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)

WEDNESDAY 19 JANUARY 2011: Morning
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 (AC/SW) 11MEP01142 40159/3

INSTRUCTIONS TO CANDIDATES

- **Write your name, centre number and candidate number in the boxes on the first page. 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.**

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.**
- **The Periodic Table is provided.**

BLANK PAGE

QUESTION 1 BEGINS ON PAGE 6

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 Molly is doing an experiment with the enzyme peroxidase.

Peroxidase speeds up the breakdown of hydrogen peroxide.

Bubbles of oxygen gas are produced.

(a) Peroxidase CANNOT be used to break down other chemicals such as starch.

Explain why.

_____

_____

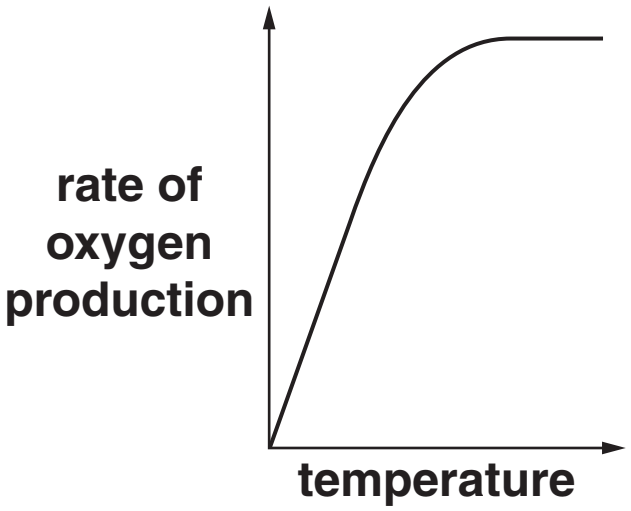
_____ **[2]**

(b) Molly changes the temperature of her mixture of enzyme and hydrogen peroxide.

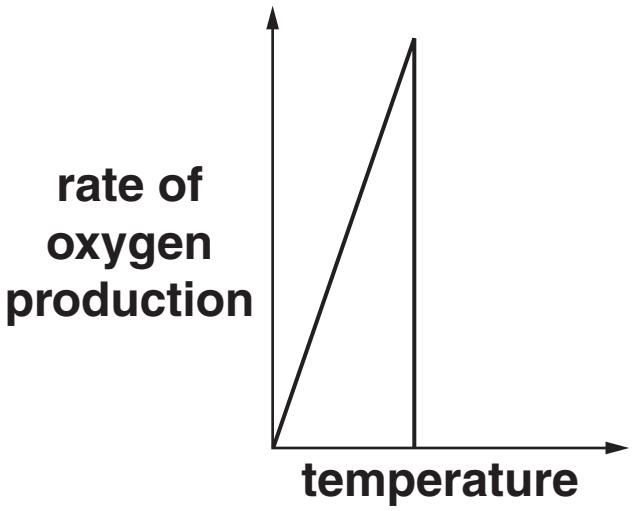
She measures the rate of oxygen production.

(i) Which graph, A, B, C or D, shows the pattern of her results as she increases the temperature to 80 °C?

