Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4791/02

ADDITIONAL APPLIED SCIENCE

UNIT 1: Science at Work in Applied Contexts
HIGHER TIER

A.M. THURSDAY, 15 May 2014

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**8**	
3.	**10**	
4.	**8**	
5.	**7**	
6.	**8**	
7.	**9**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

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.

You are reminded that assessment will take into account the quality of written communication used in your answer to question **1**(ii) and **7**(i).

You are reminded to show all your working. Credit is given for correct working even when the final answer given is incorrect.

Answer **all** *the questions in the spaces provided.*

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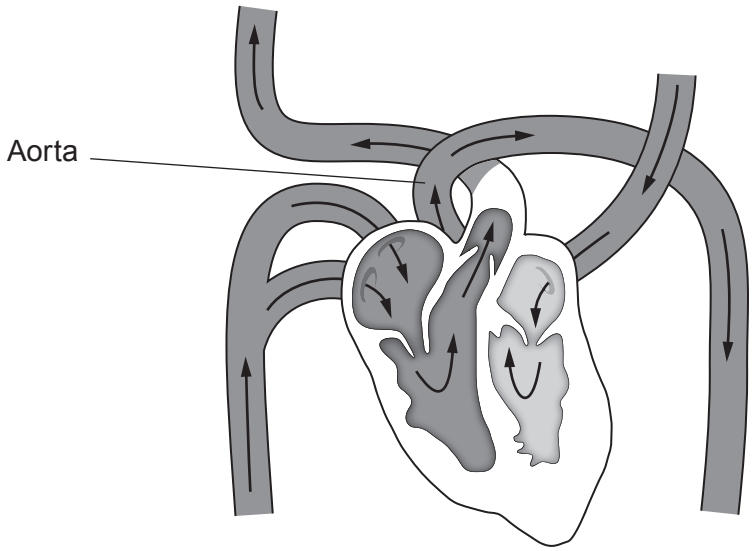
1. The diagram below shows the heart and the blood vessels connected to it. The arrows show the direction of the blood flow.

(i) Label the following parts on the diagram below. [4]

ventricle *atrium* *vein* *artery*



(ii) Explain how the cardiovascular system enables aerobic respiration to occur in muscles. [QWC 6]

Include in your answer:

- the reactants needed and how they get to the muscles;
- what happens to the waste products.

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2. *(a)* (i) Explain why ionic compounds are formed between metal ions **and** non-metal ions. [2]

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(ii) Sodium chloride is an ionic compound. Explain why it has a high melting point. [2]

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(iii) Explain why sodium chloride does not conduct electricity when solid, but will in a solution. [2]

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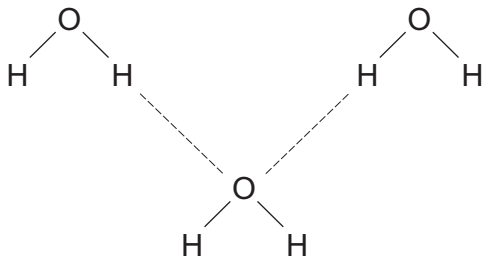
(b) The simple diagram below shows the structure of water. Describe the types of bonds shown in the diagram. [2]



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Turn over.

