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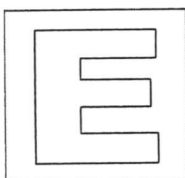
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GAN ENG SENG SCHOOL
Mid-Year Examination 2017



**CANDIDATE
NAME**

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CLASS

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**INDEX
NUMBER**

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SCIENCE

Paper 1 Multiple Choice

08 May 2017
Papers 1 & 2: 2 hours

Sec 2 Express

Additional Materials: OTAS

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, class and index number on the OTAS.

There are **thirty** questions in Section A. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the answer you consider correct and record your choice in soft pencil on the separate OTAS.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Read the instructions on the OTAS very carefully.

You may proceed to answer Paper 2 as soon as you have completed Paper 1.

Any rough working should be done in this booklet.

A copy of the Periodic Table is inserted on page 10.

Total marks
30

Answer **all** the questions with the most suitable option **A, B, C** or **D**.

- 1 Ammonium chloride crystals are changing into ammonia and hydrogen chloride vapour.



There are some statements made about this change.

- I. Heat is absorbed during the process.
- II. The particles of the substance move faster.
- III. Boiling of the substance occurs.

Which statement(s) are true?

- A** I only **B** II only **C** I and II only **D** I, II and III

Study the table below to answer Q2, Q3 and Q4.

The table shows the melting and boiling points of six substances.

Substance	Melting point (°C)	Boiling point (°C)
P	-219	-183
Q	-39	357
R	0	100
S	30	2204
T	114	184
U	1538	2861

- 2 Which substance(s) are solid at room temperature?

- A** **U** only **B** **T** and **U** only
C **S, T** and **U** only **D** **R, S, T** and **U** only

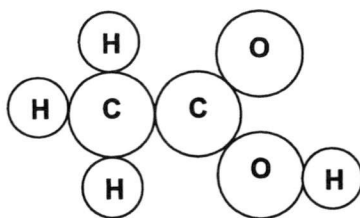
- 3 For substance **Q**, what is the characteristics of particles at 100 °C?

- A** The forces of attraction between particles is weak.
- B** The particles slide over one another.
- C** The particles vibrate about their own fixed positions.
- D** The spaces between the particles are far apart.

- 4 Which liquid at room temperature evaporates the fastest?

- A** **P** **B** **Q** **C** **R** **D** **S**

- 5 The diagram shows the atoms present in a molecule of ethanoic acid (vinegar).



Which is **false** about this molecule?

- A The molecule is a compound.
 B The molecule can be chemically separated to form hydrogen ions.
 C The number of atoms in this molecule is equal to the sum of atoms in a molecule of sulfuric acid.
 D The number of elements in this molecule is 3.
- 6 Which statement about a magnesium ion is true?
- A It has 3 electronic shells.
 B It has 24 neutrons in its nucleus.
 C It has a total of 34 subatomic particles.
 D It takes in electrons when forming a compound.
- 7 Which statement(s) is/are true about an isotope of a normal iodine atom?
- I. The isotope has 53 electrons.
 II. The isotope has an atomic number of 53.
 III. The isotope has a nucleon number of 127.
- A I only
 B I and II only
 C I, II and III only
 D None of the above
- 8 Which statement about an atom is true?
- A All atoms have its number of neutrons which is either more than or equal to its number of protons.
 B An atom gains protons to form a positively charged ion.
 C An atom is electronically neutral if its number of neutrons is equal to its number of protons.
 D The actual mass of an atom is more than the total mass of its protons and neutrons.

- 9 Magnesium burns in oxygen to form magnesium oxide. Some statements are made about this process.

- I. The process involves combustion.
- II. The process involves combination.
- III. The process involves oxidation
- IV. The process involves thermal decomposition.

Which statement(s) is/are true?

- A I only B I and II only C I, II and III only D I, II, III and IV

Use the information below to answer Q10 and Q11.

A test-tube of citric acid is poured into a conical flask with aluminium hydroxide. A chemical reaction occurs.

- 10 What is the chemical formula of aluminium hydroxide?

- A AlOH B Al(OH)_2 C Al(OH)_3 D $\text{Al}_3(\text{OH})$

- 11 Name the product produced from the above reaction.

- A Carbon dioxide gas B Hydrogen gas
C Oxygen gas D Water

- 12 Which process involves a chemical change?

- A Allowing dry ice to sublime.
B Boiling an egg.
C Heating an iron rod.
D Melting an ice.

- 13 Which group does **not** contain all abiotic factors which can affect the environment?

