

**GENERAL CERTIFICATE OF SECONDARY EDUCATION**  
**TWENTY FIRST CENTURY SCIENCE**  
**ADDITIONAL SCIENCE A**  
 Unit 1: Modules B4 C4 P4 (Higher Tier)

**A215/02**



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)

**Monday 25 January 2010**  
**Afternoon**

**Duration:** 40 minutes



Candidate Forename					Candidate Surname				
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Centre Number						Candidate Number			
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**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

**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 **16** pages. Any blank pages are indicated.

## TWENTY FIRST CENTURY SCIENCE EQUATIONS

## Useful Relationships

## Explaining Motion

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

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

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

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

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

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

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

## 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 Tina investigates the effect of temperature on enzymes.  
 She uses the enzyme catalase to break down hydrogen peroxide.  
 She collects the oxygen gas given off by the reaction.  
 Here are some of her results.

temperature of catalase and hydrogen peroxide in °C	volume of gas collected in 1 minute in cm <sup>3</sup>
20	18
30	36
40	40
90	

(a) Suggest how much gas she will collect at 90 °C.

answer..... [1]

(b) Tina tries to use a different enzyme to break down hydrogen peroxide.

Use the lock and key model to explain why this will not work.

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

(c) (i) Hydrogen peroxide molecules bind to a specific part of the enzyme.

Name this part.

..... [1]

(ii) How can a change in pH stop an enzyme from working?

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

The shape of the enzyme is changed.

The shape of the molecule binding with the enzyme is changed.

The number of collisions is increased.

The speed of the collisions is decreased.

[1]

**[Total: 6]**

2 (a) Changes take place in the body when the concentration of blood plasma becomes too low.

Choose **five** of the following statements to describe these changes and put them in the correct order.

The first one has been done for you.

- A Receptors in the hypothalamus detect **low** plasma concentration.
- B Plasma becomes less concentrated.
- C Plasma becomes more concentrated.
- D Less ADH is secreted by the pituitary.
- E More ADH is secreted by the pituitary.
- F Less urine is produced.
- G More urine is produced.
- H More water is filtered out from the kidneys.
- I Less water is filtered out from the kidneys.

A				
---	--	--	--	--

[3]

(b) The formation of urine is one way that the body loses water.

Give **two** other ways in which water is lost.

.....

.....

.....

[2]

[Total: 5]

3 Patrick is running in a race. This changes his core body temperature.

(a) Where in Patrick's body is the receptor that detects this change?

Put a (ring) around the correct word in the list below.

hypothalamus

kidney

liver

pituitary

thyroid

[1]

(b) Patrick's temperature control system involves changes to the blood vessels supplying his skin.

Draw straight lines to link each **response** to the correct **outcome**.

Draw straight lines to link each correct **outcome** to the correct **energy change**.

You should draw **four** lines.

response	outcome	energy change
vasodilation	less blood flow through skin capillaries	increased energy loss
vasoconstriction	no change in blood flow through skin capillaries	no change in energy loss
	more blood flow through skin capillaries	reduced energy loss
		no energy loss

[2]

[Total: 3]

4 Atoms are made up of protons, neutrons and electrons.

(a) The charge and the mass of protons, neutrons and electrons are not the same.

Draw straight lines to join each type of **particle** to its **charge**.

Draw straight lines to join each type of **particle** to its **relative mass**.

charge	particle	relative mass
0	proton	almost zero
-1	neutron	
+1	electron	1

[2]

(b) Many chemical changes involve ions.

Draw **one** line between the two boxes which **best** describe what an ion is.

A crystal lattice ...	... which has gained or lost electrons.
or	or
A group of atoms ...	... which has gained or lost protons.
or	or
An atom or a group of atoms ...	... which has gained or lost neutrons.
or	or
An atom ...	... which has moved from one group to another.

[2]

(c) The table gives some information about ions of different elements.

Fill in the ion symbols, including their charge.

element symbol	number of protons	number of electrons in the ion	number of neutrons	symbol for the ion
Li	3	2	4	
S	16	18	16	

[1]

(d) The table shows the electron arrangements of four elements.

element	electron arrangement
A	2.8.1
B	2.8.4
C	2.8.7
D	2.8.8.1

Which two elements have properties which are most similar?

