OCR
RECOGNISING ACHIEVEMENT

H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

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)

Wednesday 21 January 2009
Afternoon

Duration: 40 minutes

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

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 **20** pages. Any blank pages are indicated.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	**3**	
2	**2**	
3	**9**	
4	**10**	
5	**4**	
6	**4**	
7	**5**	
8	**5**	
TOTAL	**42**	

TWENTY FIRST CENTURY SCIENCE EQUATIONS

Useful Relationships

Explaining Motion

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

momentum = mass × velocity

change of momentum = resultant force × time for which it acts

work done by a force = force × distance moved by the force

change in energy = work done

change in GPE = weight × vertical height difference

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

Electric Circuits

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

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

energy transferred = power × time

power = potential difference × current

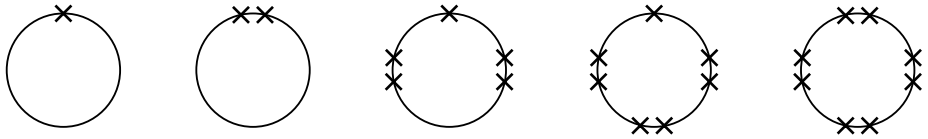
$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

The Wave Model of Radiation

wave speed = frequency × wavelength

Answer **all** the questions.

1 The diagrams show the electrons in the **outer** shell of different elements from the Periodic Table.



A **B** **C** **D** **E**

(a) **(i)** Which diagram could be for an element in Group 7?

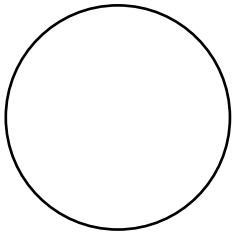
answer ..... **[1]**

(ii) Which diagram could be for an element with properties **similar** to sodium?

answer ..... **[1]**

(b) Element **D** will form an ion with a single **negative** charge.

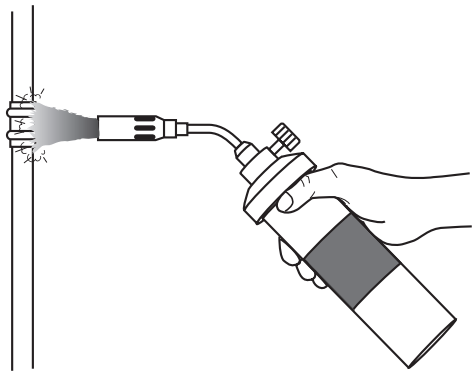
On the diagram below, show the electron arrangement for the outer shell of the **ion** of element **D**.



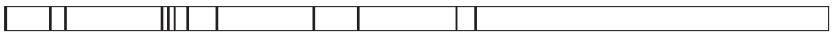
[1]

[Total: 3]

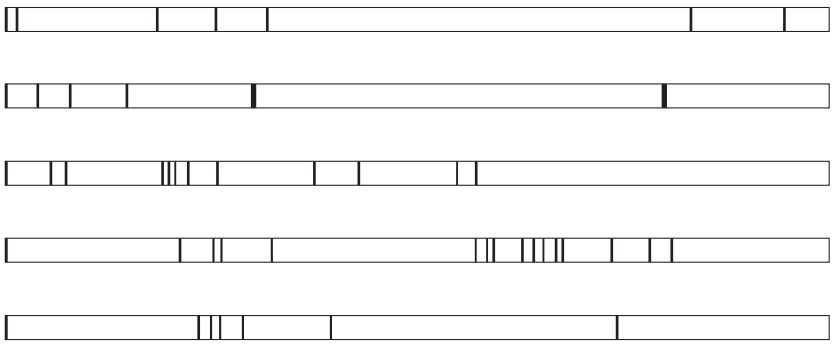
2 A plumber uses a blowtorch to mend a water pipe.
When the blowtorch flame touches the pipe the flame goes green.



(a) Emily uses a spectroscope to look at the flame.
This is what she sees.



She finds the spectra of five different elements in a book.