- A Carbon dioxide, salinity and temperature
B Light, decomposers and moisture
C Light, oxygen and moisture
D pH, oxygen and light

- 14 What is the physical environment where the organism lives in known as?

- A Community B Ecosystem C Food web D Habitat

- 15 There are three unknown processes **P**, **Q** and **R** which can be either active transport, diffusion or osmosis.

Processes **P** and **R** do not require energy to occur.

Processes **P** and **Q** do not require any partially permeable membrane to occur.

Which are the correct processes identified?

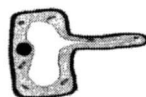
	P	Q	R
A	Active Transport	Diffusion	Osmosis
B	Diffusion	Active Transport	Osmosis
C	Osmosis	Active Transport	Diffusion
D	Osmosis	Diffusion	Active Transport

- 16 A visking tubing has a partially permeable membrane. Which process(es) can occur inside a visking tubing?

- I. Osmosis
- II. Diffusion
- III. Active transport

- A** I only **B** II only **C** I and II only **D** I, II and III

- 17 The diagram shows a picture of a root hair cell.



The surrounding soil has higher concentration of salts compared to inside of the root hair cell. Which statement best describes the movement of substances into the cell.

- A** Salt particles enter the root hair cell via active transport.
- B** Salt particles enter the root hair cell via diffusion.
- C** Water molecules enter the root hair cell via active transport.
- D** Water molecules enter the root hair cell via osmosis.

- 18 An animal cell was placed into a solution.

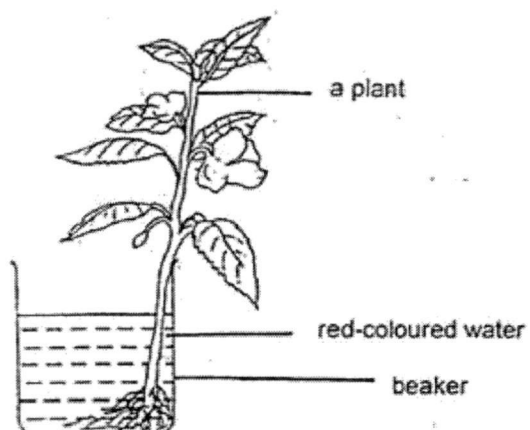


Before being placed into the solution **After being placed into the solution**

Which solution was the cell most likely being placed in?

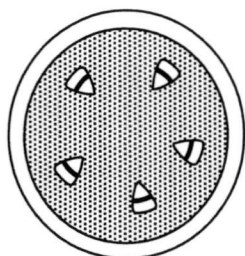
- A** Concentrated sugar solution
- B** Dilute sugar solution
- C** Distilled water
- D** Hydrochloric acid

- 19 A plant shoot is left in red solution for several hours.

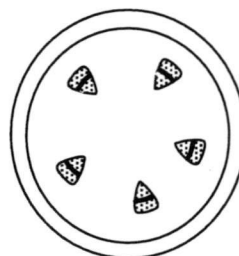


A section is cut through the stem. What would you see?

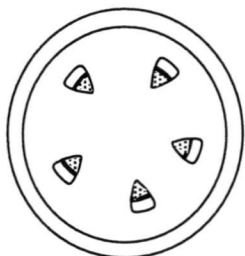
A



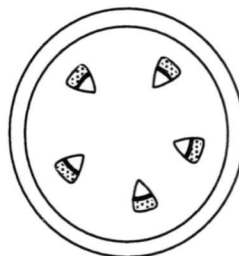
B



C



D



- 20 Which statement(s) about xylem is true?

- I. It transport water.
- II. It transport dissolved substances.
- III. It is made up of living cells.

