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OCR
RECOGNISING ACHIEVEMENT

Monday 30 January 2012 – Afternoon

GCSE TWENTY FIRST CENTURY SCIENCE
ADDITIONAL SCIENCE A

A215/02   Unit 1: Modules B4 C4 P4 (Higher Tier)

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)

Duration: 40 minutes

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. HB pencil may be used for graphs and diagrams only.
• Answer **all** the questions.
• 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).
• 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.

OCR is an exempt Charity

Turn over

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 Lucien runs a race.

(a) Oxygen and water move between his blood and his muscle cells.

Describe and explain the **processes** that move oxygen and water between his blood and muscle cells.

....

....

....

.... **[3]**

(b) As Lucien runs his body loses water.

This makes his blood plasma more concentrated.

Put a ring around the correct words to complete each sentence.

Lucien's kidneys will now produce urine that is

more dilute   /   more concentrated   /   the same concentration.

This is an example of   **homeostasis   /   evaporation   /   hypothermia**.

[1]

[Total: 4]

Turn over

2 Charlotte exercises.

Her body reacts by sweating to cool her down.

(a) A **negative feedback** mechanism stops her getting too cold.

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

Negative feedback …

… increases rates of all chemical reactions as body temperature rises. ☐

… works to change any steady state. ☐

… between effectors and receptors reverses any changes that take place. ☐

… decreases rates of all chemical reactions as body temperature rises. ☐

[1]

(b) Charlotte's body has some effectors which cool her, and some which warm her.

What is the advantage to Charlotte of having antagonistic effectors like this?

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

Antagonistic effectors …

… cancel each other out. ☐

… allow a sensitive response to a stimulus. ☐

… use more energy. ☐

… prevent a steady state. ☐

[1]

(c) When Charlotte becomes hot, her body reacts in a number of steps.

From each pair of statements choose the correct one.

Place them in the correct order by writing one letter in each box.

A The hypothalamus processes the information.

B The pituitary processes the information.

C Receptors in the brain detect blood temperature.

D Receptors in the skin detect blood temperature.

E Blood vessels in the skin vasoconstrict.

F Blood vessels in the skin vasodilate.


[2]

[Total: 4]

3 Jon does an experiment with an enzyme.

He changes the temperature and measures how fast the reaction is.

He records his results in a graph.
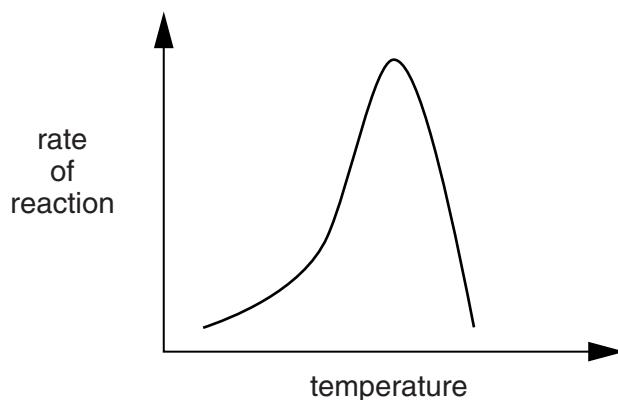
He asks some friends to explain the shape of this graph.

Which **two** give him correct answers?

Megan
At low temperature the substrate is denatured.

Harry
Raising the temperature increases collisions between enzyme and substrate.
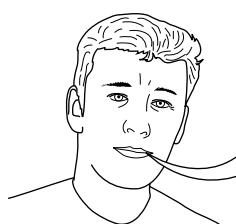
Jason
The enzyme only works at the optimum temperature.
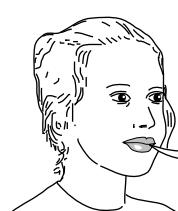
Cassie
At high temperature, collisions between enzyme and substrate stop.

Philippa
At high temperature, the enzyme is denatured.

Sandeep
Changing the temperature changes the substrate.

answers .... and .... **[2]**

[Total: 2]

4 (a) The kidneys produce urine.