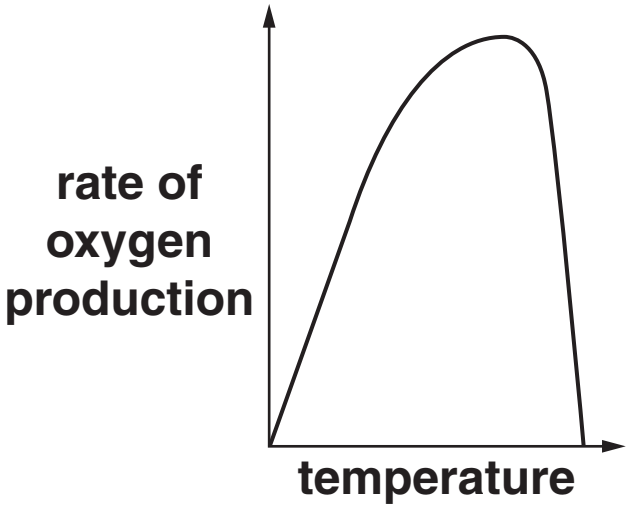
A



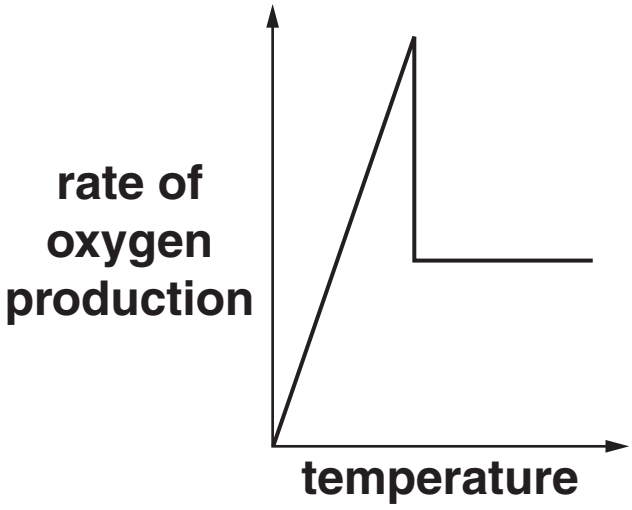
B



C



D



answer _____ **[1]**

(ii) Why does the rate of oxygen production increase in the first part of the graph?

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

The frequency of collisions increases. ☐

The enzyme is denatured. ☐

The hydrogen peroxide molecules are changing shape. ☐

The rate of collisions decreases. ☐

The size of hydrogen peroxide molecules increases. ☐

[1]

(c) Peroxidase works best at a particular pH.

Changing the pH from this value can alter the rate of this enzyme reaction.

Molly writes a sentence to explain this.

Draw ONE straight line to join the correct BEGINNING to the correct MIDDLE of the sentence.

Then draw ONE straight line to join the correct MIDDLE to the correct END of the sentence.

BEGINNING	MIDDLE	END
A large change in pH alters the shape …	… of the oxygen …	… which speeds up the reaction.
or	or	or
A large change in pH alters the speed …	… of the active site …	… which slightly slows the reaction.
or	or	or
A large change in pH alters the mass …	… of the hydrogen peroxide …	… which stops the reaction.

[2]

[Total: 6]

2 Brad is riding in a cycle race on a hot day.

(a) High external temperature and exercise causes Brad's blood plasma concentration to change.

His body tries to keep his blood plasma concentration constant by changing his urine production.

Explain how his body does this.

_____

_____

_____

_____ **[3]**

(b) How does Brad's body replace some of the water lost during the race?

Put a (ring) around the correct answer.

BREATHING **EXCRETING URINE**

GROWING **RESPIRING**

[1]

(c) Brad's body tries to keep his core temperature constant.

Where are the receptors that monitor the blood temperature found?

Put a (ring) around the correct answer.

HYPOTHALAMUS LIVER

SKIN SPINAL CORD

[1]

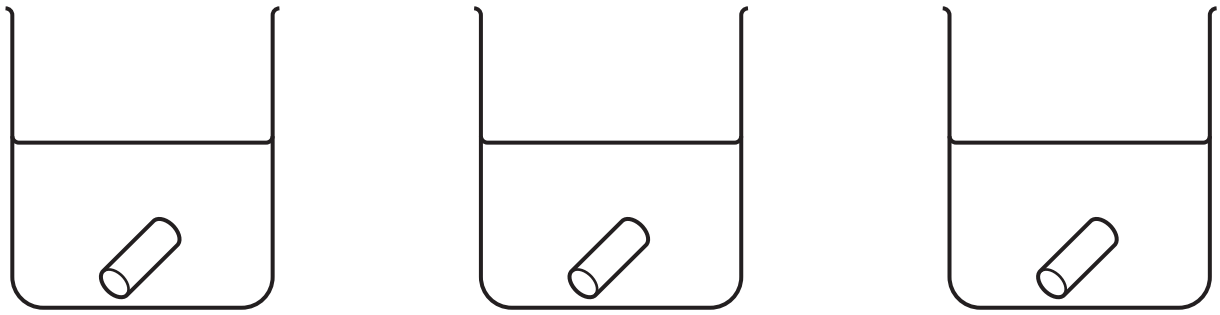
[Total: 5]

BLANK PAGE

3 Lisa investigates the movement of water into and out of potato cells.

She cuts three potato cylinders, each 50 mm long.

She places each potato cylinder in a different solution.



strong sugar solution | **distilled water** | **weak sugar solution**

After 60 minutes, she removes the potato cylinders and measures each of their lengths.

