Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GENERAL CERTIFICATE OF SECONDARY EDUCATION

A215/02

TWENTY FIRST CENTURY SCIENCE ADDITIONAL SCIENCE A

Unit 1: Modules B4 C4 P4 (Higher Tier)

MONDAY 25 JANUARY 2010: Afternoon
DURATION: 40 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

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)

READ INSTRUCTIONS OVERLEAF

DC (LEO/SW) MEP10218 24321/1

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes on the first page.
- 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.
- 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 pages 4 and 5.
- A copy of the Periodic Table is provided.

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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

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

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

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

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

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

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^3
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 <u>TWO</u> 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
	less blood flow through skin capillaries	increased energy loss
vasodilation	no change in blood flow through skin capillaries	no change in energy loss
vasoconstriction	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
+1	electron	

[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, oppposite, gives some information about ions of different elements.

Fill in the ion symbols, including their charge.

(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]

15

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]

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.

green	solid
or	or
brown	liquid
or	or
purple	gas
or	
colourless	

[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.

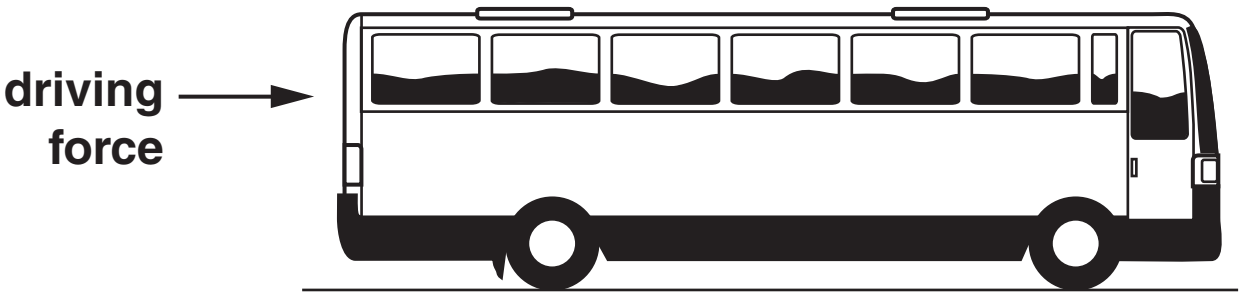
_____

_____

_____ [1]

[Total: 8]

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.

