

**GENERAL CERTIFICATE OF SECONDARY EDUCATION  
TWENTY FIRST CENTURY SCIENCE  
ADDITIONAL SCIENCE A**

**A215/02**

Unit 1: Modules B4 C4 P4 (Higher Tier)

**Wednesday 25 May 2011  
Morning**

**Duration: 40 minutes**

Candidates answer on the question paper.  
A calculator may be used for this paper.

**OCR supplied materials:**  
None

**Other materials required:**

- Pencil
- Ruler (cm/mm)



|                    |  |                   |  |
|--------------------|--|-------------------|--|
| Candidate forename |  | Candidate surname |  |
|--------------------|--|-------------------|--|

|               |  |  |  |  |  |                  |  |  |  |  |
|---------------|--|--|--|--|--|------------------|--|--|--|--|
| Centre number |  |  |  |  |  | Candidate number |  |  |  |  |
|---------------|--|--|--|--|--|------------------|--|--|--|--|

**MODIFIED LANGUAGE**

**INSTRUCTIONS TO CANDIDATES**

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Answer **all** the questions.
- Do **not** write in the bar codes.

**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **42**.
- A list of physics equations is printed on page **2**.
- The Periodic Table is printed on the back page.
- This document consists of **20** pages. Any blank pages are indicated.

## TWENTY FIRST CENTURY SCIENCE EQUATIONS

### Useful Relationships

#### Explaining Motion

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

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{change of momentum} = \text{resultant force} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \text{distance moved in the direction of the force}$$

$$\text{change in energy} = \text{work done}$$

$$\text{change in GPE} = \text{weight} \times \text{vertical height difference}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

#### Electric Circuits

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

$$\text{energy transferred} = \text{power} \times \text{time}$$

$$\text{power} = \text{potential difference} \times \text{current}$$

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

#### The Wave Model of Radiation

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

Answer **all** the questions.

1 Vikram is studying enzymes.

(a) Put a tick (✓) in the box next to the correct statement.

Enzymes are ...

... carbohydrates that slow down chemical reactions.

... carbohydrates that speed up chemical reactions.

... proteins that slow down chemical reactions.

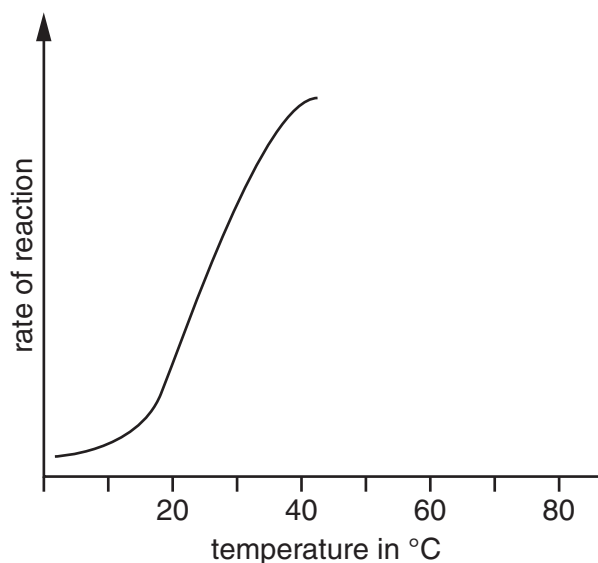
... proteins that speed up chemical reactions.

[1]

(b) Vikram does some experiments with enzymes.

He measures the rate of reaction at different temperatures.

Here is a graph of his results.



|          | <b>As the temperature ...</b> | <b>... the frequency of collisions ...</b> | <b>... and the rate of reaction ...</b> |
|----------|-------------------------------|--|---|
| <b>A</b> | ... increases ...             | ... decreases ...                          | ... increases.                          |
| <b>B</b> | ... increases ...             | ... increases ...                          | ... increases.                          |
| <b>C</b> | ... decreases ...             | ... increases ...                          | ... increases.                          |
| <b>D</b> | ... decreases ...             | ... decreases ...                          | ... increases.                          |

Which row, **A**, **B**, **C** or **D**, is the best explanation for his results?

row ..... [1]

Turn over

(c) Vikram continues to increase the temperature in his experiment.

What will happen?

Put a **ring** around the correct word in each sentence.