Which element, **A**, **B**, **C**, **D** or **E**, caused the colour of the flame?

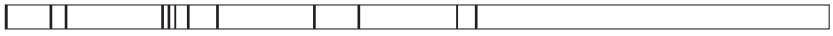
answer ..... **[1]**

(b) A flame usually produces several spectra at the same time.
The spectrum below shows that two different elements are present.

Use the sample spectra to decide which **two** elements are present.


A


B


C


D

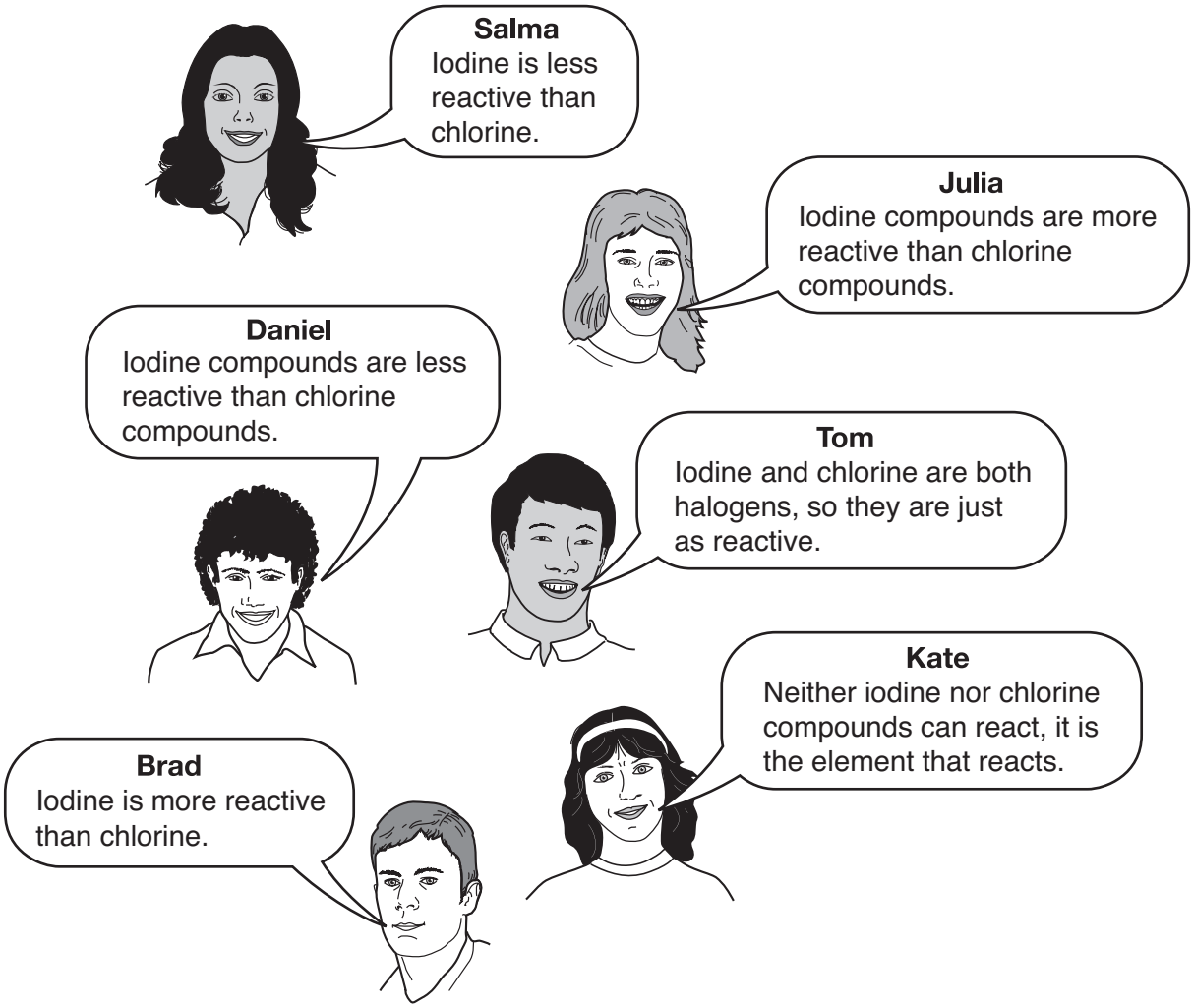

E

answers ..... and ..... **[1]**

[Total: 2]

3 Mary compares chlorine with iodine. She knows that chlorine is a highly reactive element that forms unreactive compounds.