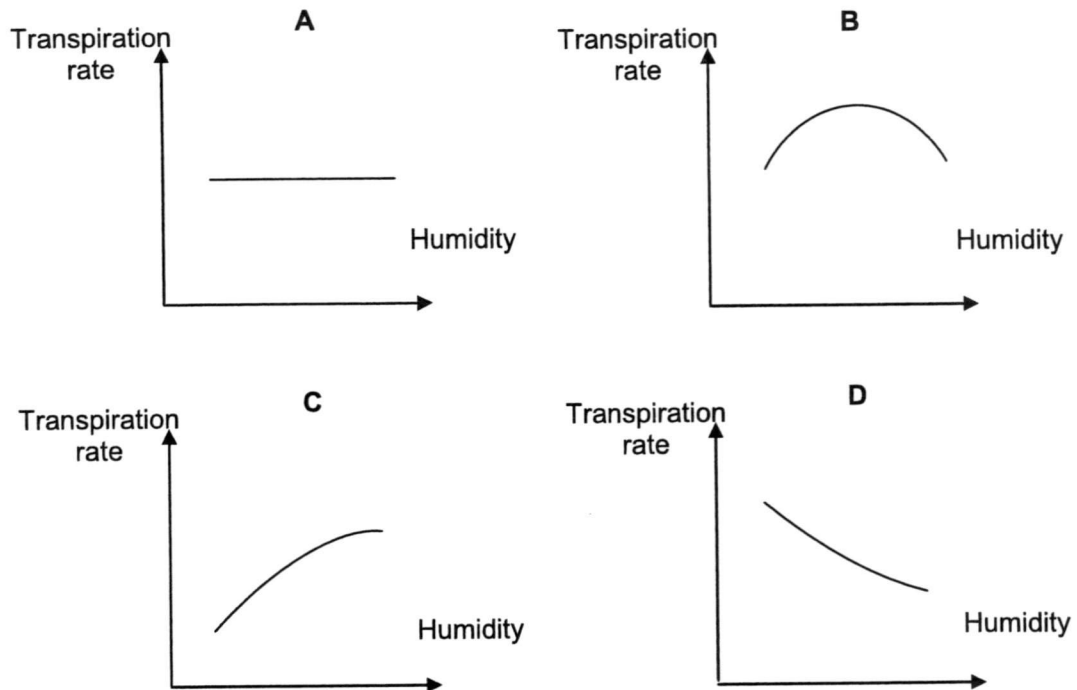
A I only

B I and II only

C I and III only

D I, II and III

- 21 Which graph shows the effect of increased humidity on the transpiration rate of a plant?



- 22 Which shows an **incorrect** segment of the flow of blood in a human body?

- A kidney → vena cava → left atrium → left ventricle
- B left ventricle → aorta → liver → vena cava
- C right atrium → right ventricle → pulmonary artery → lungs
- D pulmonary vein → left atrium → left ventricle → aorta

- 23 A vessel has the following characteristics.

It contains no valves.

It does not allow substances to enter or leave the vessel.

What is this vessel?

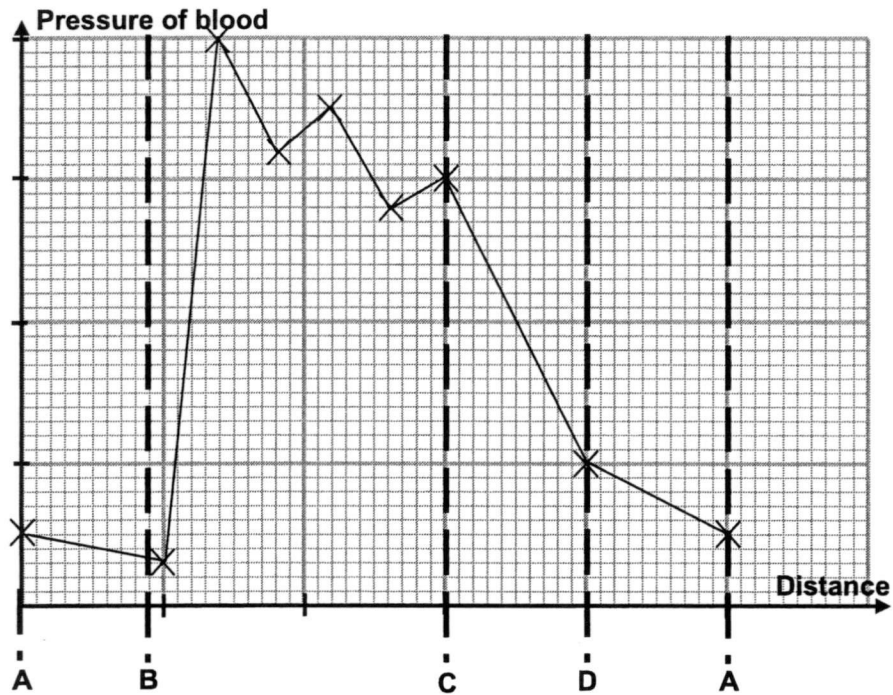
- | | |
|--------------------|--------------------|
| A Aorta | B Capillary |
| C Vena cava | D Ventricle |

- 24 Which component of the blood helps to transport carbon dioxide?

- | | |
|--------------------------|----------------------------|
| A Platelets | B Plasma |
| C Red blood cells | D White blood cells |

Use the following figure to answer Q25 and Q26.

