

Surname	Centre Number	Candidate Number
Other Names		0



GCSE

4791/01

**ADDITIONAL APPLIED SCIENCE
UNIT 1: Science at Work in Applied Contexts
FOUNDATION TIER**

A.M. WEDNESDAY, 8 January 2014

1 hour

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	4	
2.	8	
3.	13	
4.	10	
5.	6	
6.	5	
7.	14	
Total	60	

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 7(b).

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

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

1. The growth of bacteria can be slowed down in many ways.

Draw lines to match the methods to how they are achieved.

[4]

One has been done as an example.

Method	Achieved by.....
drying	adding sodium chloride
refrigerating	reducing the temperature
salting	removing moisture
smoking	adding vinegar
pickling	storing food in a cool smoke environment
freezing	turning water content in food to ice

2. Fertilisers can be prepared by neutralisation reactions.

(i) A neutralisation reaction is shown in the equations below.

Complete **both** equations. [3]

nitric acid + ammonia \longrightarrow

..... + \longrightarrow NH_4NO_3

(ii) Name **two** substances, other than nitrates, which plants need from the soil for healthy growth. [2]

1.

2.

(iii) Farmers who use too much fertiliser can cause a problem for fish.

The list below shows how this happens but the **stages are in the wrong order**.

1. Fertiliser is washed into a lake.
2. The microbes which make the algae decay take up all the oxygen.
3. The dead algae begin to decay.
4. Algae grow quickly because of fertiliser.
5. Some algae do not get enough light and die.
6. The fish die.

Put the stages in the **correct order** in the table below. [3]

1	6
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3. The photograph shows images of a sprinter at different times during a training run.



(a) The images are taken at 0.1 s intervals.

(i) Complete the table below.

[1]

Position	A	B	C	D	E	F
Time (s)	0	0.1	0.2	0.4	0.5

(ii) State **two** differences between the body shape at **A** and **F**.

[2]

1.
2.

(iii) Between which points is the sprinter running fastest, **AB**, **BC**, **CD**, **DE**, or **EF**?

[1]

.....

How can you tell this from the photograph?

[1]

.....

(iv) The distance between **A** and **F** is 3 m.

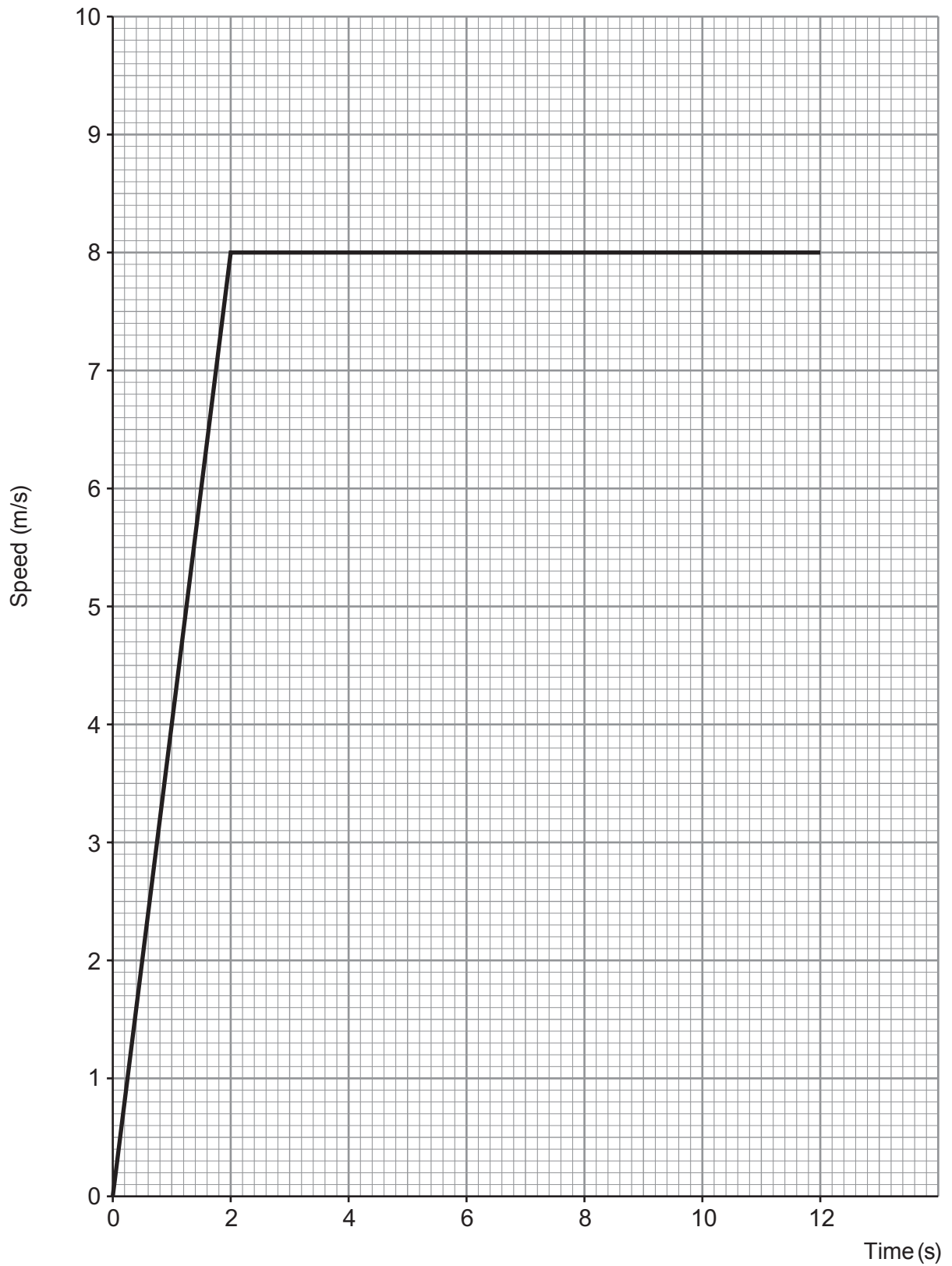
[2]