The rate of reaction will **increase** / **decrease** / **stay the same**.

This is because the enzyme is **broken down** / **denatured** / **killed**.

The enzyme now has the wrong **shape** / **mass** / **chemicals** for the other molecules to fit.

[2]

[Total: 4]

2 Susan uses a microscope to look at red blood cells.

She adds distilled water to the red blood cells.

Explain what will happen to the red blood cells in the distilled water.

.....  
.....  
.....  
..... [3]

[Total: 3]

3 Experiments show that chemical X moves into muscle cells by diffusion.

What does this tell you about the concentration of X inside the muscle cell?

Put a tick (✓) in the box next to the correct answer.

The concentration of X inside the muscle cell is ...

- ... greater than outside the cell.
- ... the same as outside the cell.
- ... less than outside the cell.

[1]

[Total: 1]

4 Arjun is doing a long distance swim in the cold sea.

His body tries to maintain a constant core temperature.

To do this, his body detects his blood temperature, processes the information, and then makes a response.

(a) Use words from the list to complete the sentences.

You may use each word once, more than once, or not at all.

**hypothalamus**

**pituitary**

**skin**

**sweating**

**vasoconstriction**

**vasodilation**

Arjun's blood temperature is detected by receptors in his .....

This information is processed in the .....

Effectors in blood vessels then cause .....

[1]

(b) In temperature regulation, vasoconstriction and vasodilation are antagonistic effects.

What is the advantage of this?

Put a tick (✓) in the box next to the **best** answer.

It allows a stronger response.

It allows energy to be saved.

It allows a more sensitive response.

It allows temperature to vary across a wider range.

[1]

[Total: 2]

5 Connor is at a party. He is hot and begins to sweat. He produces less urine.

(a) The concentration of Connor's urine is controlled by a hormone.

What is the name of this hormone?

..... [1]

(b) Which gland releases this hormone?

Put a (ring) around the correct answer.

**hypothalamus      pituitary      thyroid      pancreas**

[1]

(c) Connor then drinks some alcohol.

Alcohol affects the production of the hormone.

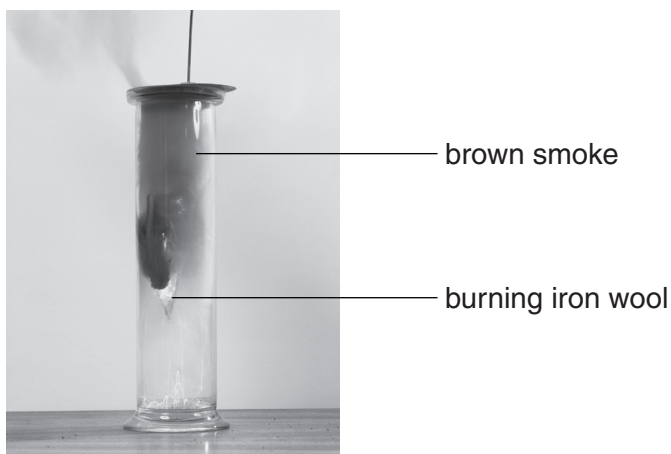
The concentration of Connor's urine changes.

Describe the effect on hormone production **and** explain how this changes the urine produced.

.....  
.....  
.....  
..... [2]

[Total: 4]

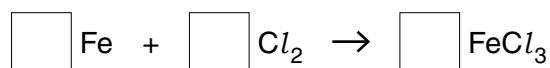
- 6 William's teacher burns some hot iron wool in chlorine gas.



- (a) The iron reacts with the chlorine to make a brown smoke.

The brown smoke is made of small particles of solid iron chloride,  $\text{FeCl}_3$ .

Write numbers in the boxes to balance the equation for this reaction.



[1]

- (b) Chlorine is a halogen.

Complete the table about the halogens.

| halogen  | colour     | state at room temperature<br>[solid/liquid/gas] |
|----------|------------|---|
| chlorine | green      |   |
| bromine  |            | liquid  |
| iodine   | grey/black |   |

[1]



(c) William's teacher then burns some sodium in a jar of chlorine gas.

When the sodium burns it makes sodium chloride.

sodium + chlorine  $\rightarrow$  sodium chloride

Write the chemical formula of sodium chloride.

answer ..... [1]

**[Total: 3]**

- 7 Potassium bromide contains potassium ions,  $K^+$ , and bromide ions,  $Br^-$ .