(a) Mary asks her friends what they know about chlorine and iodine and their compounds.



(i) Who has made the correct statement about the reactivity of iodine?

..... **[1]**

(ii) Who has made the correct statement about the reactivity of the compounds of chlorine and iodine?

..... **[1]**

(b) One compound of chlorine is potassium chlorate, $KClO_3$.

Draw a (ring) around a possible formula for sodium bromate.

NaBr **KBO_3** **NaBrO**

$NaClO_3$ **$KBrO_3$** **$NaBrO_3$**

[1]

(c) Large amounts of chlorine are used to make calcium hypochlorite bleach.

(i) Calcium hypochlorite, $Ca(OCl)_2$, is made of two types of ion. One of these is Ca^{++}.

Put a (ring) around the formula of the **other** type of ion in calcium hypochlorite.

Cl^- **Cl_2^{2-}** **OCl^-** **OCl_2^{2-}**

[1]

(ii) When calcium hypochlorite reacts with dilute acid, water and oxygen are formed.

Fill in the boxes to balance the equation.

$$Ca(OCl)_2 + \square\ HCl \rightarrow 2Cl_2 + \square\ H_2O + CaCl_2$$

[2]

(d) Chlorine will form chlorine dioxide, ClO_2.

Chlorine dioxide solution is unstable, and breaks down into chlorine and oxygen gases.

Write a balanced symbol equation, including state symbols, underneath the word equation.

chlorine dioxide $\rightarrow$ chlorine + oxygen

[3]

[Total: 9]

4 Selina is running in a marathon.

(a) During the race Selina gets hot.
The sentences **A**, **B**, **C**, **D**, **E** and **F** describe how her body cools down.
They are in the wrong order.

A The sweat evaporates from her body.

B Her brain stimulates her sweat glands.

C Her muscles are respiring and producing heat.

D The sweat glands produce more sweat.

E The sweat carries heat away from her body.

F Her brain detects an increase in body temperature.

Put the letters **A**, **B**, **C**, **D**, **E** and **F** in the boxes in the correct order.
The last one has been done for you.

					E

[4]

(b) Sweating is one way that the body maintains a constant temperature.
Why is a constant body temperature important?

Put a tick (✓) in the boxes next to the **two best** answers.

Enzymes are made of carbohydrate.	☐
Enzymes slow down chemical reactions in cells.	☐
Enzymes work best at an optimum temperature.	☐
Enzymes are denatured at low temperatures.	☐
Enzymes can stop working at high temperatures.	☐

[2]

(c) Blood vessels supplying capillaries in the skin are also important in maintaining body temperature.

The sentences show changes that happen as the body becomes overheated.

Put a (ring) around the **correct** word to complete each sentence.

As the body gets hotter, the blood vessels supplying the capillaries in the skin …

constrict **dilate** **move upwards**

The blood flow through the capillaries …

decreases **increases** **remains constant**

Energy loss from the skin …

decreases **increases** **is prevented**

This process is called …

hypothermia **vasoconstriction** **vasodilation**

[4]

[Total: 10]

5 Selina must take regular drinks of water during the race.
This is to keep the water level in her body balanced.

(a) Why is a balanced water level important?

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

So that the body does not overheat.	☐
To keep the cell contents at the correct concentration.	☐
So that the kidneys can continue to produce urine.	☐
So that blood can reach every part of the body.	☐

[1]

(b) Urine production is controlled by a hormone called ADH.
ADH controls the concentration of the urine produced.