Calculate the mean speed of the sprinter over this distance using the equation:

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

Mean speed = m/s

- (b) The graph below shows how the speed of the sprinter changed during another training run.



- (i) Use the graph to find the change in speed in the first 2 seconds. [1]

.....

- (ii) Calculate the acceleration of the sprinter using the equation: [2]

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

$$\text{Acceleration} = \dots\dots\dots \text{ m/s}^2$$

- (iii) Calculate the distance covered by the sprinter between 2 and 12 s of the training run. [3]

Use the equation:

Distance travelled = area under a speed-time graph

$$\text{Distance} = \dots\dots\dots \text{ m}$$

4. The alloy nitinol is a smart material made from nickel and titanium.

(a) Tick (✓) the statements that describe a smart material.

[2]

Property	Tick (✓)
They can change their chemical properties.	
They can change their physical properties.	
They can react to changes in the environment.	
All smart materials can change back to their original shape.	

(b) The table shows some properties of nickel, titanium and nitinol.

Property	Nickel	Titanium	Nitinol
melting point (°C)	1453	1677	1310
density (g/cm ³)	8.9	4.5	6.5
electrical resistivity (units)	95	53	82
tensile strength (MPa)	450	434	195

(i) Which material is the **strongest**?

[1]

.....

(ii) Which material would be the **poorest** conductor of electricity?

[1]

.....

(iii) What happens to the melting point when nickel and titanium are combined?

[1]

.....

(iv) If there were identical volumes of each material, which would be **heaviest**?

[1]

.....

(c) The table gives information about different types of smart materials.

Type of smart material	Unusual property
Shape-memory alloy	If bent out of shape, when it is heated above a certain temperature it will return to its original shape.
Piezoelectric	If squeezed rapidly, it produces a small electrical voltage.
Electroluminescent	Give out light when an electric current is applied to them.
Thermochromic	Change colour as the temperature changes.
Polymer gel	Expands when it absorbs fluid.

State which type of smart material should be used for **each** of the following:

- (i) disposable nappies; [1]

- (ii) frames for reading glasses; [1]

- (iii) sensors for alarm systems; [1]