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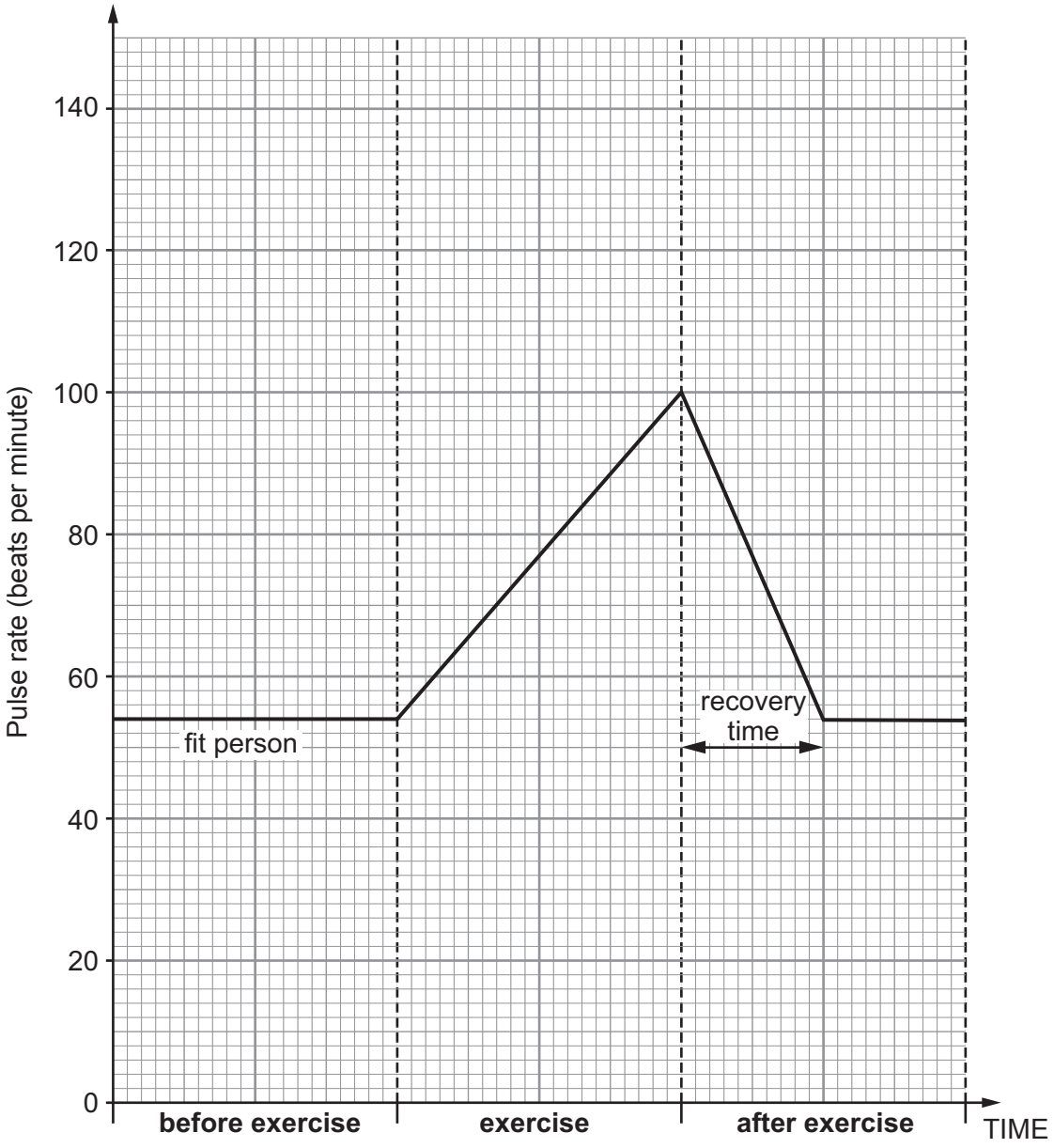
3. When members join a gym, their personal trainer will record basic information about them. One of these is pulse rate.

(a) Name **two** other body measurements that will be collected during the initial health check. [2]

1. .....

2. .....

(b) The graph below shows how the pulse rate for a fit person changes during the labelled time intervals.



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(i) An unfit person has a normal resting pulse rate of 80 beats per minute before exercise. During exercise, the pulse rate rises to 140 beats per minute. The pulse rate returns to normal by the end of the 'after exercise' time interval.

Plot the information for the unfit person on to the graph on the previous page. [3]

(ii) Compare the pulse rate for the fit person with the unfit person for the time shown on the graph. [3]

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(c) (i) State the name of the **group** of exercises (including cycling and running) that the unfit person needs to do, to eventually reduce their resting pulse rate. [1]

..... exercise

(ii) Give **one** reason for your answer. [1]

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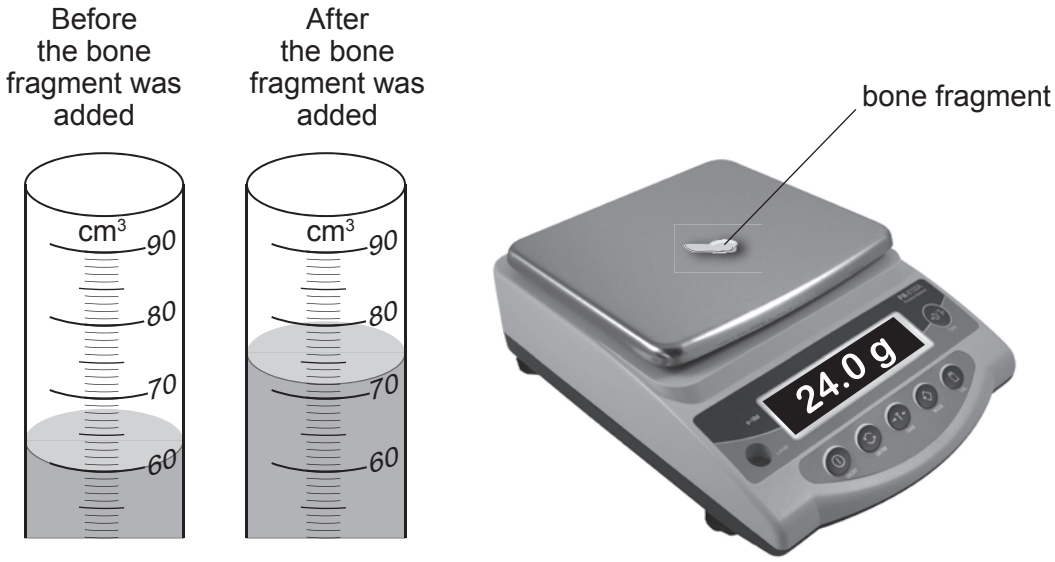
Turn over.