If an atom gains an electron it turns into a negative ion.

If an atom loses an electron it turns into a positive ion.

- (a) Draw lines to link each **symbol** for an atom or ion to its correct **electron arrangement**.

One has been done for you.

| symbol | electron arrangement |
|--------|----------------------|
| $Br^-$ | 2.8.8                |
| Br     | 2.8.8.1              |
| K      | 2.8.18.7             |
| $K^+$  | 2.8.18.8             |

A line is drawn from the  $Br^-$  symbol box to the 2.8.18.8 electron arrangement box.

[2]

- (b) The potassium bromide forms ionic crystals.

Matilda dissolves potassium bromide crystals in a beaker of water.

Complete the sentence to describe what happens to potassium bromide crystals when they dissolve.

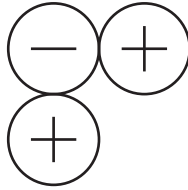
Draw **one** line to link the correct **start** and **middle** of the sentence, and one line to link the correct **middle** and **end**.

| start                        | middle                             | end   |
|------------------------------|------------------------------------|---|
| Atoms turn into ions ...     |                                    | ... and settle to the bottom.                 |
| or                           |                                    | or  |
| Ions stay as ions ...        | which move ... closer together ... | ... and escape by evaporation.                |
| or                           | or                                 | or  |
| Ions turn into atoms...      | which move ... further apart ...   | ... and move randomly through the solution.   |
| or                           |                                    | or  |
| Ions turn into molecules ... |                                    | ... and move to opposite sides of the beaker. |

[2]

(c) Matilda starts to draw a diagram of the ions in a potassium bromide crystal.

Continue her diagram by drawing in **four** more of the ions.



[1]

(d) Matilda does an experiment to show that potassium bromide is ionic.

How does she do this?

Your answer should include

- what she should do
- how she can tell that the potassium bromide is ionic.

.....

.....

..... [2]

[Total: 7]

8 Edith does a project on atoms and ions.

She finds out how many electrons, protons and neutrons they have.

Here are her results.

Write the correct symbol for **each** atom or ion including its charge where needed.

You may use the Periodic Table on the back page to help you.

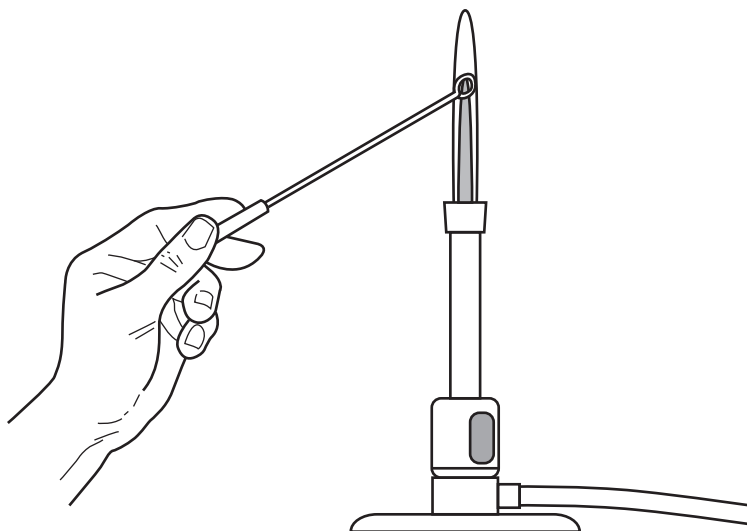
| number of protons | number of neutrons | number of electrons | symbol |
|-------------------|--------------------|---------------------|--------|
| 3                 | 4                  | 3                   | Li     |
| 9                 | 10                 | 10                  | .....  |
| 11                | 12                 | 10                  | .....  |
| 15                | 16                 | 15                  | .....  |

[2]

[Total: 2]

9 Stephen makes some sodium chloride in the laboratory.

He looks at its flame colour through a spectroscope.



Here is the spectrum that he sees.



He finds the spectrum for sodium in a book. It looks like this.



What can he tell about his own sample? Explain how he can tell.

.....

.....