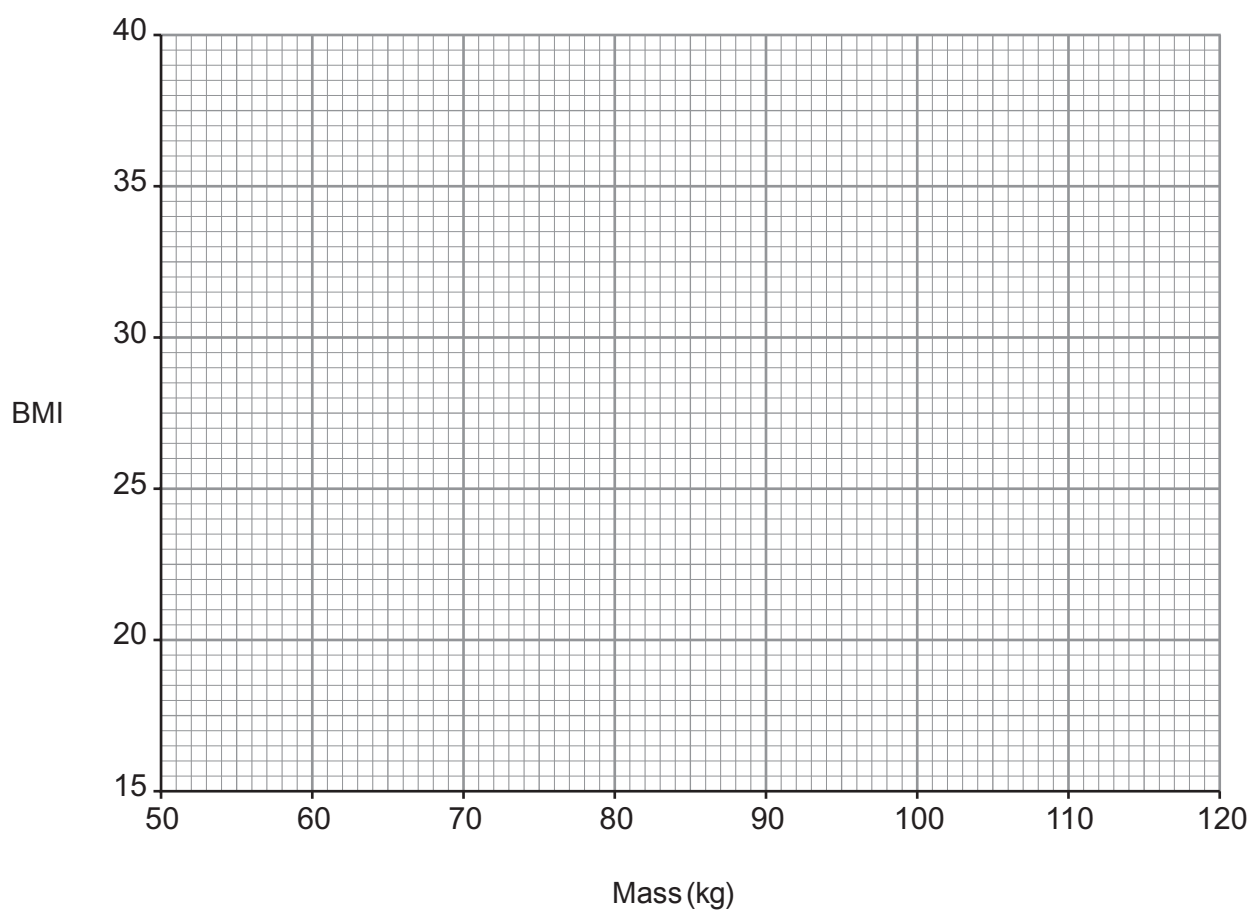
- (iv) forehead strip thermometer. [1]

5. The table shows how the Body Mass Index (BMI) of a **1.80 m** tall adult varies with mass.

Mass (kg)	BMI
50	15
60	19
80	25
100	31
120	37

- (a) (i) Use the data to plot a graph on the grid below.

[2]



- (ii) Use the graph to **estimate** the BMI for a mass of 90 kg.

[1]

.....

(iii) BMI values indicate the following body types.

Underweight (< 18.5)

Normal (18.5-25)

Overweight (25-30)

Obese (> 30)

Use the information above to find the body type for a 1.80m tall adult of mass 60 kg. [1]

.....

(b) The equation used to calculate BMI is given by:

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

Use this equation to calculate the BMI for a **1.60 m** tall adult who has a mass of 70 kg. [2]

BMI =

6. A forensic scientist tested some powder from a crime scene. She carried out flame tests and precipitation reactions on solutions of the powder.

Tests for negative ions

Negative ion	Test	Results
carbonate	add dilute hydrochloric acid	carbon dioxide gas is given off
chloride	add dilute nitric acid followed by silver nitrate solution	thick white precipitate
nitrate	add iron(II) sulfate solution followed by concentrated sulfuric acid	brown ring forms
sulfate	add a solution of barium chloride	white precipitate

Flame tests for positive ions

Metal ions	Flame test colour
barium	yellow-green
calcium	red
copper	green
lead	blue

Using the information above, the forensic scientist carried out tests on solutions of the powder. The tests and her observations are recorded in the table below.

Test	Observation	Ions present
flame test	green flame
hydrochloric acid added	carbon dioxide given off
barium chloride added	white precipitate formed

- (i) **Complete** the table above to show the ions present in the powder.

[3]

(ii) Name the **two** compounds in the powder.

1.

2.