Examiner only

4. *(a)* The diagrams below show the apparatus used to find the density of a fragment of bone.

The diagram of the measuring cylinder shows the water level before and after the bone fragment was added.



(i) Use the information to find the volume of the bone. [1]

Volume = ... cm^3

(ii) Calculate the density of the bone using the equation: [2]

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

Density = ... g/cm^3

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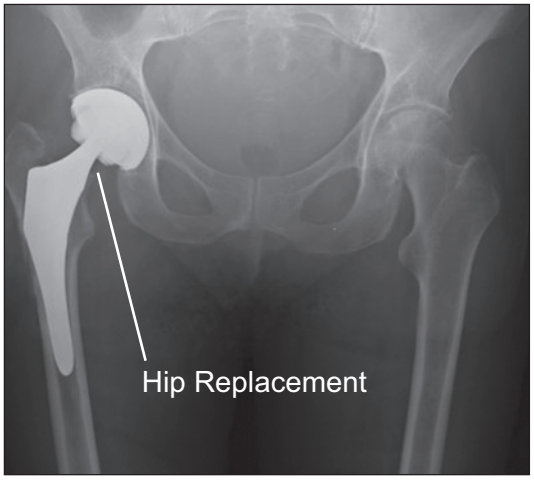
(b) Various tests are carried out on different materials and the data is recorded in the table below. Use this data to answer the questions that follow.

Material	Density (kg/m^3)	Strength MPa	Biologically inert	Resistant to corrosion	Brittle
bone	1900	170	Yes	Yes	No
stainless steel	7860	400	Yes	Yes	No
aluminium	2710	110	Yes	No	No
titanium	4500	450	Yes	Yes	No
glass	2190	50	Yes	Yes	Yes

(i) Explain why hip replacements are made from titanium rather than stainless steel or aluminium. [3]



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(ii) Give **two** reasons why glass would not be suitable for hip replacements. [2]

1. .....

2. .....

Turn over.

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5. Growers and plant breeders use trials to make decisions about improving productivity.

(i) In one trial, growers investigated whether the rate of germination (when seeds sprout and begin to grow) is affected by stratification. Stratification exposes the seeds to cold, moist conditions for a period of time.

Four groups of 100 seeds were treated as shown in the table below. The table also shows the numbers of seeds that germinated at 10-day intervals after being removed from cold storage and planted.

		Number of seeds germinating after:						
Group	No of days 100 seeds were kept at 5ºC before planting	0 days	10 days	20 days	30 days	40 days	50 days	60 days
A	120	0	3	37	55	66	70	73
B	100	0	2	37	43	46	50	50
C	40	0	0	0	0	2	9	10
D	Not stratified	0	0	0	0	0	0	0

What conclusions should the growers make from their results? [3]

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(ii) The germinated seeds were grown in a controlled environment as shown in the photograph below.

Explain how the use of this controlled environment can increase food production. [4]

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Turn over.

Examiner only

6. (i) Describe the optimum conditions required for food spoilage. [3]

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(ii) Explain **one** way in which food spoilage can be slowed down. [2]