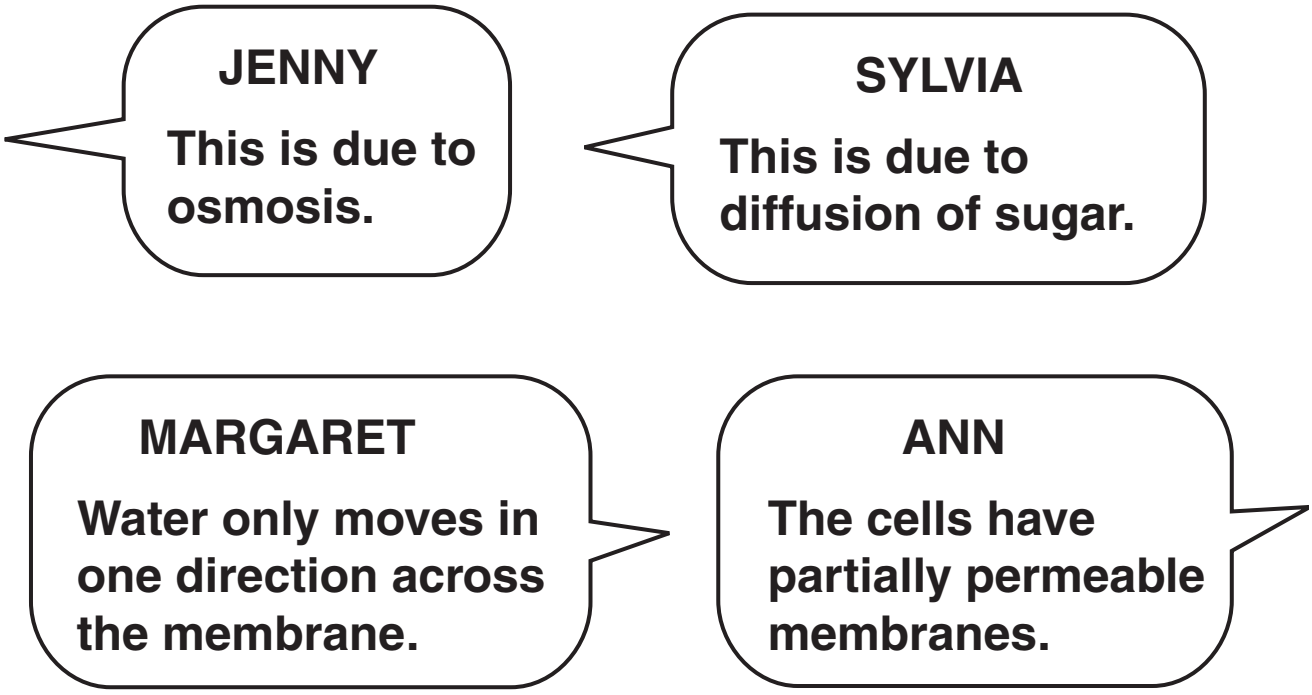
SOLUTION	LENGTH OF POTATO CYLINDER IN mm	
	AT THE START	AFTER 60 MINUTES
strong sugar solution	50	47
distilled water	50	52
weak sugar solution	50	50

(a) Calculate the percentage INCREASE in length of the potato cylinder placed in distilled water.

Show your working.

answer _____ % [1]

(b) Lisa asks some friends to explain her results.



Her friends give either right or wrong answers.

Write the NAMES of each of her friends in the correct boxes.

gives a RIGHT answer	gives a WRONG answer

[2]

[Total: 3]

4 David's teacher tells the class about the elements in Group 1 of the Periodic Table.

She shows them three of the elements, lithium, sodium and potassium.

(a) The teacher puts small pieces of each element into beakers of water.
They all react with the water.

Lithium floats, remains as solid lumps, and moves slowly.
Sodium floats, melts, and moves rapidly.
Potassium floats, melts, moves rapidly, and bursts into flames.

What is the most likely reason for these differences in behaviour?

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

differences in density ☐

differences in reactivity ☐

differences in conductivity ☐

differences in melting point ☐

differences in product of reaction ☐

[1]

(b) When sodium reacts with water it forms sodium hydroxide and hydrogen.

Complete the balanced chemical equation for this reaction.

$2Na + 2H_2O \rightarrow$ _____ + _____

[2]

(c) Which element in Group 1 is the MOST reactive?

Use the Periodic Table provided to help you.

element name _____ [1]

(d) A compound containing lithium, sodium or potassium gives out coloured light when heated.