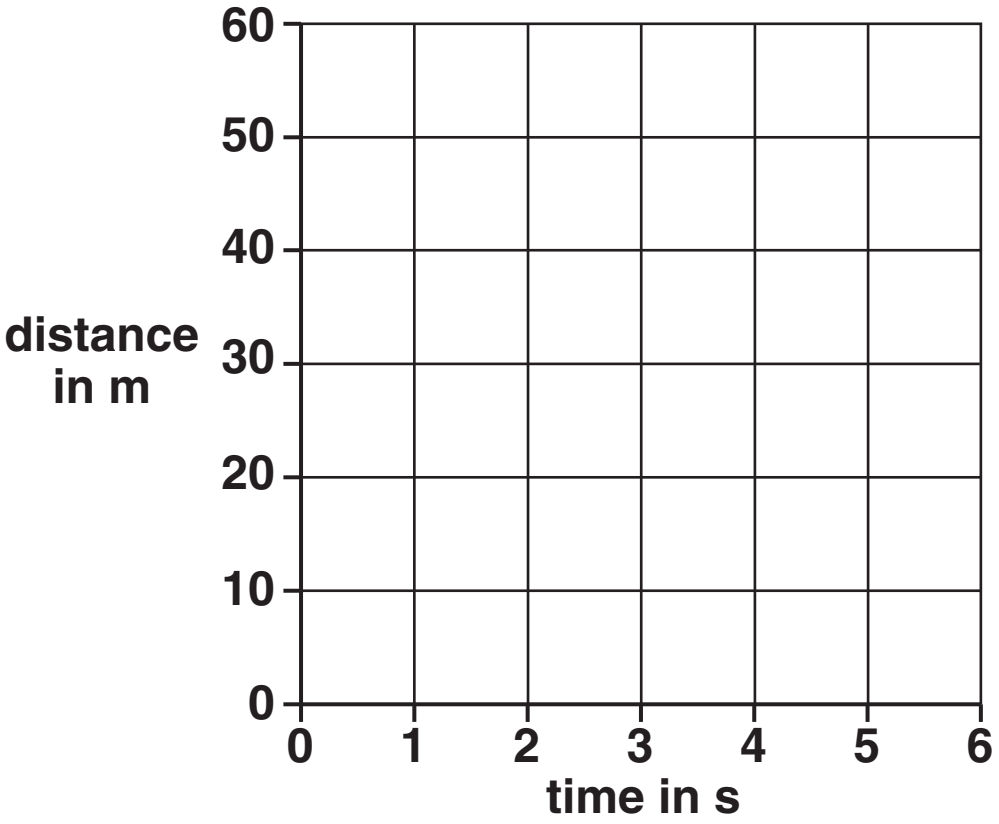
_____

_____

_____ [2]

(b) On the axes below, sketch a <u>DISTANCE-TIME</u> graph for the bus as it travels at a steady speed of 15 m/s.

Start the graph at the point 0,0.

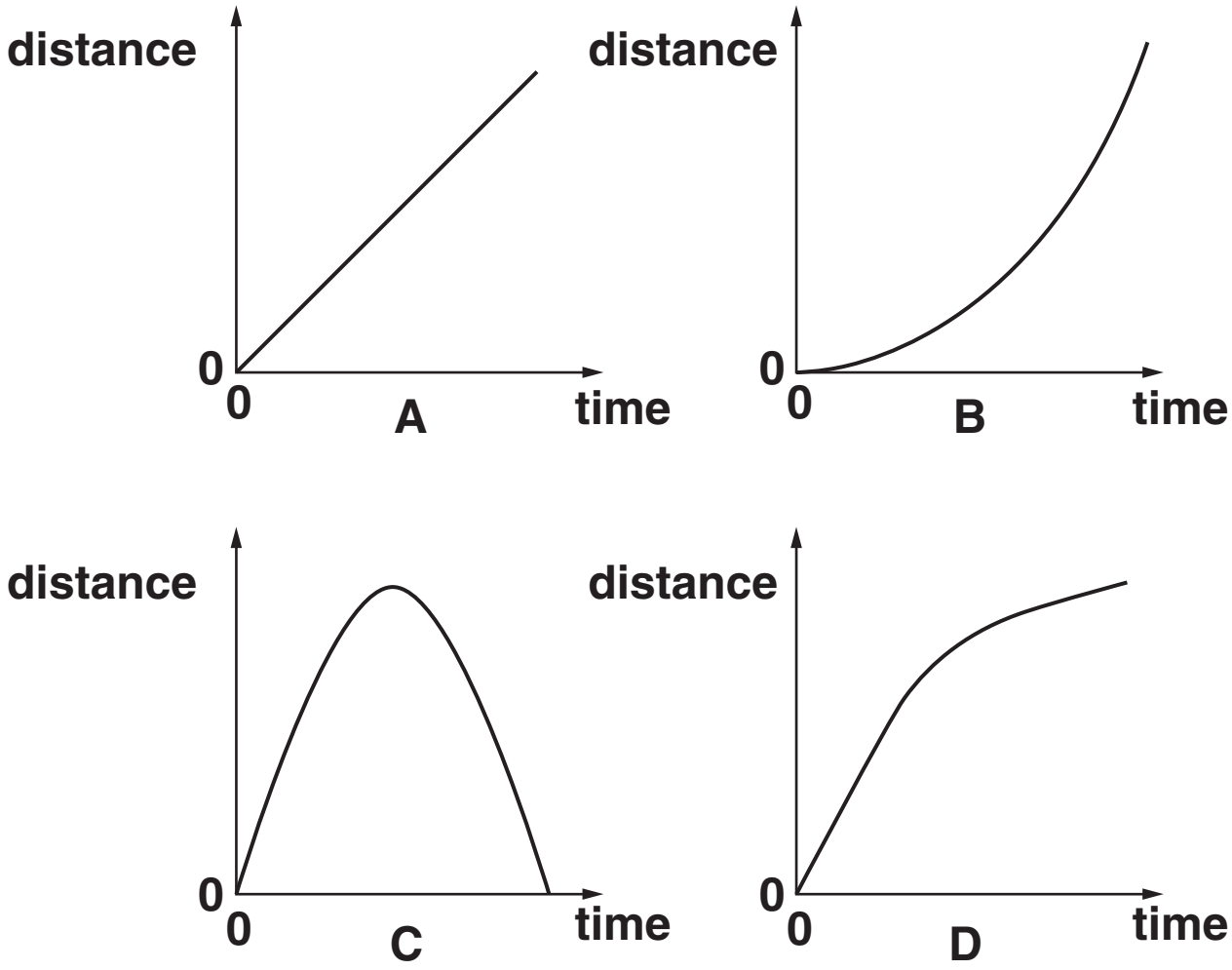


[2]

