Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3440U20-1

S18-3440U20-1

APPLIED SCIENCE (Single Award)

UNIT 2: Science to Support our Lifestyles

FOUNDATION TIER

TUESDAY, 15 MAY 2018 – AFTERNOON

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**10**	
3.	**6**	
4.	**8**	
5.	**7**	
6.	**8**	
7.	**13**	
8.	**11**	
9.	**8**	
Total	**75**	

3440U201
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.

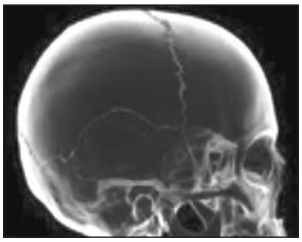
The Periodic Table is printed on the back cover of the examination paper.

BLANK PAGE

Examiner only

Answer **all** *questions.*

1. *(a)* The images below show X-rays of joints. Identify the correct type of joint by drawing a line. *Each type of joint may be used once, more than once, or not at all.* [3]
One has been completed for you.

Image	**Type of joint**
skull 	Hinge
hip 	Ball and socket
elbow 	Fixed
knee 	

(b) Name **one** disease that can cause a patient to have a hip replacement. [1]

.....

Examiner only

2. Professional rugby players need a special diet.

The guideline daily amounts (GDA) for a male rugby player compared to a typical man are shown in the table below.

GDA	Typical man	Male rugby player
energy (kcal)	2500	4800
carbohydrate (g)	300	600
of which are sugars (g)	120	120
fat (g)	95	95
fibre (g)	24	24
protein (g)	55	100
salt (g)	6	6

(a) Use the information in the table to answer the following questions.

(i) Calculate the extra energy required by the rugby player compared to a typical man. [1]

Extra energy = ... kcal

(ii) Other than extra energy, state **two** other differences in the rugby player's diet compared to a typical man. [2]

1. .....

2. .....

Examiner only

(b) It is important for the health of a rugby player that salt and fat intake are monitored.

Complete the following sentences by selecting the correct phrase from the list below.

muscle cramps ***indigestion*** ***tooth decay*** ***high blood pressure*** ***obesity***

(i) Too little salt in the diet can cause ..... . [1]

(ii) Too much salt in the diet can cause ..... . [1]

(iii) Too much fat in the diet can cause ..... . [1]

(c) A rugby player has a mass of 110 kg and a height of 1.9 m.

(i) Calculate the value of his height squared (height^2). [1]

Height^2 = ... m^2

(ii) Use the equation and the information above to calculate the rugby player's body mass index (BMI). [2]

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

BMI = ...

(iii) People are grouped according to their BMI as shown below.

underweight = less than 18.5
normal weight = 18.5–24.9
overweight = 25–29.9
obese = 30 or more

State which BMI group the rugby player belongs to.

Group = ... [1]

10

3440U201
05

Examiner only

3. Human features are controlled by genetic and environmental factors.

(a) Place **three** ticks (✓) in the table below to show the features that are **only** determined by genes. [3]

Feature	Determined only by genes
tongue rolling	
hair length	
blood group	
welsh speaking	
eye colour	
tattoos	

(b) Cystic fibrosis is an inherited disease.

The disease can be passed to the offspring if both parents are carriers of a recessive allele **(n)**.

Complete the Punnett square below to calculate the chance of a child inheriting this disease if both parents are heterozygous (Nn). [3]

	.....	.....
.....	.....	.....
.....	.....	.....

% chance = ...

6

BLANK PAGE

Examiner only

4. Doctors can use antibiotics to treat diseases.
One way to test the effectiveness of an antibiotic is to see how well it kills bacteria. Three laboratory technicians used the following method.

1. Spread a culture of bacteria onto an agar plate.
2. Place different antibiotic discs onto the agar plate.
3. Allow the culture to grow for 3 days.
4. Measure the diameter of each clear zone.