[2]

Examiner
only

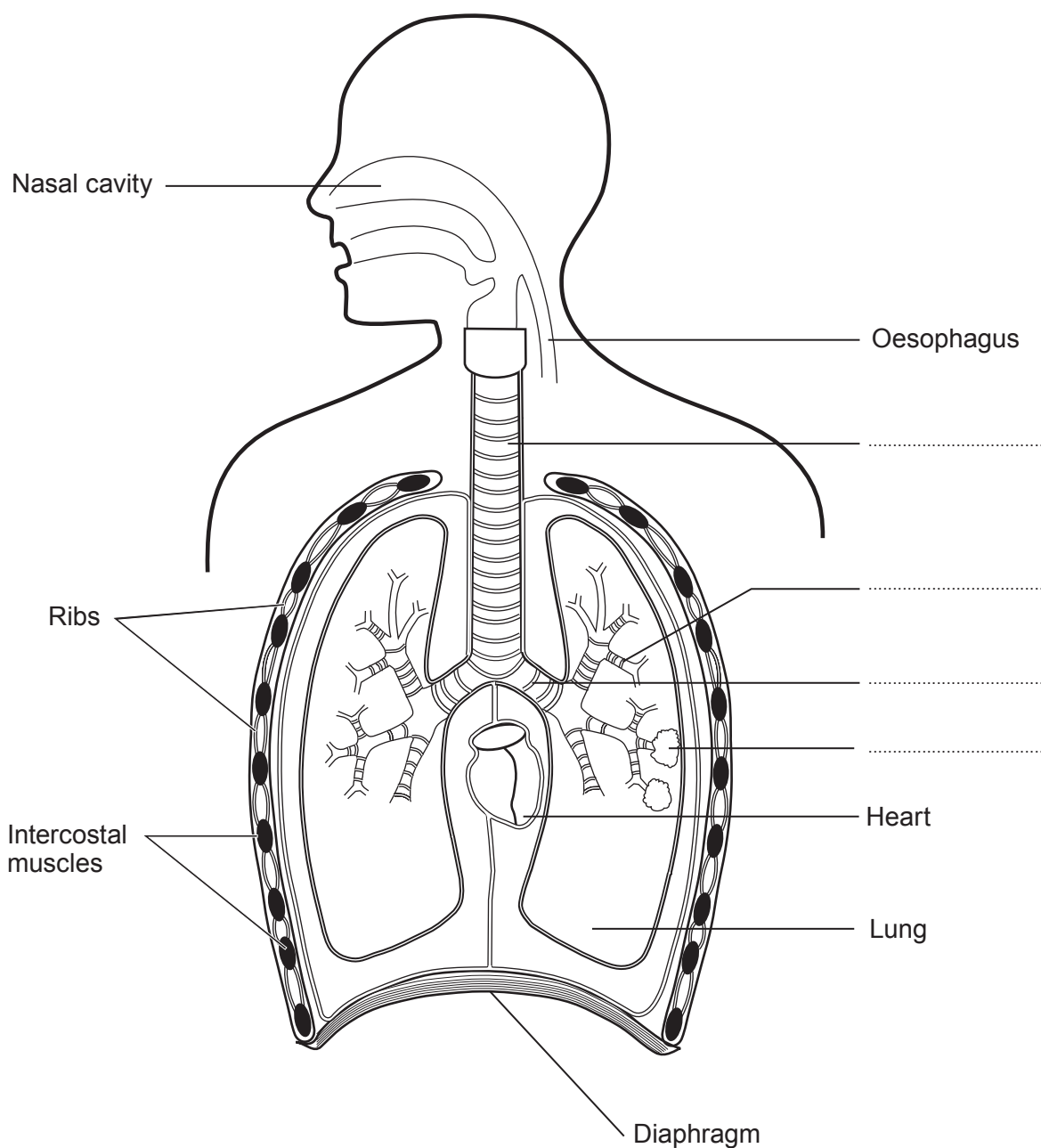
7. Some healthcare practitioners monitor our respiratory system.

(a) They need to be able to identify the parts of this system.

Label the following parts on the diagram below.

[3]

bronchiole	trachea	alveoli	bronchus
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(c) Inhaled air contains:

- 78 % nitrogen
- 21 % oxygen
- 0.04 % carbon dioxide
- a little water vapour

Describe how the content of exhaled air compares with inhaled air.

[3]

.....

.....

.....

.....

(d) **Underline** the correct word in each bracket to complete the sentences below.

[2]

During exercise, the breathing rate (increases / stays the same / decreases).

This allows the body to gain enough (carbon dioxide / nitrogen / oxygen).

END OF PAPER