..... [2]

[Total: 2]

10 Reshma runs at a hurdle and jumps over the bar of the hurdle.



(a) As Reshma moves over the bar, she is moving horizontally with a speed of 8 m/s.

Her mass is 50 kg.

What is the correct way of calculating her kinetic energy?

Put a **ring** around the correct answer.

$50 \times 8$

$50 \times 8^2$

$\frac{1}{2} \times 50 \times 8^2$

$\frac{1}{2} \times 50 \times 8$

[1]

(b) The diagram shows Reshma when she is moving forwards above the bar.

At that instant, she has both kinetic and gravitational potential energy.

Explain how their values change as she drops down towards the ground again.

.....

.....

.....

.....

.....

.....

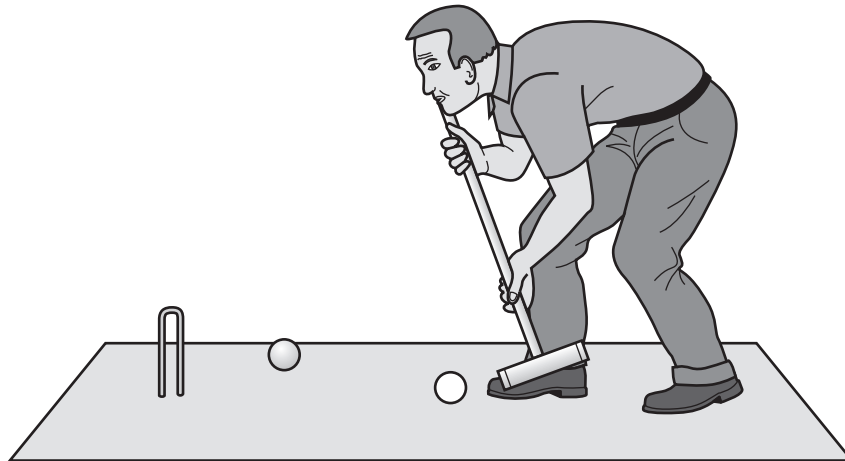
[3]

[Total: 4]

**15**  
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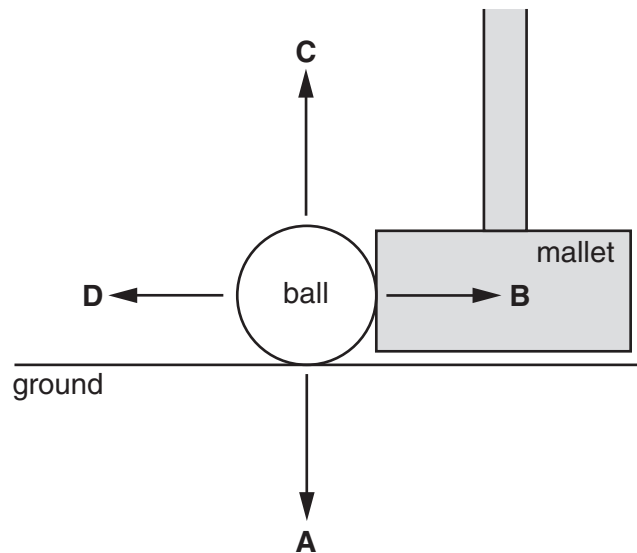
**Question 11 starts on page 16**  
**PLEASE DO NOT WRITE ON THIS PAGE**

11 Jim enjoys playing croquet.



(a) Jim hits the ball with the mallet.

The diagram shows four possible directions of forces on the ball.



(i) Three of these forces act on the ball at the instant it is hit by the mallet.

Complete the table with **A**, **B**, **C** or **D** to show the direction of these forces.

|                               |  |
|-------------------------------|--|
| weight due to gravity         |  |
| reaction from the ground      |  |
| driving force from the mallet |  |

[1]



(ii) In this case, all three forces have the same size of 5 N.

What is the size of the resultant force on the ball?

resultant force = ..... N [1]

(b) Jim hits the ball again.

The mallet hits the ball with a force of 5 N, changing its momentum by 2.5 kg m/s.

