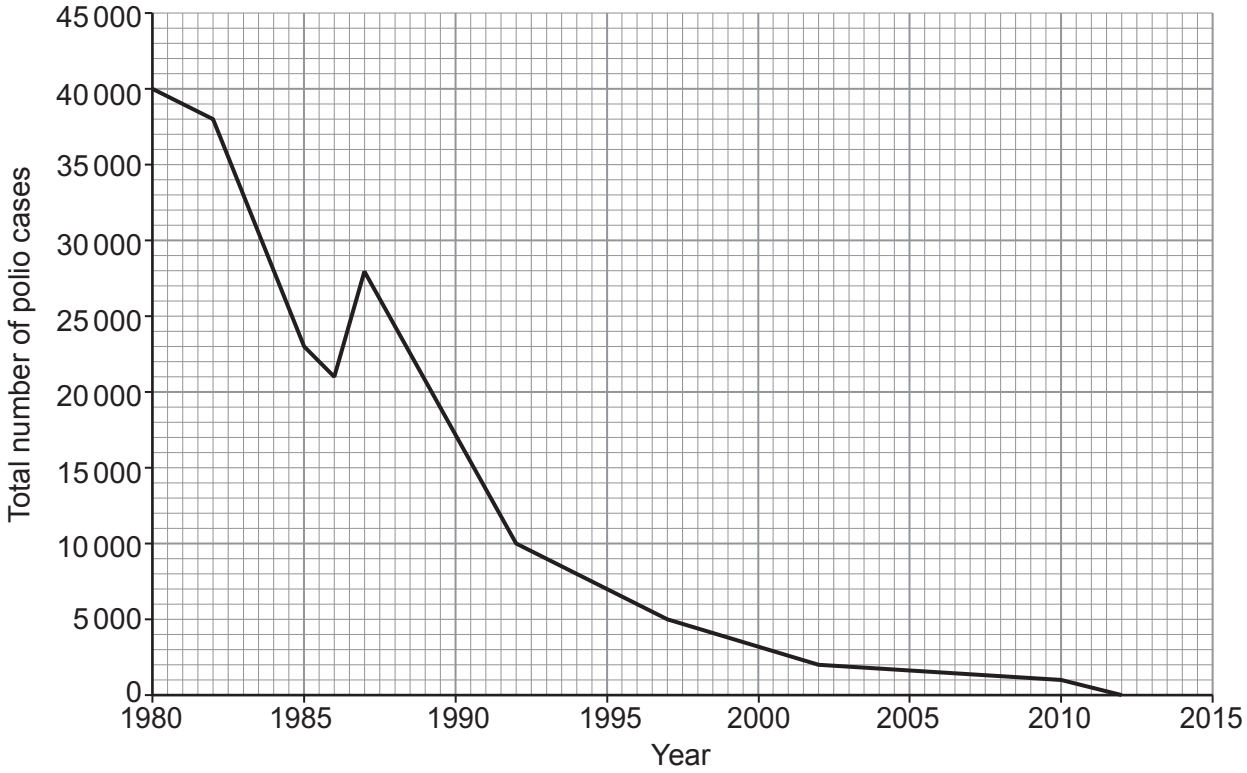
8

Turn over.