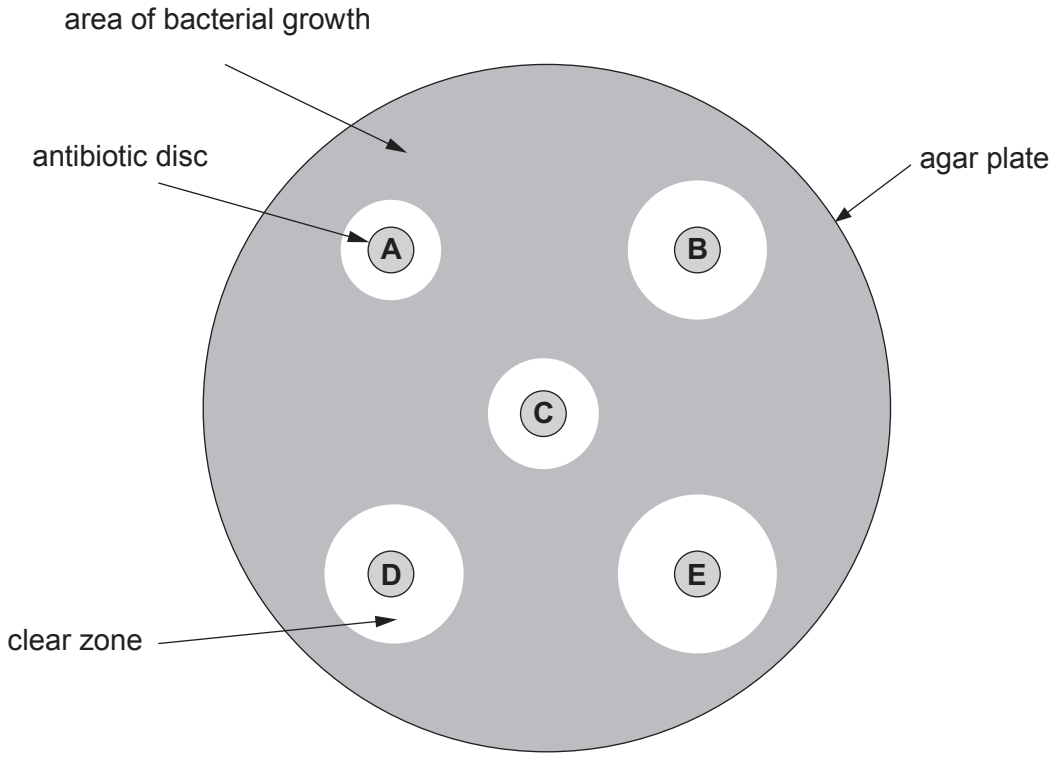


Diagram not drawn to scale.

(a) The results were as follows.

Antibiotic disc	Diameter of the clear zone (mm)			
	plate 1	plate 2	plate 3	mean
A	15	14	16	15
B	24	26	25	25
C	17	15	31	21
D	24	22	23	.....
E	27	29	31	29

(i) **Complete** the table. [1]

Examiner only

(ii) State which antibiotic (**A**, **B**, **C**, **D** or **E**) is the most effective at preventing bacterial growth. Give a reason for your answer. [2]

Antibiotic: .....

Reason: .....

(iii) Circle the anomalous result in the table. [1]

(iv) State **one** way to check the repeatability of the results. [1]

.....

(b) Some bacteria, such as MRSA, are resistant to antibiotics.

(i) State **one** human activity that has increased the number of antibiotic-resistant bacteria. [1]

.....

(ii) State **two** methods that hospitals use to reduce the spread of antibiotic-resistant bacteria. [2]

1. .....

2. .....

8

Turn over.