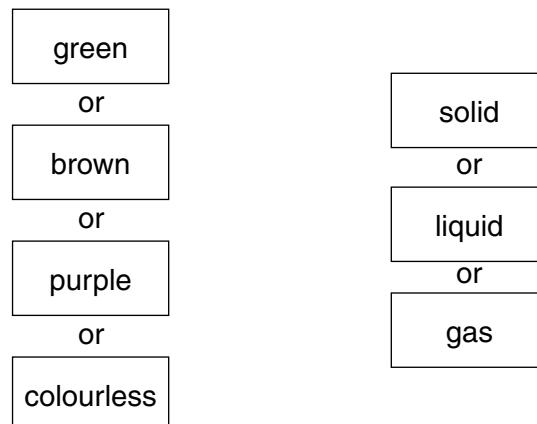
elements ..... and ..... [1]

[Total: 6]

5 Sodium is in group 1 of the Periodic Table.

(a) Sodium burns in chlorine gas to make sodium chloride.

Draw one line between **two** boxes to show what sodium chloride looks like.



[1]

(b) Sodium reacts with iodine to make sodium iodide.

Sodium iodide dissolves in water.

Describe what happens when it dissolves in water.

Use ideas about ions and molecules in your answer.

.....

.....

.....

[2]

(c) Sodium also reacts with water.

(i) Name the two products formed when sodium reacts with water.

..... [1]

(ii) Write a balanced symbol equation for this reaction.

..... [3]

(iii) A lump of sodium melts as it reacts with cold water.

Suggest why the sodium melts.

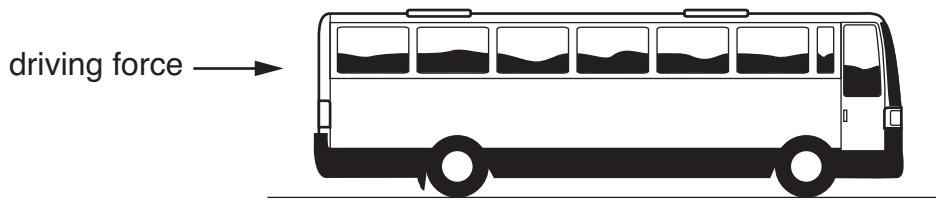
.....  
.....  
.....

[1]

[Total: 8]

10

6 Joe drives a bus along a level road.



(a) A driving force acts forwards on the bus when it is moving at a steady speed.

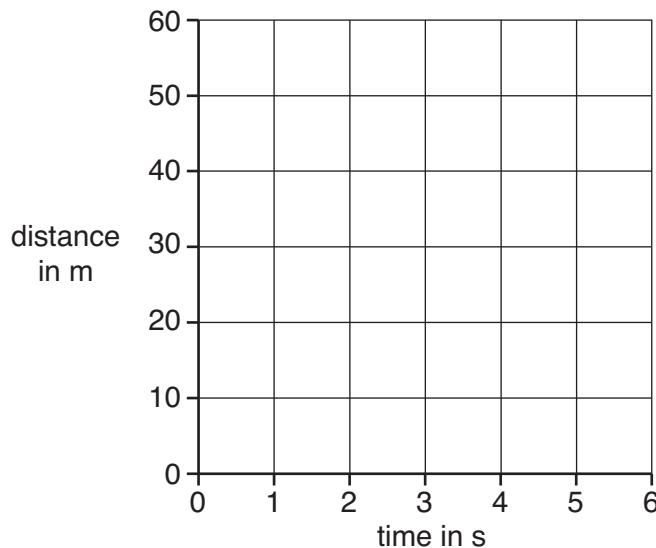
Explain why the driving force does not increase the speed of the bus.

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

[2]

(b) On the axes below, sketch a **distance-time** graph for the bus as it travels at a steady speed of 15 m/s.

Start the graph at the point 0,0.