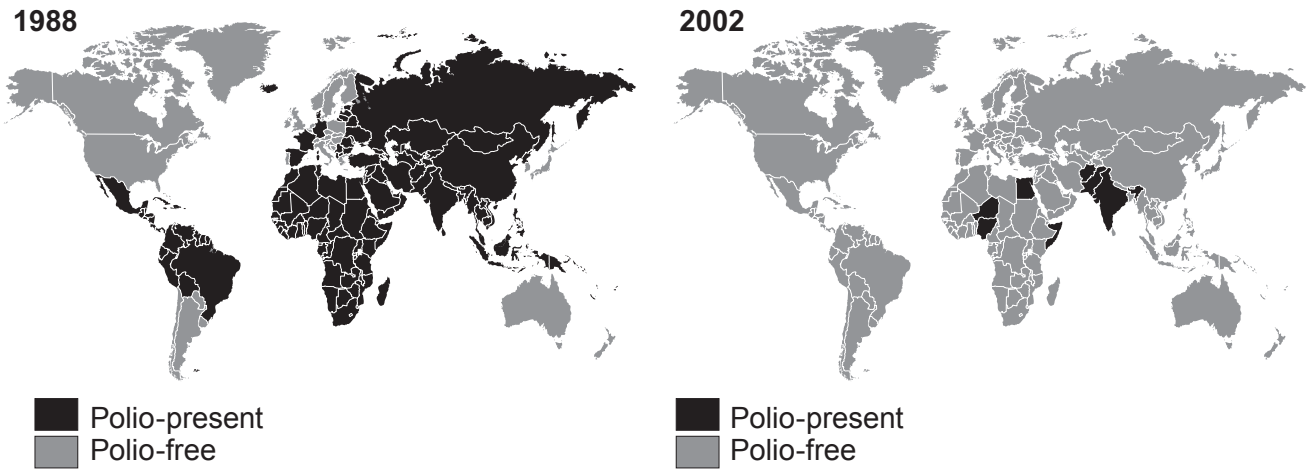
7. Poliomyelitis (polio), has been eliminated from many parts of the world and may hopefully be completely eradicated in the near future. Polio sometimes causes muscle weakness, most commonly in the legs, that can last over a few hours or days. Many people are able to fully recover, but some cases of polio result in permanent paralysis or other disability.

The virus enters the body through the mouth when people eat food or drink water that is contaminated with faeces. The reduction in polio cases was made possible by polio vaccines developed in the 1950s.

The total number of cases of polio in India between 1980 and 2015 are shown in the graph below.



The World Health Organisation (WHO) measures how the amount of cases varies over time. Results for 1988 and 2002 are shown in the diagram below.



India was declared polio-free in 2014. The last case was reported from the eastern state of West Bengal in 2011.

Examiner only

(a) Suggest **two** reasons why countries with widespread poverty have found it more difficult to eradicate polio. [2]

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.....

(b) WHO normally uses the number of cases per 100 000 of the population when reporting the number of cases of polio.

(i) State why cases per 100 000 are used when collecting evidence from different countries. [1]

.....

(ii) In 1987 the population of India was 850 million. Use this figure and information from the graph to calculate the number of cases per 100 000. [2]

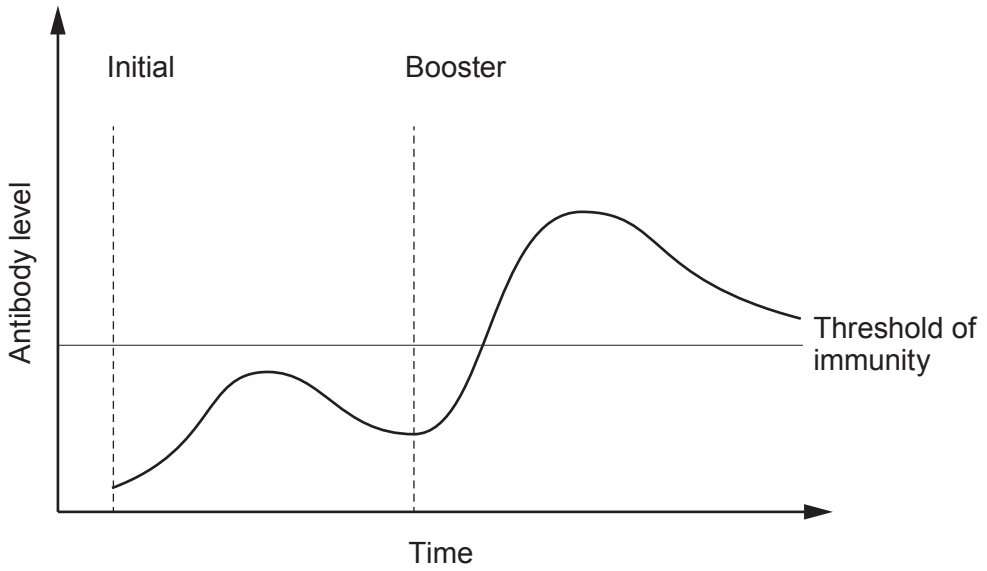
number of cases per 100 000= .....