[Total: 4]

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

(a) Which of these <u>DISTANCE-TIME</u> 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.

18 000 72 000 180 000 2 160 000

[1]

(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.	☐

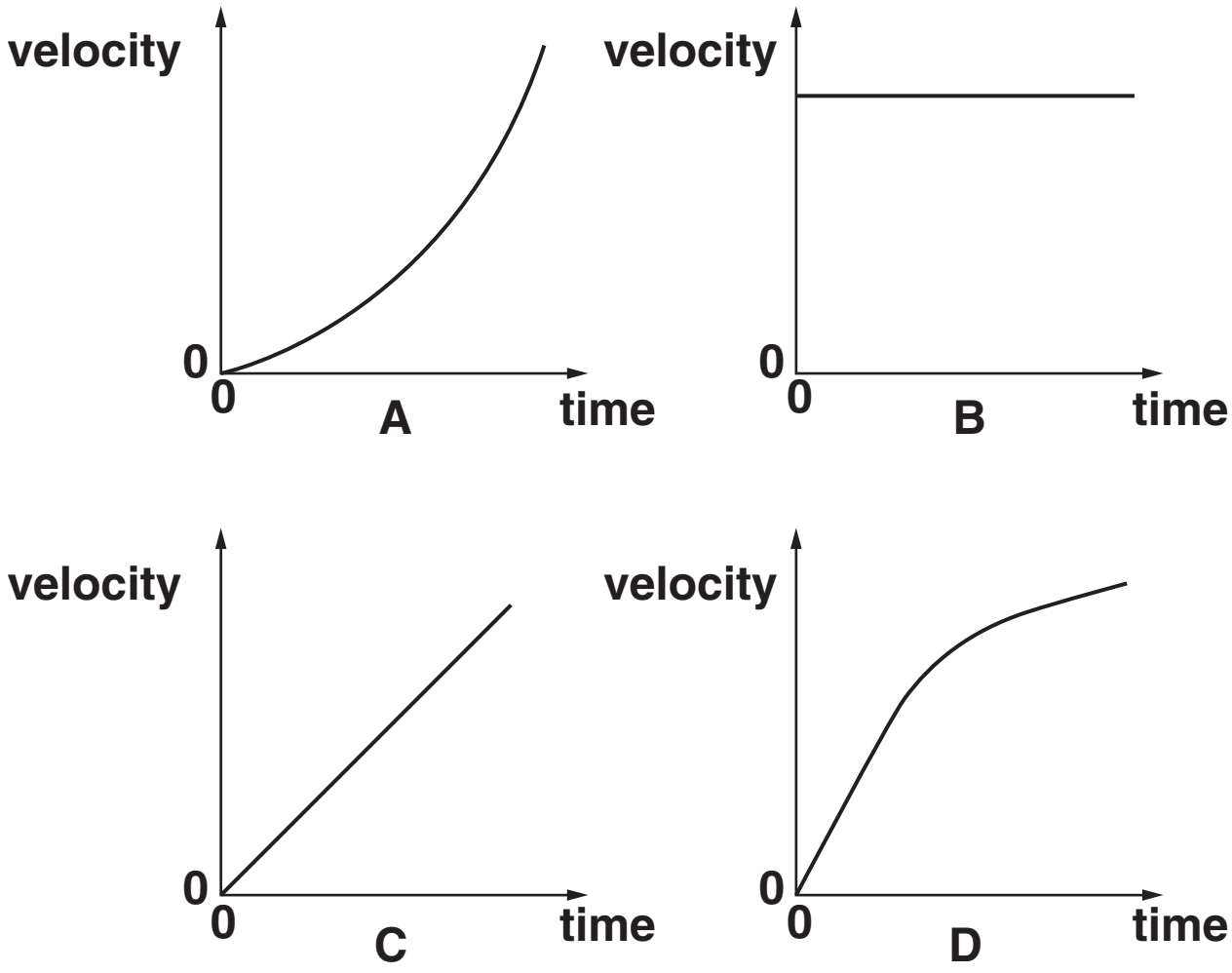
[1]