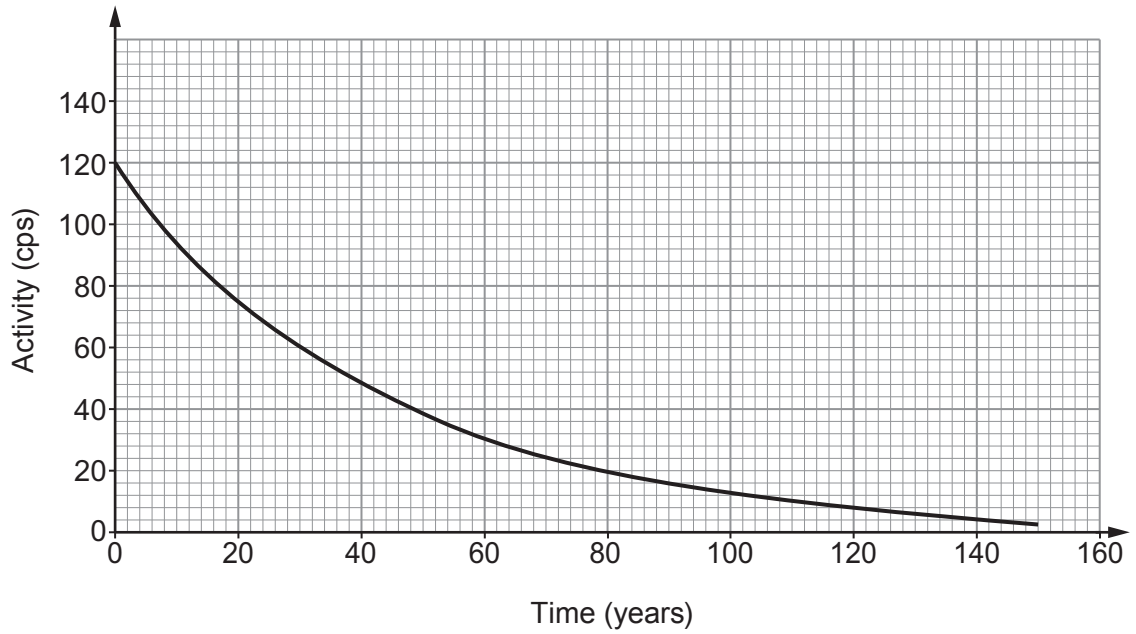
Examiner only

5. On March 11, 2011, a tsunami damaged a reactor at the Fukushima nuclear plant. The damage caused a radioactive meltdown. There was also a number of explosions which released radioactive products including caesium-137 (Cs-137) into the sea and air.

Caesium levels have now returned to normal in the seawater but they are still high in the seabed near to the site. Levels are also high in the fish which feed off the seabed.

Before the disaster the Cs-137 contamination of 1 kg seabed was measured at 0.3 cps (counts per second). In 2016 the contamination was measured at 120 cps.

The decay curve of Cs-137 for a 1 kg seabed sample is given below.



(a) Tick (✓) the correct definition of a half-life. [1]

Half the time for the activity of a radioactive sample to decrease by half ☐

The time taken for the radiation to decrease by half ☐

The time taken for the activity of a radioactive sample to decrease by half ☐

Examiner only

(b) (i) Draw lines on the graph to find the half-life of Cs-137 and write down this value. [2]

half-life = ... years

Scientists state that it will take 90 years before it will be safe to eat the fish from the area.

(ii) Calculate how many half-lives will need to pass before the fish are safe to eat. [1]

number of half-lives = ...

(c) Cs-137 decays by beta emission.

(i) Circle the correct decay equation. [1]

$$^{137}_{55}\mathrm{Cs} \rightarrow {}^{137}_{54}\mathrm{Xe} + {}^{0}_{-1}\mathrm{e}$$

$$^{137}_{55}\mathrm{Cs} \rightarrow {}^{137}_{56}\mathrm{Ba} + {}^{0}_{-1}\mathrm{e}$$

$$^{137}_{55}\mathrm{Cs} \rightarrow {}^{133}_{53}\mathrm{I} + {}^{4}_{-2}\mathrm{He}$$

(ii) Explain why it is dangerous to eat fish contaminated with Cs-137. [2]