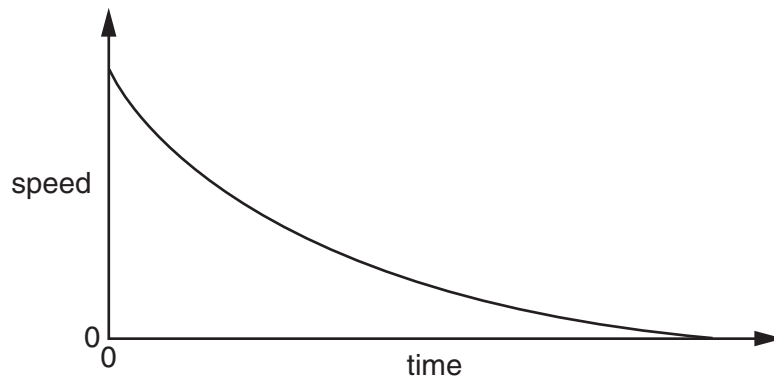
For how long is the mallet in contact with the ball?

Put a (ring) around the correct answer.

- 0.25 s      0.5 s      1.0 s      2.0 s

[1]

(c) The graph shows how the speed of the ball changes with time **after** Jim has hit it.



Here are some possible explanations for the shape of the graph.

Put ticks (✓) in the boxes next to the **two** correct explanations.

Work done on the moving ball reduces its kinetic energy.

The driving force on the ball is greater than the counter force.

The force from the mallet decreases the momentum of the ball.

The friction on the ball from the ground reduces its momentum.

The reaction from the ground reduces the momentum of the ball.

[2]

[Total: 5]

12 Pete enjoys a short run.



(a) Pete has a mass of 60 kg.

His weight is 600 N.

He runs at a steady speed of 5 m/s.

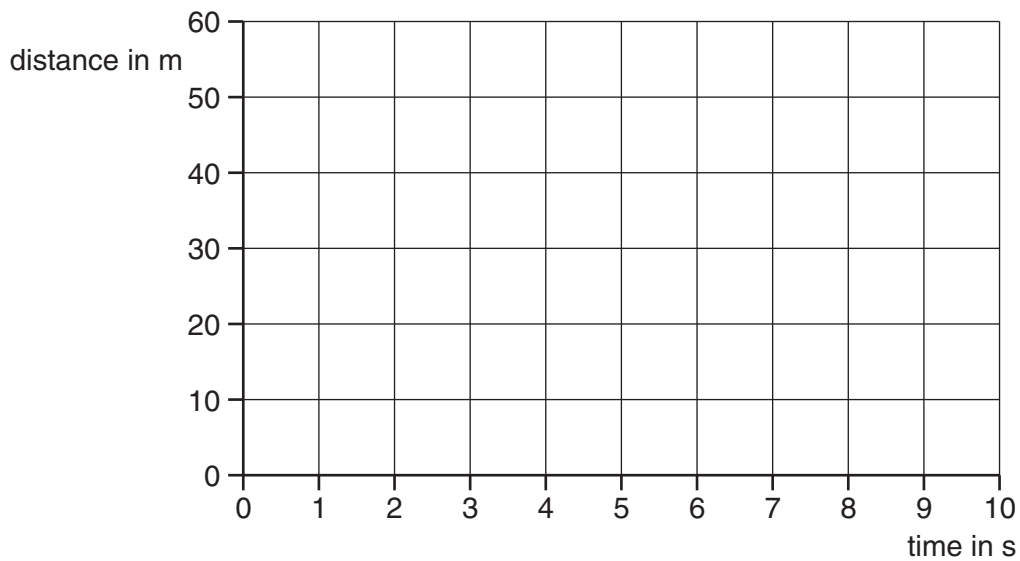
How much momentum does he have in kg m/s?

Put a **ring** around the correct answer.

**12      120      300      750      3000**

[1]

(b) Draw a distance-time graph for Pete as he runs forward at a steady speed of 5 m/s for 10 s of his run. When the time is 0 s his distance is 0 m.



[2]

(c) Pete runs uphill at a steady speed.

Draw straight lines to link the **start** of each sentence to its correct **end**.

**start**

**end**

Pete's kinetic energy ...

A force on Pete from the ground ...

Pete's gravitational potential energy ...

... remains constant.

... heats up the air as he moves.

... increases steadily with time.

... pushes him in the direction of his motion.

[2]

[Total: 5]

**END OF QUESTION PAPER**

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