[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]

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

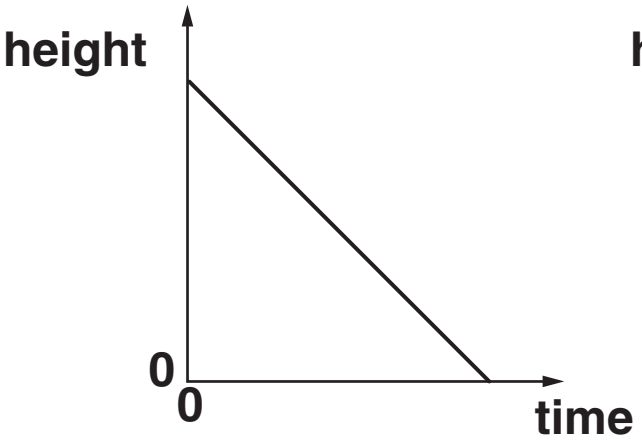
Who has the correct value for his kinetic energy?

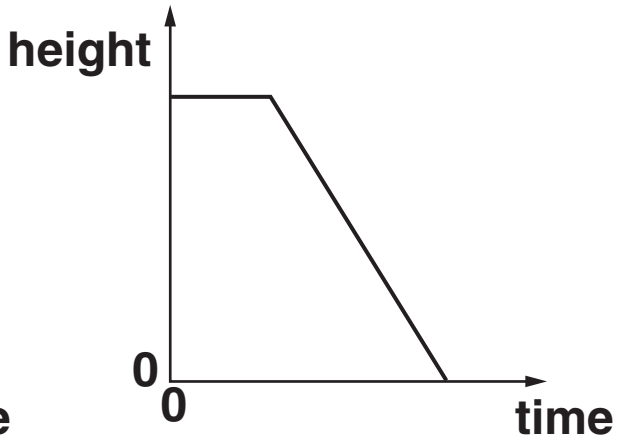
ALAN	CARLOS	BESS	DAVINA
280 J	2240 J	560 J	78 400 J

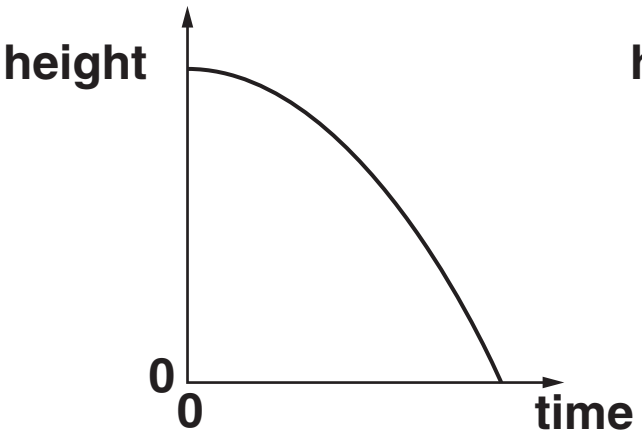
answer _____ [1]

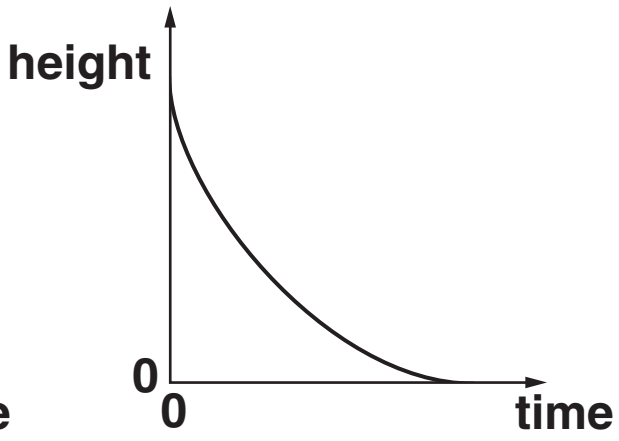
(c) Jim clears the bar, then falls back to the ground.

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

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.