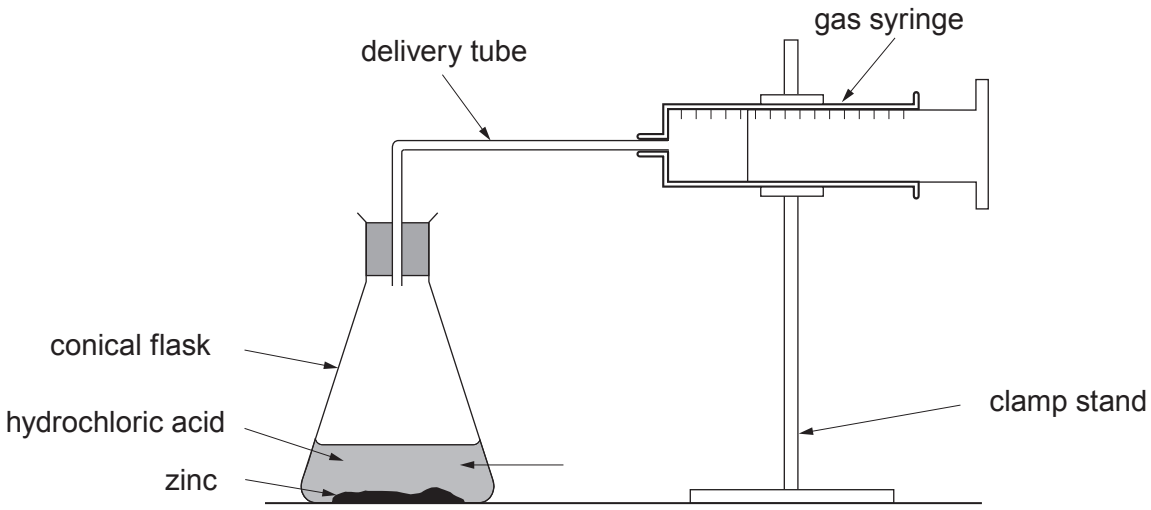
.....

.....

.....

7

6. A science student carries out an experiment to investigate how temperature affects the reaction between zinc and hydrochloric acid. The reaction produces hydrogen gas, which can be collected using the following apparatus.