The graph shows the pressure of the blood as it completes one circulation of the body (excluding the lungs).



A, B, C or D could represent artery, capillary, vein and the heart.

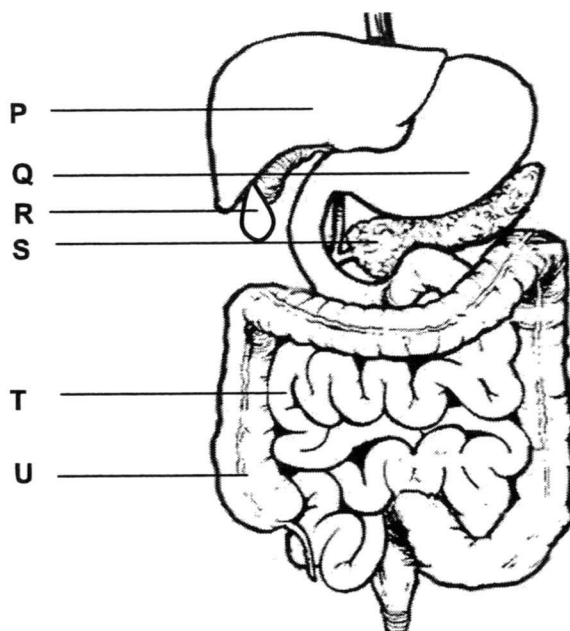
25 Which part (A, B, C and D) represents the heart?

26 Which part (A, B, C and D) represents the vein?

27 What are the functions of the colon?

	Water absorption	Enzymes secretion
A	No	No
B	No	Yes
C	Yes	No
D	Yes	Yes

Use the diagram below to answer **Q28**, **Q29** and **Q30**.



The diagram shows part of the human digestive system.

28 Which organ(s) produce(s) enzymes to digest fats?

- A** P, R, S only
C S only

- B** P, R, S and T only
D S and T only

29 Which organ(s) has/have acidic environment in it/them?

- A** P only
C Q only

- B** P and S
D Q and S

30 Which organ(s) absorb(s) water?

- A** Q, T and U only
C T and U only

- B** T only
D U only

END OF PAPER

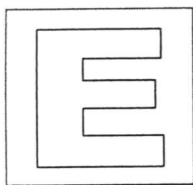
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3 Li lithium 7	4 Be beryllium 9	1 H hydrogen 1	5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20	11 Na sodium 23	12 Mg magnesium 24																																																																																																																																			
13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40	19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84																																																																																																																						
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131	55 Cs caesium 133	56 Ba barium 137	57-71 lanthanoids -	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium -	85 At astatine -	86 Rn radon -																																																																																																										
87 Fr francium -	88 Ra radium -	89-103 actinoids -	104 Rf rutherfordium -	105 Db dubnium -	106 Sg seaborgium -	107 Bh bohrium -	108 Hs hassium -	109 Mt meitnerium -	110 Ds darmstadtium -	111 Rg roentgenium -	112 Cn copernicium -	114 Fl flerovium -	116 Lv livermorium -	118 Og oganeson -	119 Nh nihonium -	120 Ds darmstadtium -	121 Nh nihonium -	122 Nh nihonium -	123 Nh nihonium -	124 Nh nihonium -	125 Nh nihonium -	126 Nh nihonium -	127 Nh nihonium -	128 Nh nihonium -	129 Nh nihonium -	130 Nh nihonium -	131 Nh nihonium -	132 Nh nihonium -	133 Nh nihonium -	134 Nh nihonium -	135 Nh nihonium -	136 Nh nihonium -	137 Nh nihonium -	138 Nh nihonium -	139 Nh nihonium -	140 Nh nihonium -	141 Nh nihonium -	142 Nh nihonium -	143 Nh nihonium -	144 Nh nihonium -	145 Nh nihonium -	146 Nh nihonium -	147 Nh nihonium -	148 Nh nihonium -	149 Nh nihonium -	150 Nh nihonium -	151 Nh nihonium -	152 Nh nihonium -	153 Nh nihonium -	154 Nh nihonium -	155 Nh nihonium -	156 Nh nihonium -	157 Nh nihonium -	158 Nh nihonium -	159 Nh nihonium -	160 Nh nihonium -	161 Nh nihonium -	162 Nh nihonium -	163 Nh nihonium -	164 Nh nihonium -	165 Nh nihonium -	166 Nh nihonium -	167 Nh nihonium -	168 Nh nihonium -	169 Nh nihonium -	170 Nh nihonium -	171 Nh nihonium -	172 Nh nihonium -	173 Nh nihonium -	174 Nh nihonium -	175 Nh nihonium -	176 Nh nihonium -	177 Nh nihonium -	178 Nh nihonium -	179 Nh nihonium -	180 Nh nihonium -	181 Nh nihonium -	182 Nh nihonium -	183 Nh nihonium -	184 Nh nihonium -	185 Nh nihonium -	186 Nh nihonium -	187 Nh nihonium -	188 Nh nihonium -	189 Nh nihonium -	190 Nh nihonium -	191 Nh nihonium -	192 Nh nihonium -	193 Nh nihonium -	194 Nh nihonium -	195 Nh nihonium -	196 Nh nihonium -	197 Nh nihonium -	198 Nh nihonium -	199 Nh nihonium -	200 Nh nihonium -	201 Nh nihonium -	202 Nh nihonium -	203 Nh nihonium -	204 Nh nihonium -	205 Nh nihonium -	206 Nh nihonium -	207 Nh nihonium -	208 Nh nihonium -	209 Nh nihonium -	210 Nh nihonium -	211 Nh nihonium -	212 Nh nihonium -	213 Nh nihonium -	214 Nh nihonium -	215 Nh nihonium -	216 Nh nihonium -	217 Nh nihonium -	218 Nh nihonium -	219 Nh nihonium -	220 Nh nihonium -	221 Nh nihonium -	222 Nh nihonium -	223 Nh nihonium -	224 Nh nihonium -	225 Nh nihonium -	226 Nh nihonium -	227 Nh nihonium -	228 Nh nihonium -	229 Nh nihonium -	230 Nh nihonium -	231 Nh nihonium -	232 Nh nihonium -	233 Nh nihonium -	234 Nh nihonium -	235 Nh nihonium -	236 Nh nihonium -	237 Nh nihonium -	238 Nh nihonium -	239 Nh nihonium -	240 Nh nihonium -	241 Nh nihonium -	242 Nh nihonium -	243 Nh nihonium -	244 Nh nihonium -	245 Nh nih