Draw lines to link each **response** to its correct **stimulus**, and to link each **response** to its correct **effect**.

stimulus	response	effect
blood salt concentration rises		a small amount of concentrated urine is made
blood salt concentration falls	more ADH is secreted	a small amount of dilute urine is made
blood sugar concentration rises	less ADH is secreted	a large volume of concentrated urine is made
blood sugar concentration falls		a large volume of dilute urine is made

[2]

(c) Urine production is controlled by a negative feedback process.

What is negative feedback?

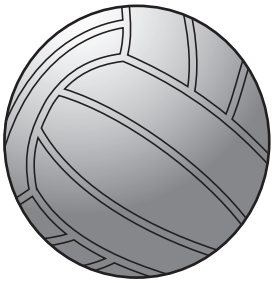
Put a tick (✓) in the box next to the **best** answer.

A process that maintains any change to a system's steady state.	☐
A process that reverses any change to a system's steady state.	☐
A process that increases any change to a system's steady state.	☐
A process that is not influenced by a system's steady state.	☐

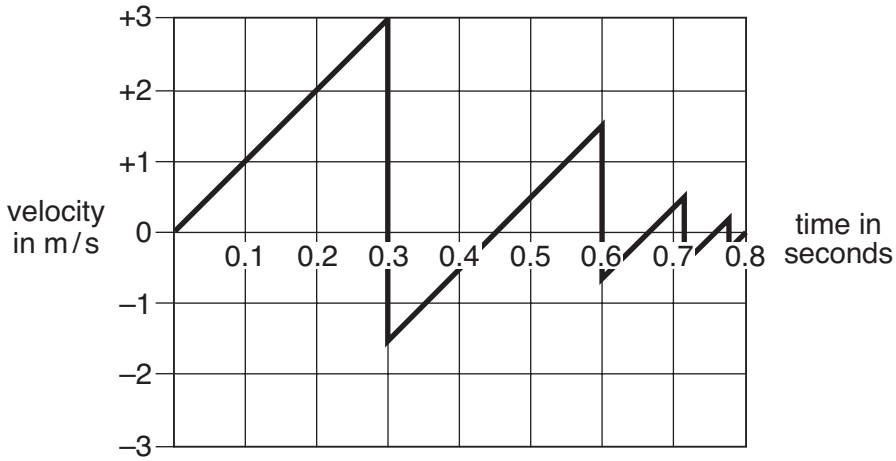
[1]

[Total: 4]

6 Dan drops a ball onto the floor. The ball bounces several times.



The graph shows how the velocity of the ball changes with time.



(a) When is the velocity of the ball negative?

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

when the velocity is increasing ☐

when the velocity is decreasing ☐

when the ball is moving upwards ☐

when the ball is falling downwards ☐

[1]

(b) Complete the sentences.

Choose the **best** words from this list.

decreases **increases** **stays the same**

As the ball falls towards the floor its velocity ..... .

This is because its gravitational potential energy ..... ,

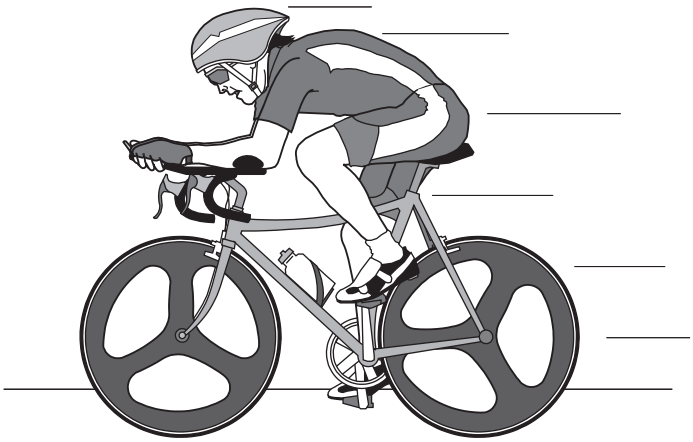
so its kinetic energy ..... .