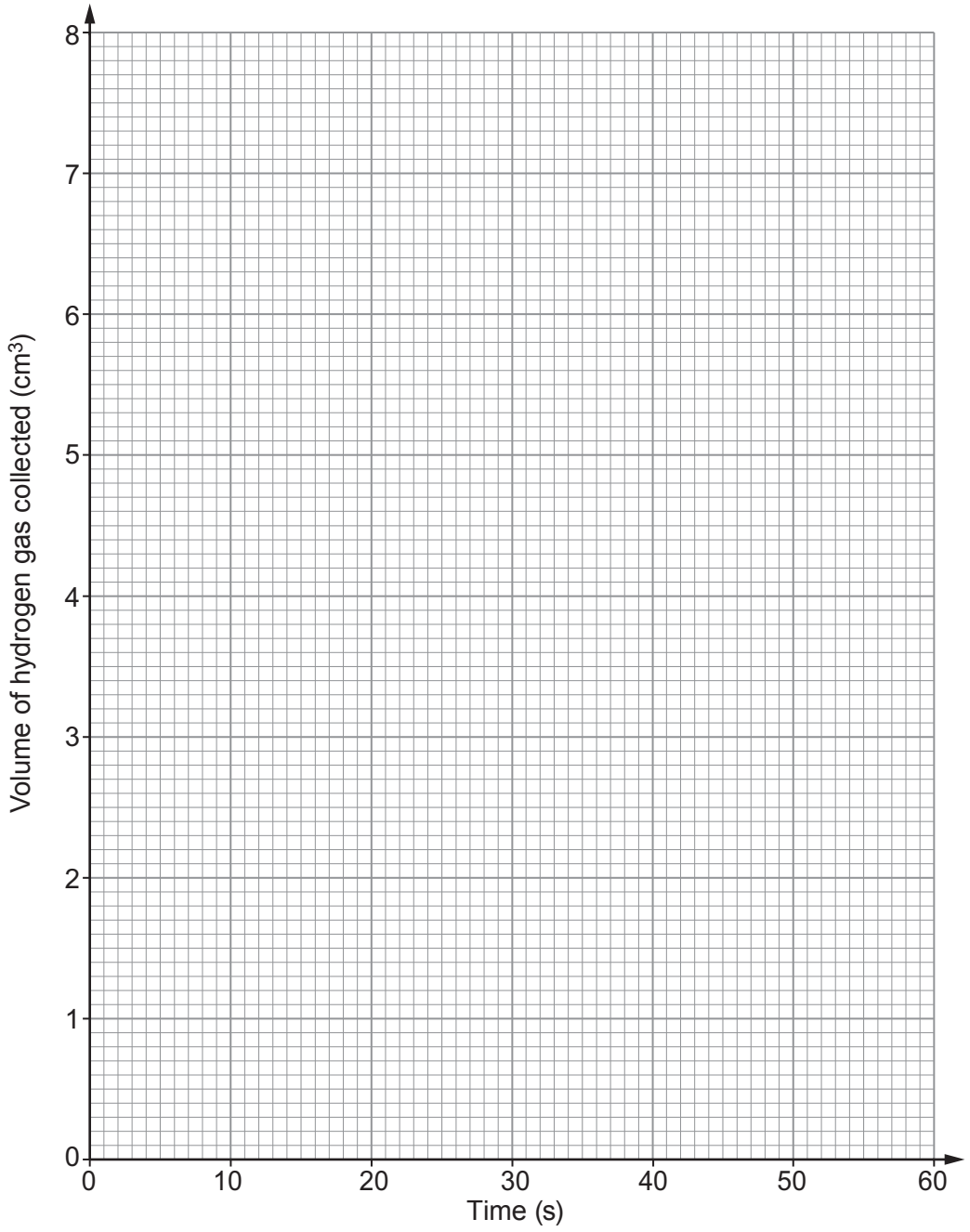


The results are shown in the table below.

Time (s)	Volume of hydrogen gas collected at 30 °C (cm^3)
0	0.0
10	3.2
20	4.6
30	6.5
40	7.2
50	7.6
60	7.6

Examiner only

(a) (i) Use the data to plot a graph on the grid below and draw a suitable line. [3]



(ii) State the time at which the reaction was complete. [1]

Time = ... s

(iii) Add another line on the grid to show the expected results at 40 °C. [2]

(b) Explain in terms of particles how the rate of reaction changes when an acid of higher concentration is used. [2]

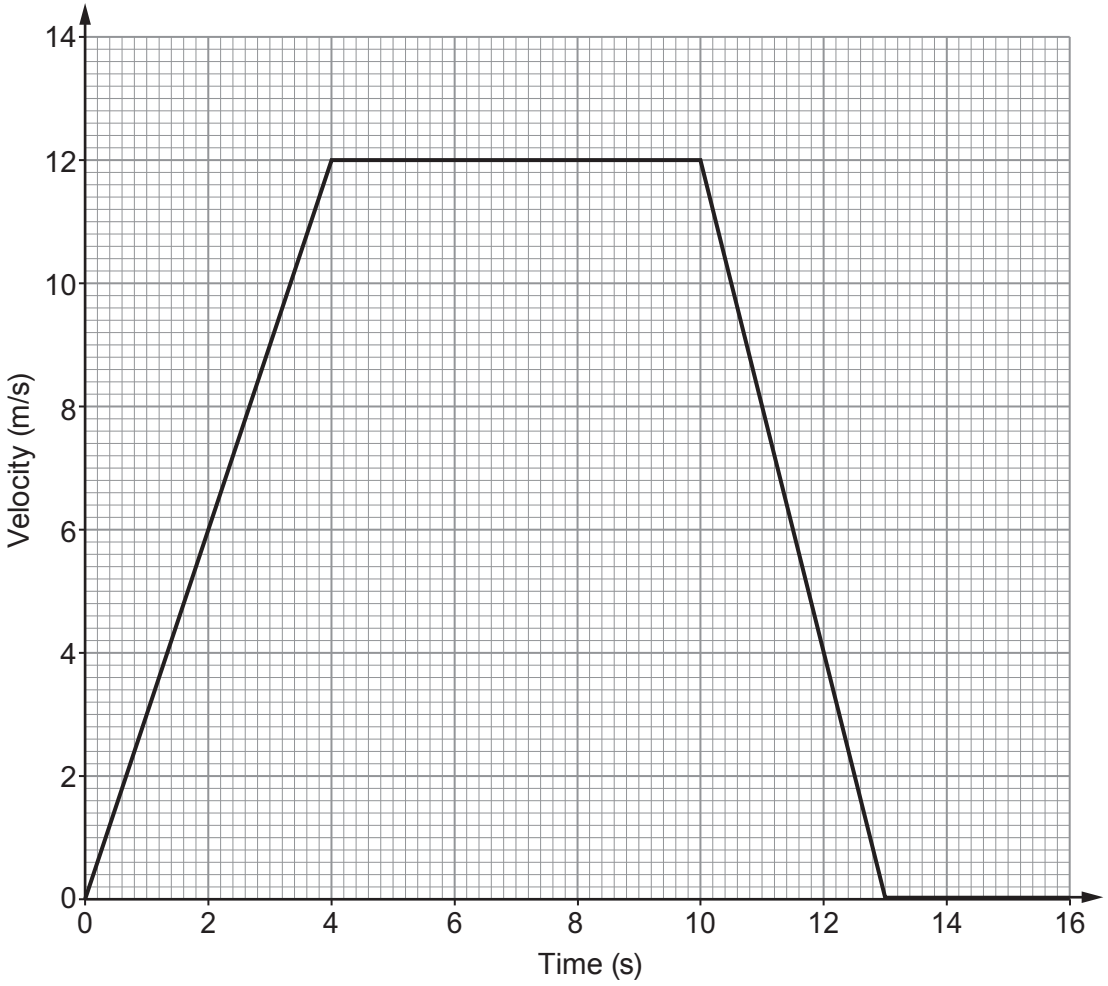
.....