How could David find out which element is in the compound?

Your answer should include

- **what method he should use**
- **how he should use his results.**

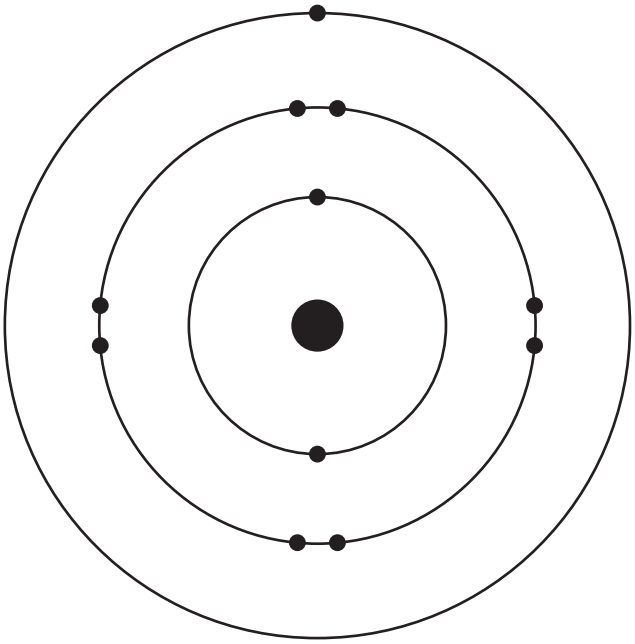
_____

_____

_____ **[2]**

[Total: 6]

5 David draws a diagram of an atom of an element.



(a) (i) How many PROTONS does this atom have?

answer _____ [1]

(ii) This atom can easily form an ion.

How does it do this?

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

It loses an electron. ☐

It gains an electron. ☐

It loses a proton. ☐

It gains a proton. ☐

[1]

(b) Another atom has a relative atomic mass of 39 and a proton number of 19.

How many neutrons does this atom contain?

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

19 ☐

20 ☐

39 ☐

58 ☐

[1]

[Total: 3]

6 The Group 7 elements are called halogens.

These elements look very different from each other.

(a) Complete the table to show the colour and state of each halogen at room temperature.

ELEMENT	COLOUR AT ROOM TEMPERATURE	STATE AT ROOM TEMPERATURE
CHLORINE		
BROMINE		
IODINE	dark grey	solid

[2]

(b) Group 7 elements such as chlorine react with Group 1 elements such as sodium.

When chlorine reacts with sodium, the chlorine is reacting in a different way to sodium.

Use your understanding of electrons in atoms of these elements to explain why chlorine and sodium react in different ways.

_____

_____

_____

_____ **[3]**

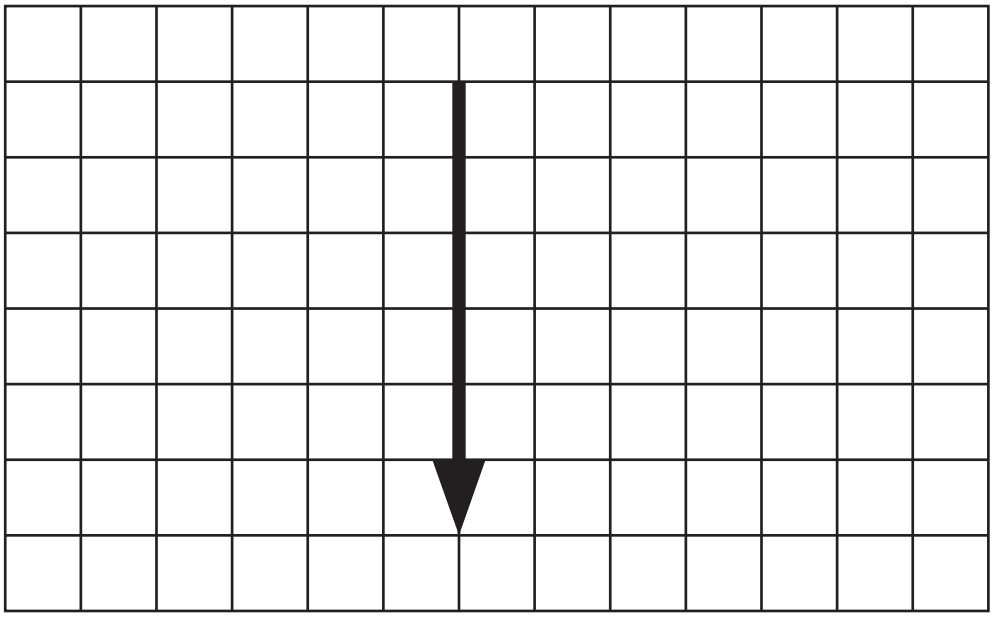
[Total: 5]

7 Ivan uses a snowmobile while he is on holiday.

At one place in the journey, these five forces act on the snowmobile.