If there is no air resistance, the total energy of the ball ..... as it falls.

[3]

[Total: 4]

7 Jake rides a bike in a race.



Jake and his bike have a weight of 800 N.
Jake and his bike can reach a momentum of 1200 kg m/s in 6 s from a **standing start**.

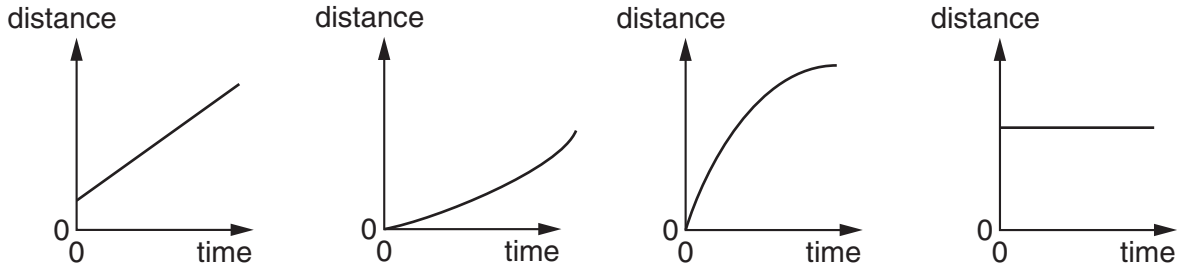
(a) What is the resultant force on the bike during those 6 s?

Put a (ring) around the correct answer.

200 N **800 N** **1200 N** **7200 N**

[1]

(b) Which of these distance-time graphs is correct for Jake **as he speeds up**?



answer ..... **[1]**

(c) Complete the sentences.

Choose the **best** words from this list.

counter **driving** **gravitational** **kinetic**

momentum **tension** **work**

Jake supplies the ..... force for the bike.

Air resistance supplies a ..... force.

For the momentum of the bike to increase, the ..... force must be greater than the ..... force.

[2]

(d) Jake wears a cycle helmet. This protects him if he has a crash.

How does it protect him?

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

It increases the duration of the impact for his head.	☐
It decreases the duration of impact for his head.	☐
It reduces the momentum change of his head.	☐
It absorbs all of the kinetic energy of his head.	☐

[1]

[Total: 5]

8 Dave uses a sled to slide down a hill.

(a) Complete the energy transfer diagram for Dave as he slides down the hill.

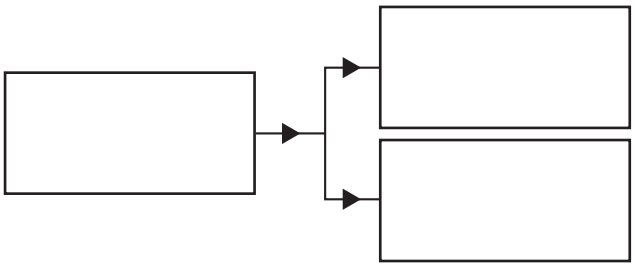
Use words from the list.

gravitational potential energy

heat energy

kinetic energy

work



[1]

(b) Dave and his sled lose 7800 J of gravitational potential energy (GPE) as they slide down the hill.
The weight of Dave and his sled is 650 N.
How should Dave calculate the vertical height he has fallen?

Put a (ring) around the correct answer.

$\frac{\textbf{7800}}{\textbf{650}}$ **7800 x 650** $\frac{\textbf{650}}{\textbf{7800}}$

[1]

(c) At the bottom of the hill, Dave and his sled have a kinetic energy of 4680 J. The mass of Dave and his sled is 65 kg.
How fast are they moving at the bottom of the hill?
Who has calculated the correct answer?

answer ..... **[1]**

(d) The columns show the forces on Dave and the sled, and the direction of the force.

Draw lines to connect each **force** on Dave and the sled to the **direction of the force**.

force	direction of the force
weight	vertically up
	up the slope
reaction	vertically down
	down the slope
friction	at right angles to the slope

[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
							1 **H** hydrogen 1										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	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** 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