.....

8

Examiner only

7. An athlete ran in a 100 metre race. The velocity-time graph for the athlete's motion in the race is shown below.



(a) (i) State the motion of the athlete between 4 and 10 seconds. [1]

.....

(ii) State the motion of the athlete between 10 and 13 seconds. [1]

.....

(iii) <u>Underline</u> the time interval when the athlete travelled the greatest distance. [1]

0-4 s 4-10 s 10-13 s 13-16 s

Examiner only

(b) (i) Use the equation:

$$\text{distance} = \text{velocity} \times \text{time}$$

to calculate the distance travelled between 4 and 10 seconds. [2]

Distance = ... m

(ii) Use the equation:

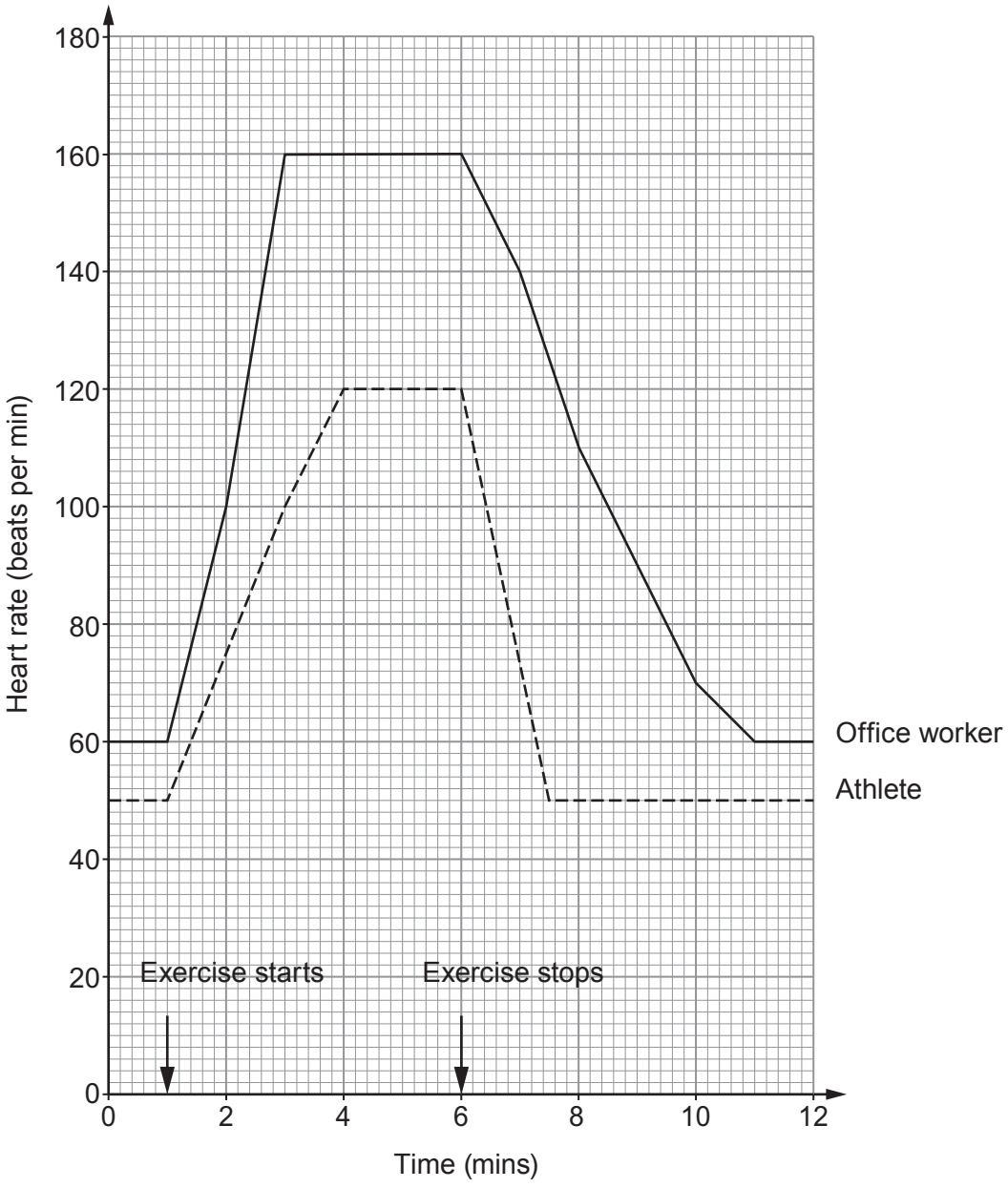
$$\text{acceleration} = \frac{\text{change of velocity}}{\text{time}}$$