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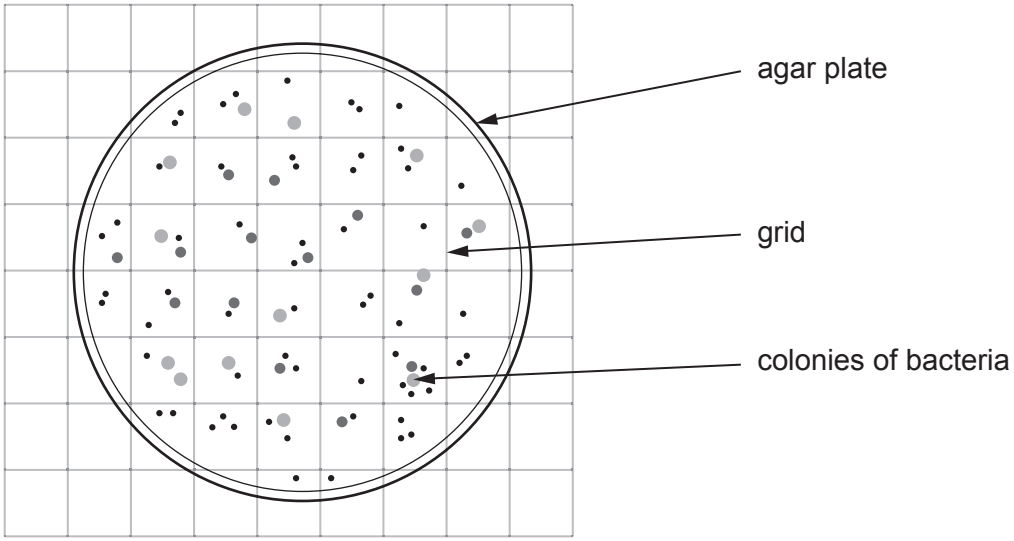
(iii) It is suspected that a cause of food poisoning is bottled water. Samples of water, each of volume 100 cm^3 are taken and prepared for testing on agar plates of **area 57.4 cm^2**. The sample of water smeared on the plates is 2.5 cm^3. After a period of time, the number of bacterial colonies in four 1 cm^2 grid squares is counted.



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The results are shown below. The table has been completed for E-coli bacteria.
Complete the table for coliform bacteria. [3]

		E-coli	*Coliform bacteria*
Number of colonies in grid section	1	0	2
	2	1	1
	3	1	1
	4	0	1
Mean (colonies per cm^2)		0.5	.....
Mean colonies per plate		28.7	.....
Sample volume (cm^3)		2.5	2.5
Colony-forming units estimate (mean number per 100 cm^3)		1148	.....

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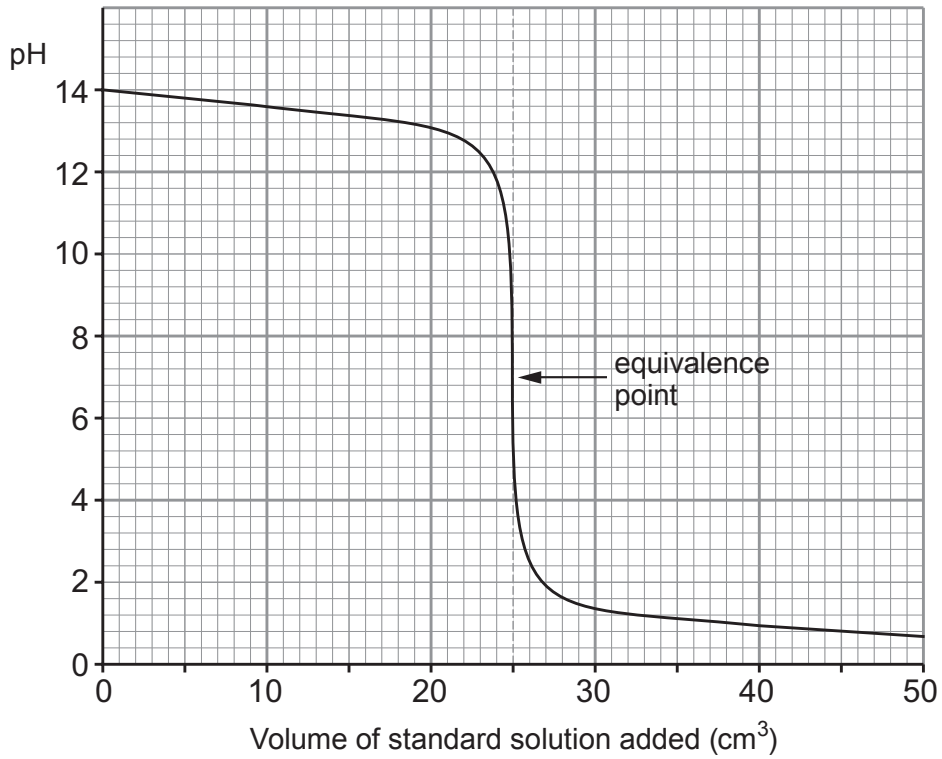
7. The concentration of a solution can be determined by titration against a standard solution.

(i) Explain what can be inferred from the titration curve below. [QWC 6]



Include, in your answer, information about the:

- standard solution
- solution of unknown concentration
- equivalence point.

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Examiner only

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(ii) In **another** titration, 20 cm^3 (V_{HCl}) of HCl is neutralised by 25 cm^3 (V_{NaOH}) NaOH. The concentration of the NaOH (C_{NaOH}) is 0.50 mol/dm^3.

Use the equation below to calculate the concentration of HCl (C_{HCl}). [3]

$$C_{HCl} \times V_{HCl} = C_{NaOH} \times V_{NaOH}$$

Concentration of HCl = ... mol/dm^3

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END OF PAPER

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