FORCE ACTING	DIRECTION	SIZE IN NEWTONS
reaction from snow	upwards	1800
snowmobile's weight	downwards	1200
Ivan's weight	downwards	600
driving force	forwards	300
counter force	backwards	100

(a) This arrow represents the force of Ivan's weight on the snowmobile.



Draw another arrow on the grid to represent the DRIVING FORCE on the snowmobile. [1]

(b) What is the size and direction of the RESULTANT force in the HORIZONTAL direction?

Draw one line to link the SIZE of the RESULTANT horizontal force to its DIRECTION.

SIZE	DIRECTION
100 N	forwards
200 N	backwards
300 N	
400 N	

[1]

(c) The resultant vertical force on the snowmobile is zero.

Here are some statements about the snowmobile.

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

The vertical momentum of the snowmobile is constant. ☐

The total mass of the snowmobile is zero. ☐

The snowmobile starts to move upwards. ☐

The snowmobile starts to slow down. ☐

[1]

(d) The speed of the snowmobile is 15 m/s.

Ivan's mass is 60 kg and his weight is 600 N.

Put a (ring) around the correct value for Ivan's momentum in kg m/s.

4 40 900 9000

[1]

[Total: 4]

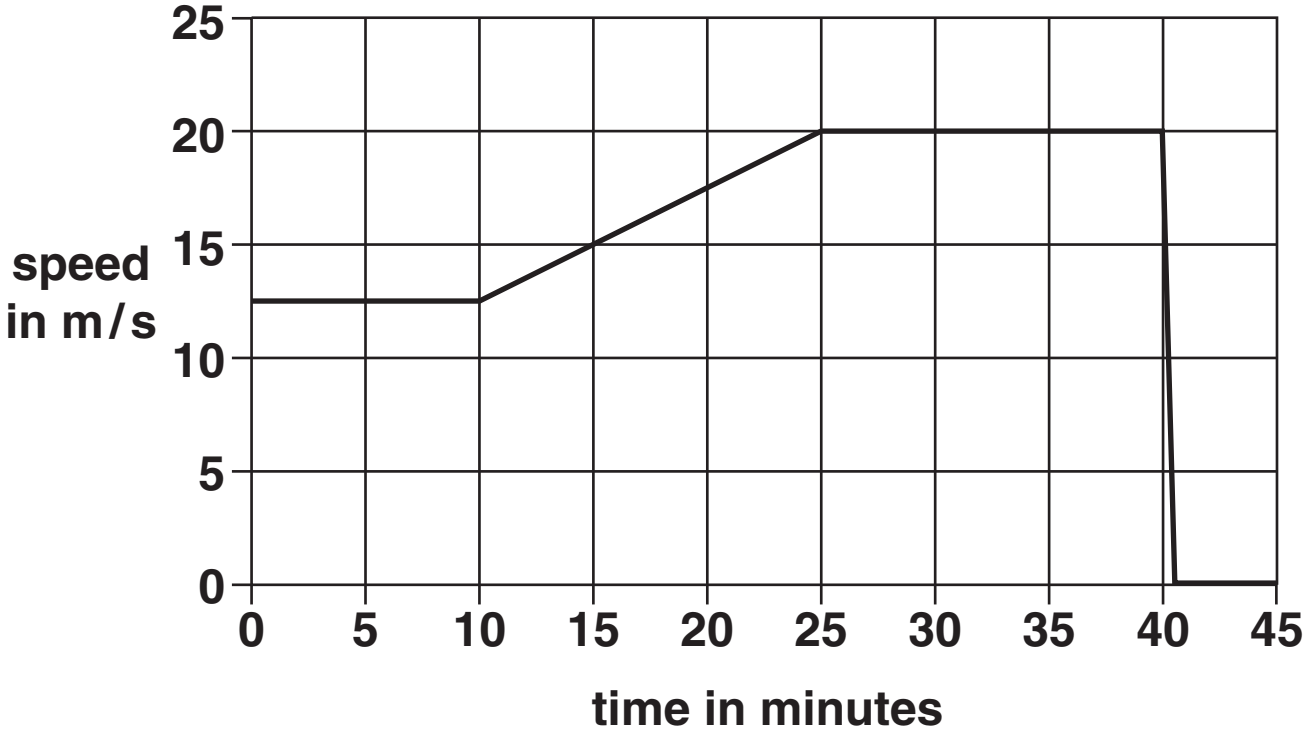
BLANK PAGE

QUESTION 8 BEGINS ON PAGE 26

8 Sam is a truck driver.

Sam's truck contains a tachograph. This records a speed-time graph for her truck.

(a) Here is the speed-time graph for part of her journey.



Use the graph on the opposite page to describe in detail the motion of the truck.

Include data from the graph in your answer.

_____

_____

_____

_____

_____

_____

_____

_____ **[3]**

(b) Sam travels a total distance of 40.5 km in the 45 minutes shown on the graph.

What is her average speed during this part of the journey?

Put a (ring) around the correct answer.