to calculate the acceleration of the athlete during the first 4 seconds of the race. [2]

Acceleration = ... m/s^2

Examiner only

(c) The graphs show how the heart rate of the athlete compares to an office worker during an identical exercise session.



Compare the graphs for the office worker and the athlete and explain the differences between them. [6 QER]

.....

.....

.....

.....

.....

Examiner only

13

Examiner only

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

.....

.....

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

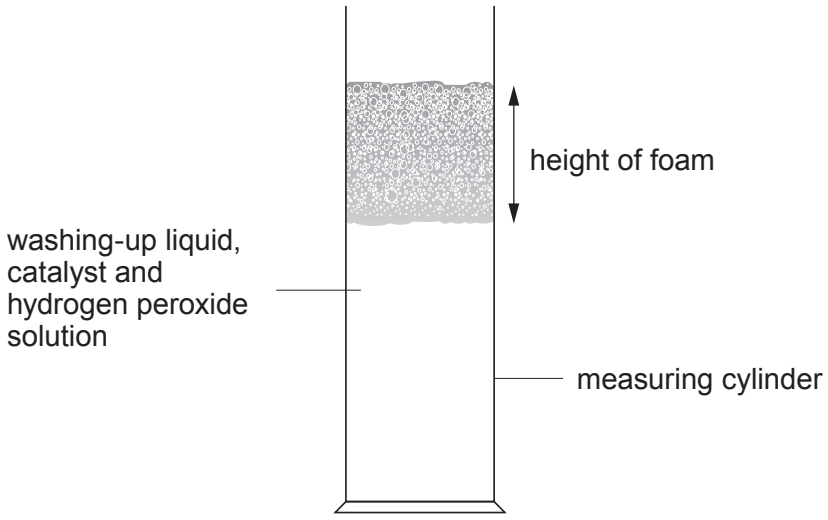
.....

.....

(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]

.....

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

.....

.....

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

.....

.....

.....

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

.....

.....

11

Examiner only

9. 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]

.....

.....

.....

Examiner only

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

.....

.....

.....

(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]

.....

.....

.....

8

END OF PAPER

BLANK PAGE

BLANK PAGE

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