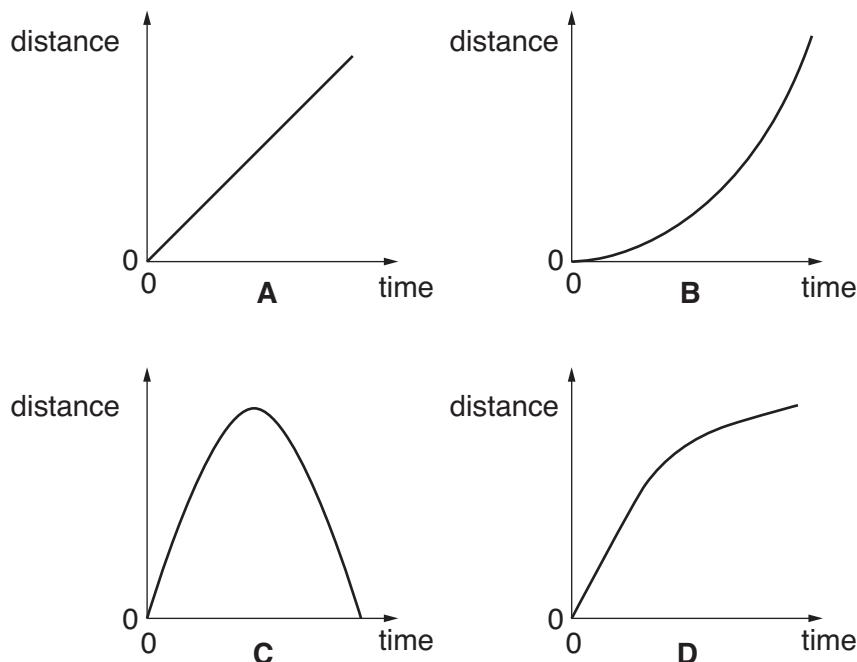
[2]

[Total: 4]

7 A small jet aircraft is speeding up along a runway.



(a) Which of these **distance-time** graphs, **A**, **B**, **C** or **D**, shows a steadily increasing speed?



answer ..... [1]

(b) The engines exert a force of 6000 N on the aircraft as it moves along the runway.

After 12 s it reaches its takeoff speed of 30 m/s from a standing start.

What is the momentum of the aircraft, in kg m/s, as it takes off?

Put a (ring) around the correct answer.

18000

72000

180000

2160000

[1]

## 12

(c) The jet engine provides the driving force for the aircraft by pushing out hot gas.

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

**start**

**end**

... pushed forwards by the gas.

The gas is ...

... pushed backwards by the gas.

... pushed forwards by the engines.

The engine is ...

... greater than the force on the gas.

... smaller than the force on the gas.

The force on the engine is ...

... pushed backwards by the engines.

... the same size as the force on the gas.

[2]

(d) As it moves along the runway the aircraft has an average speed of 15 m/s.

Why is this **different** from the takeoff speed of 30 m/s?

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

The counter force of friction increases as the aircraft speeds up.

Average values are always less accurate than instantaneous ones.

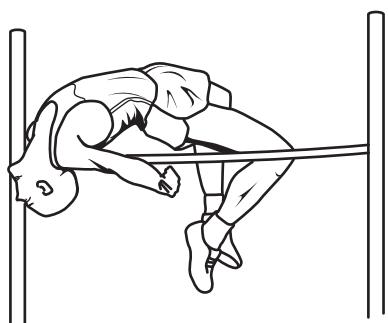
The takeoff speed of the aircraft is always double the average speed.

The instantaneous speed of the aircraft changes as it moves along the runway.

[1]