(iii) Calculate the percentage drop in cases between 1987 and 2010. [2]

..... %

Examiner only

(c) The polio vaccine is given orally as an initial dose followed by a booster at a later stage as shown in the graph below.



Explain how the polio vaccine prevents an individual from contracting the disease and why a booster is needed. [6 QER]

Examiner only

(d) Explain how a vaccination programme eradicates a disease like polio from a population. [2]

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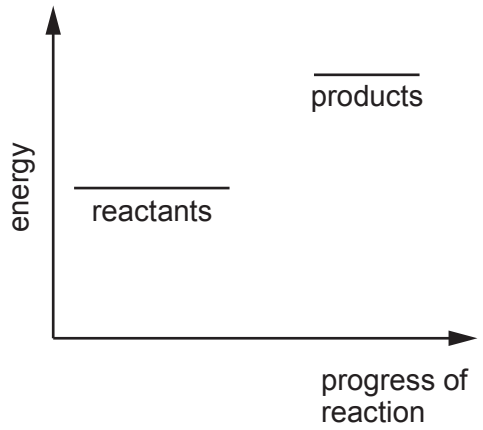
Examiner only

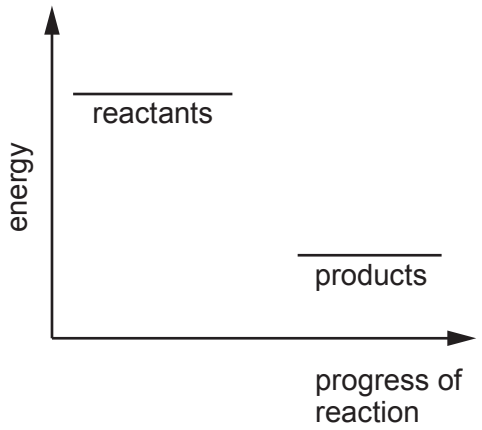
8. *(a)* The following diagrams show the energy stored in the bonds of reactants and products for some endothermic and exothermic reactions.

The scales on each diagram are the same.

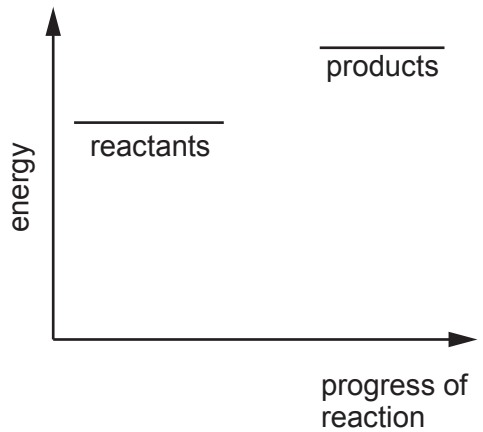
A



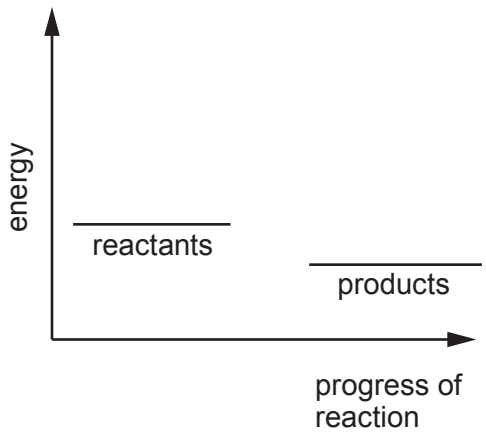
B



C



D



(i) State the difference between an endothermic and an exothermic reaction. [1]

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(ii) Explain which reaction (**A**, **B**, **C** or **D**) is the most endothermic. [2]

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Examiner only

(b) It is important to control exothermic reactions to reduce the chance of thermal runaway.