7.5 m/s 10 m/s 12.5 m/s

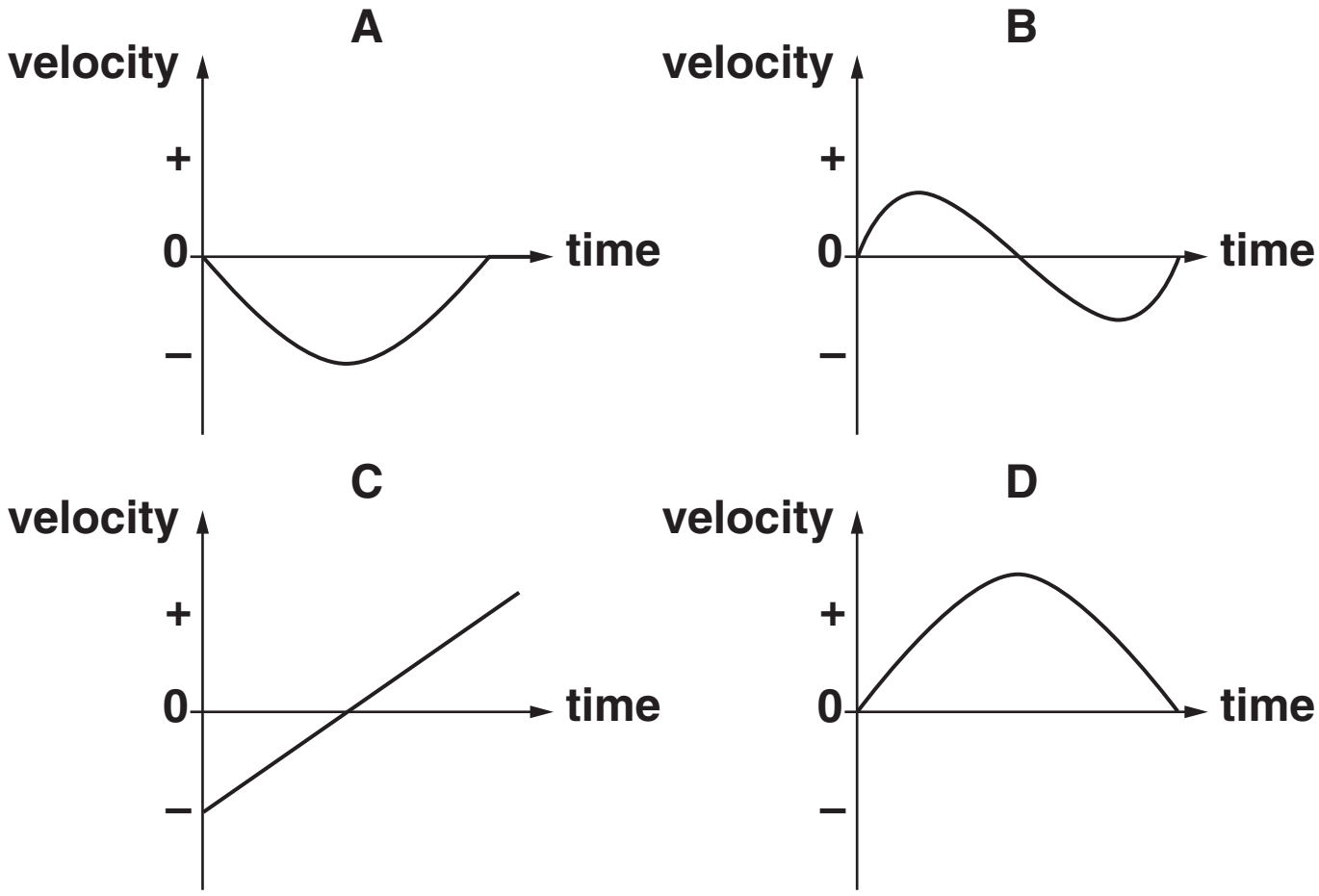
15 m/s 17.5 m/s

[1]

(c) Sam reverses the truck into a parking space.

This requires a change of distance of –15 m over a time of 5 s.

Here are some velocity-time graphs.

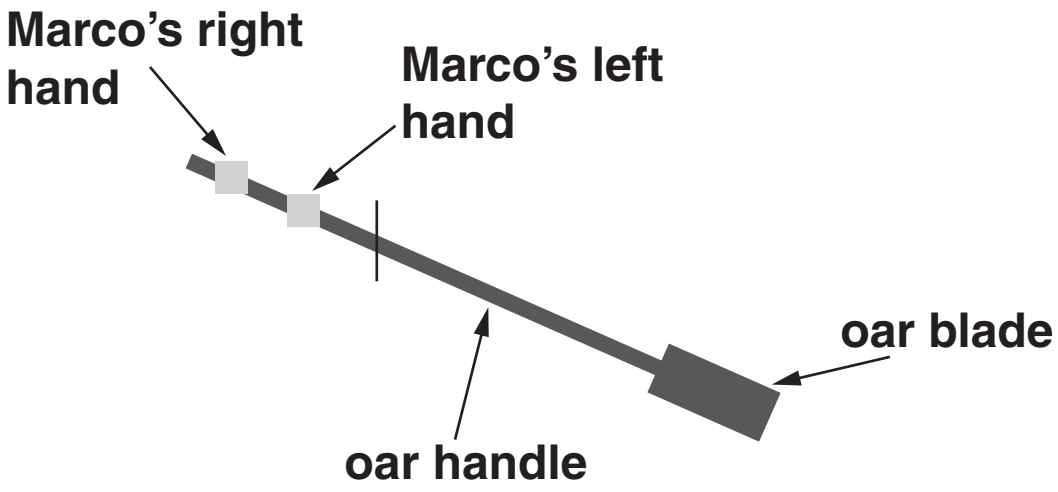


Which graph, A, B, C or D, best shows how the velocity of the truck changes with time as Sam parks it?

answer _____ [1]

[Total: 5]

9 Marco rows a boat along a canal.



(a) Marco uses an oar to push the boat along.

Marco and the oar handle are an interaction pair.

Marco pushes the oar handle forwards with a force of 60 N.

What is the size and direction of the force of the oar handle on Marco's hand?

_____ **[1]**

(b) During one stroke, the oar blade exerts a force of 20 N on the water.

This transfers a momentum of 40 kg m/s to the water.

For how long does the force act?

Put a (ring) around the correct answer.

0.5 s 1 s 2 s 20 s 40 s

[1]

(c) Marco is pushing the boat along the canal at a STEADY SPEED.

(i) Draw a straight line to link the START of the sentence with its correct END.

START	END
The work done by Marco …	… increases the momentum of the boat.
	… is completely transferred to the boat.
	… increases the kinetic energy of the boat.
	… increases the kinetic energy of the water.

[1]

(ii) Draw a straight line to link the START of the sentence with its correct END.

START	END
The friction of the boat in the water …	… increases the speed of the boat.
	… dissipates energy through heating.
	… increases the kinetic energy of the boat.
	… acts in the same direction as the boat's velocity.

[1]

(d) Marco and his boat have a kinetic energy of 75 J.

The total mass of Marco and his boat is 150 kg.

Put a (ring) around the correct way of calculating Marco's speed in m/s.

$$\sqrt{\frac{150}{2 \times 75}} \qquad \sqrt{\frac{2 \times 75}{150}} \qquad \sqrt{2 \times 75} \qquad \frac{75}{150}$$

[1]

[Total: 5]

END OF QUESTION PAPER

BLANK PAGE

BLANK PAGE

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.