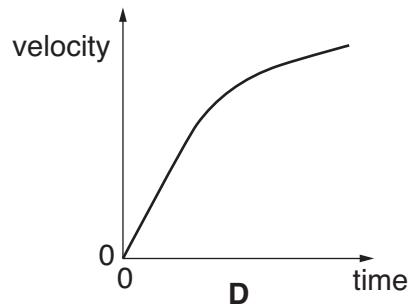
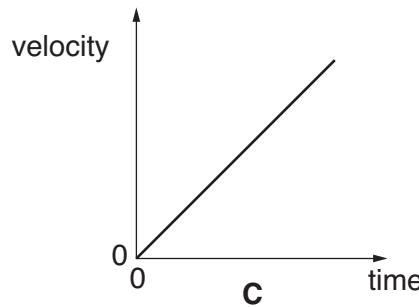
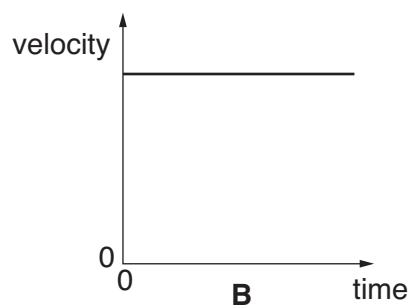
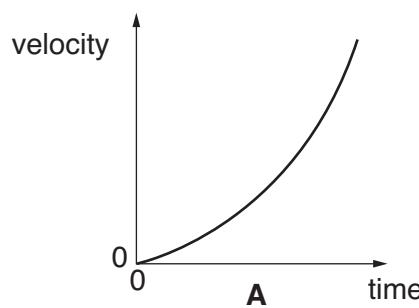
[Total: 5]

8 Jim takes part in a high jump contest.



(a) Jim runs up to the bar, increasing his velocity steadily from a standing start.

Which of these **velocity-time** graphs, **A**, **B**, **C** or **D**, shows this?



answer ..... [1]

14

(b) Jim has a mass of 70kg. Just before he jumps up, his velocity is 8m/s.

Who has the correct value for his kinetic energy?

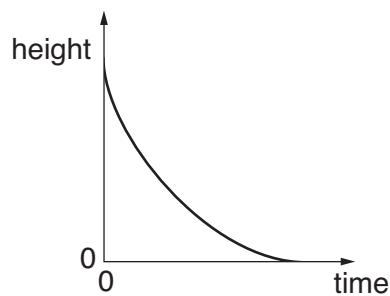
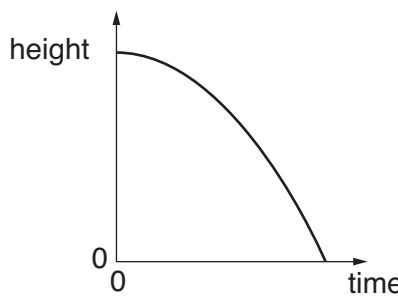
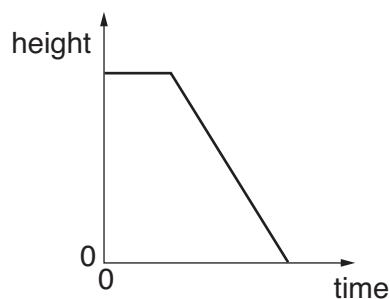
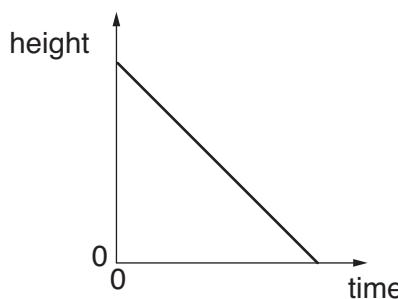


answer ..... [1]

15

(c) Jim clears the bar, then falls back to the ground.

Put a **ring** around the correct **height-time** graph for Jim as he **falls**.



[1]

(d) Jim comes to rest after he hits the crash mat.

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

Friction from the crash mat stops him falling over.

The reaction force from the crash mat reduces his momentum.

As he hits the crash mat, his kinetic energy is reduced through heating.

His weight decreases because the crash mat provides a reaction force.

His gravitational potential energy increases as he hits the crash mat.

[2]

[Total: 5]

**END OF QUESTION PAPER**



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# The Periodic Table of the Elements

1	2	3	4	5	6	7	0	
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	
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	[98] Tc technetium 43	101 Ru ruthenium 44	
133 Cs caesium 55	137 Ba barium 56	139 La* lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhodium 75	190 Os osmium 76	
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[268] Mt meitnerium 108	
[271] Ds darmstadtium 110	[277] Hs hassium 108	[271] Rg roentgenium 111	[272] Rg roentgenium 111				Elements with atomic numbers 112-116 have been reported but not fully authenticated	

\* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number