The hormone ADH controls the volume and concentration of urine produced.

Put a tick (✓) in the box next to the correct choice to complete each sentence.

ADH is released by the

adrenal gland.	
hypothalamus.	
pituitary gland.	

It is carried to the kidneys by the

blood.	
neurons.	
lymph.	

If there is more ADH the urine is more

concentrated.	
dilute.	
sugary.	

[2]

(b) The drugs alcohol and Ecstasy affect the secretion of ADH.

Place **two** ticks (✓) in each row of the table to show the effects.

drug	effect on ADH secretion		effect on urine volume	
	increase	decrease	increase	decrease
alcohol				
Ecstasy				

[2]

[Total: 4]

5 The element helium was discovered in the Sun before it was found on Earth.

Astronomers discovered it when they used telescopes to study the Sun.

Suggest how an astronomer can use a telescope to find out what elements are in the Sun.

....

....

....

....

.... **[3]**

[Total: 3]

6 Tony studies the halogens.

(a) Complete the table to show the colour and state (**solid**, **liquid** or **gas**) of each halogen at room temperature.

name	colour	state
bromine		
chlorine		
iodine		

[3]

(b) Tony studies the reactions of sodium with the halogens.

Sodium, Na, reacts with bromine, Br_2.

Write a balanced chemical equation for this reaction.

.... [2]

(c) Tony knows that sodium chloride melts at 800 °C, and that sodium iodide melts at 660 °C.

Suggest the melting point of sodium bromide.

melting point .... °C [1]

(d) When a sodium atom reacts it turns into a sodium ion, Na^+.

What happens during this process?

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

It gains an electron. ☐

It loses an electron. ☐

It gains a proton. ☐

It loses a proton. ☐

[1]

[Total: 7]

7 Atoms are made of protons, neutrons and electrons.

(a) When deciding which element an atom belongs to, which of the following is most important?

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

The number of protons in the atom. ☐

The number of neutrons in the atom. ☐

The relative atomic mass of the atom. ☐

The size of the atom. ☐

[1]

(b) A sulfur atom has 16 protons, 16 neutrons and 16 electrons.

Complete the diagram to show the electron arrangement of a sulfur atom.
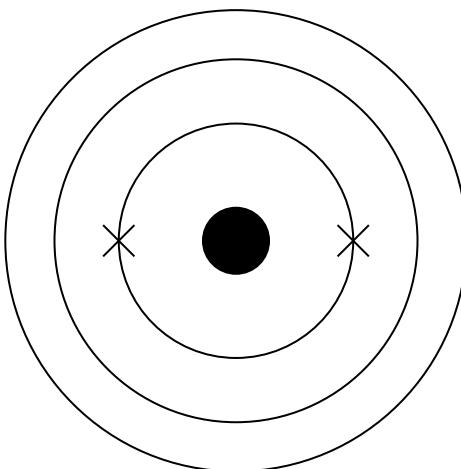
[1]

(c) Mary finds out that sulfur reacts with sodium to make sodium sulfide.

The sodium ion is Na^+ and the sulfide ion is S^{2-}.

Put a (ring) around the formula of sodium sulfide.

Na_2S NaS Na_2S_2 NaS_2

[1]

(d) The element to the right of sulfur in the Periodic Table is chlorine.

Chlorine forms a chloride ion, Cl^-.

What is the difference between a chloride ion and a chlorine atom?