Explain what is meant by thermal runaway in a chemical reaction and why it can lead to a disaster. [2]

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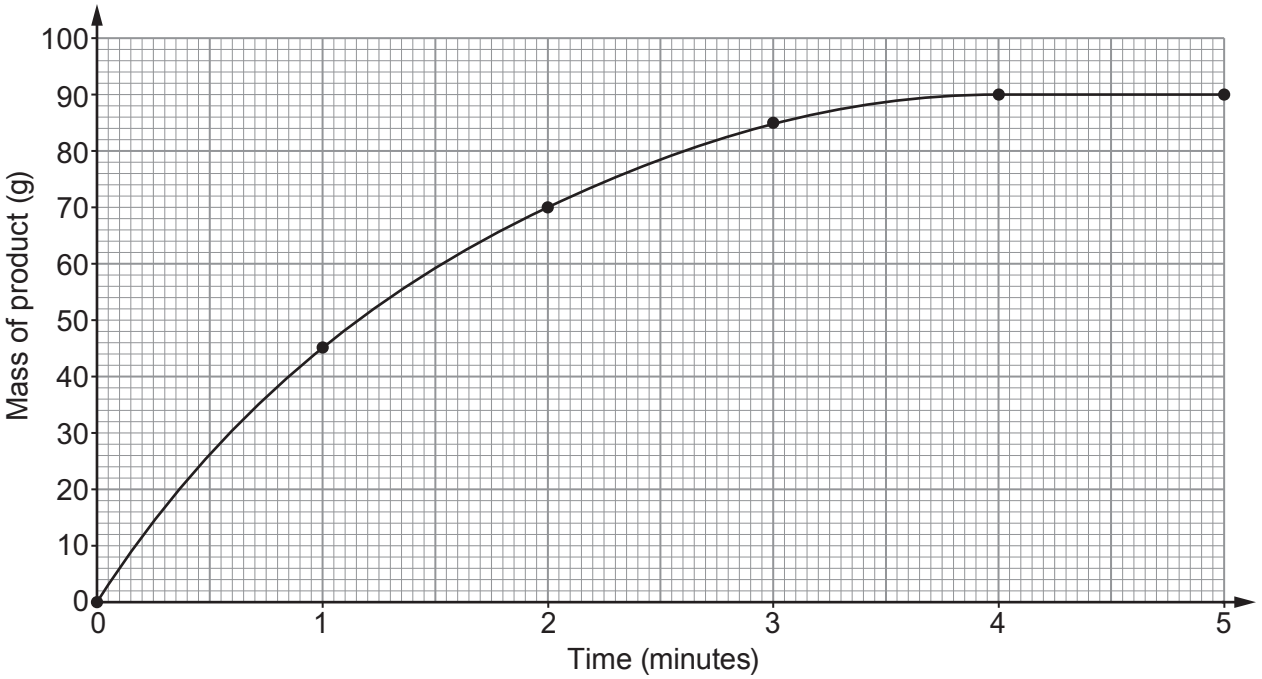
(c) In a chemical reaction the mass of product produced was measured over 5 minutes.



(i) State why the reaction stops at 4 minutes. [1]

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.....

(ii) Calculate the rate of the reaction at 2 minutes by drawing a tangent. [3]

Rate = ... g/min

Examiner only

(iii) As the reaction proceeds, it is predicted that the mass of product collected each minute is half of the previous minute.

Explain whether the graph supports this predication.

You must show any calculations used to support your answer. [3]

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END OF PAPER

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THE PERIODIC TABLE

1	2	Group										3	4	5	6	7	0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key