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

The ion has one electron more than the atom. ☐

The ion has one electron less than the atom. ☐

The ion has one electron shell more than the atom. ☐

The ion has one electron shell less than the atom. ☐

[1]

[Total: 4]

8 Jack has a car accident.
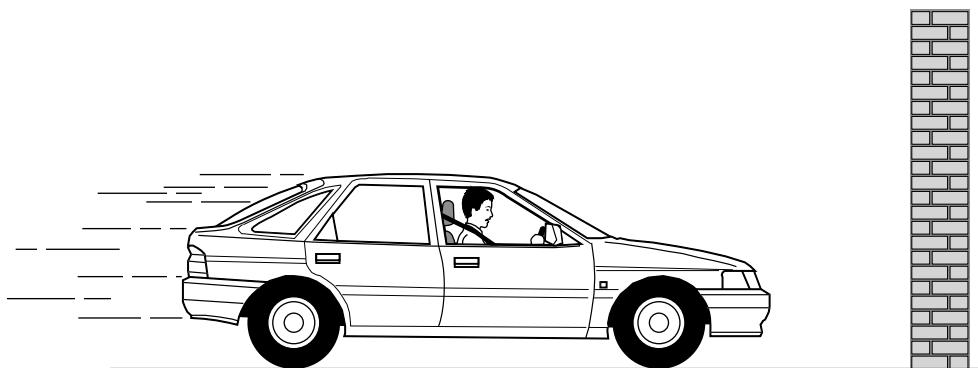
He drives his car into a wall.

The seat-belt and crumple zone of the car stop Jack getting hurt.

(a) Here are some possible reasons why the crumple zone protects Jack.

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

It transfers kinetic energy from the car to Jack. ☐

It increases the time for which forces act on Jack. ☐

It provides a counter force to the force from the wall. ☐

It redirects the force from the wall towards the ground. ☐

[1]

(b) The speed of the car drops from 15 m/s to zero as it collides with the wall.

This takes a time of 0.1 s. The car moves 0.75 m in that time.

Calculate the average speed of the car during its collision with the wall.

average speed = ... m/s **[1]**

(c) Complete the following sentences.

Choose words from this list.

force   **friction**   **mass**   **momentum**   **weight**   **work**

Jack has to get a new car seat-belt after the accident.

This is because it has become permanently stretched.

During the accident, a .... acts on the seat-belt.

This does .... on the seat-belt.

[2]

[Total: 4]

9 Jim jumps out of an aeroplane.
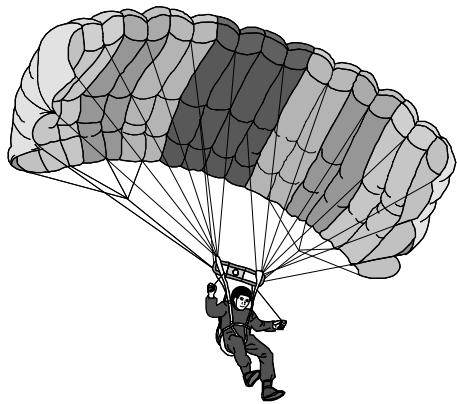
He opens his parachute on the way down and lands safely.

Jim uses a speed sensor to measure his speed as he falls towards the ground.

He uses the data from the sensor to draw a speed–time graph.
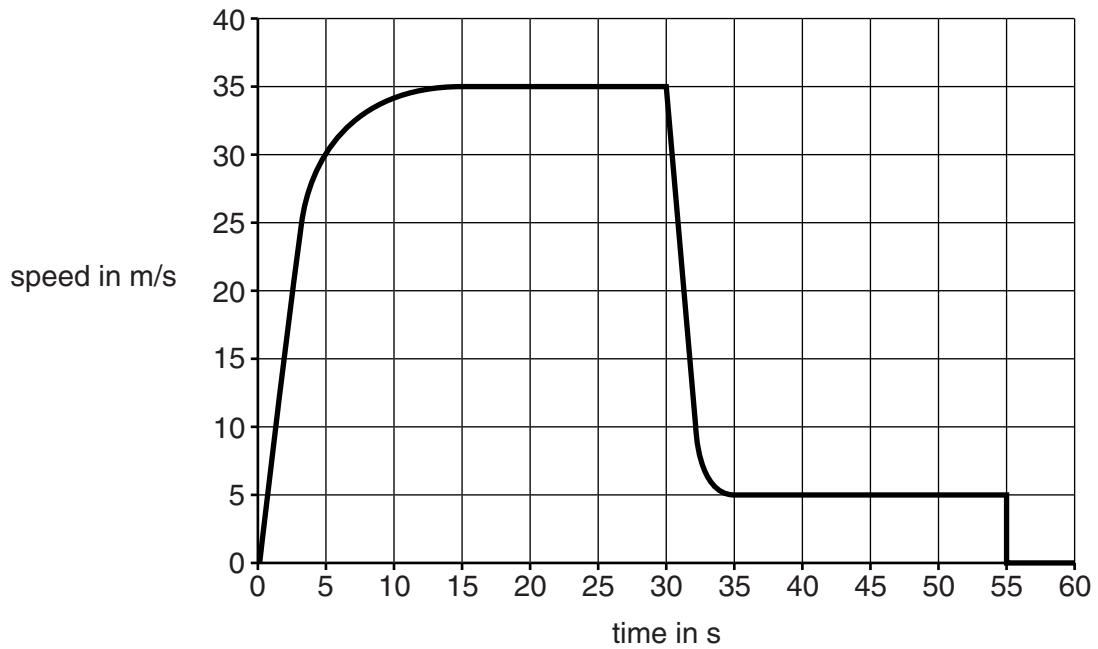
(a) Use the graph to complete this table.

event during Jim's fall	time in seconds
jumps out of the aeroplane	0
reaches his maximum speed	
opens his parachute	
lands safely on the ground	

[1]

 (b) When Jim opens his parachute, he slows down.

Why does the parachute slow him down?

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

Air resistance reduces his momentum. ☐

Jim and his parachute are an interaction pair. ☐

The counter force is now less than his weight. ☐

The reaction of the parachute cancels out his weight. ☐

[1]

 (c) When Jim's parachute is fully open he falls at a steady speed.

Describe and explain the energy changes as he falls towards the ground at a steady speed.

....

....

....

....

....

....

.... **[3]**

[Total: 5]

Turn over

**10** A small rocket in space switches on its engine for 10 seconds.

gas   rocket
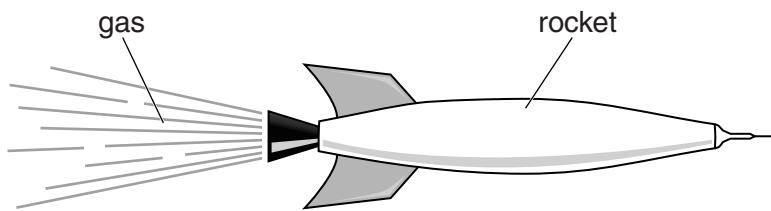
High speed gas comes out of the engine.

This increases the momentum of the rocket in the forward direction.

(a) The gas exerts a force of 1000 N on the rocket when the rocket has a speed of 50 m/s.

Calculate the increase of momentum of the rocket in 10 s.

momentum increase = ... kg m/s **[1]**

(b) Explain **why** the momentum of the rocket increases while the engine is switched on.

....

....

....

....

....

... **[3]**

(c) On the axes below, sketch a distance–time graph for the rocket while the engine is turned on. Assume that it starts off at zero time and zero distance.

distance

0
  0   time
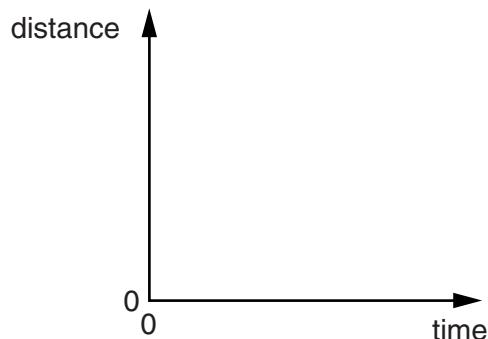
[1]

[Total: 5]

END OF QUESTION PAPER

18

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The Periodic Table of the Elements

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

1	2											3	4	5	6	7	0
																	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
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	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	178 **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	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[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	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111							

1
H
hydrogen
1

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.