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

[illegible]

Answers:

Qn	Ans	Reasons
1	C	Solid changes to gas – sublimation instead of boiling (L→G) occurs
2	C	Rm temp at 25°C. Substances with melting pts above 25°C will be solid at rm temp
3	B	Q is liquid at 100°C
4	C	Only Q and R are liquid at rm temp. R evaporates faster because of lower boiling pt
5	C	No of atoms in a molecule of sulfuric acid (H ₂ SO ₄) is 7
6	C	Mg ²⁺ has 12 protons, 12 neutrons and 10 electrons (34 subatomic particles)
7	B	Isotope has the same number of protons but different number of neutrons
8	D	An atom contains protons, neutrons and electrons (although mass of e is small)
9	C	Thermal decomposition involves breaking down of compounds, not addition.
10	C	Al ³⁺ , OH ⁻
11	D	Acid mixes with alkali to form salt and water. No gas is produced.
12	B	A chemical change occurs where raw egg changes to hard-boiled egg.
13	B	Decomposers are biotic factors
14	D	Definition of habitat
15	B	Diffusion and osmosis are passive processes. Osmosis requires p.p.m.
16	C	Active transport can only occur in living cell as it requires energy
17	B	Higher conc of salt and lower water potential are higher in surrounding than cell
18	C	Too much water enters the cell and bursts the cell.
19	C	Water and dissolved minerals move into the xylem.
20	B	Characteristics of xylem
21	D	The higher the humidity, the lower the rate of transpiration
22	A	left atrium → left ventricle → aorta → Rest of body → vena cava → right atrium → right ventricle → pulmonary artery → lungs → pulmonary vein → left atrium
23	A	Artery does not have valves and do not allow substances to diffuse
24	B	Plasma transports carbon dioxide, waste products and nutrients.
25	B	The heart pumps the blood, where the pressure of the blood is the highest.
26	A	Vein has the slowest flow of blood, so the pressure of the blood is the lowest.
27	C	Colon or large intestine helps to absorb water. No digestion occurs
28	D	Only small intestine and pancreas produce lipase to digest fats.
29	C	Only stomach is acidic.
30	C	Only small intestine and large intestine absorb water.



GAN ENG SENG SCHOOL

Mid-Year Examination 2017



CANDIDATE
NAME

CLASS

INDEX
NUMBER

SCIENCE

Paper 2

08 May 2017

Papers 1 & 2: 2 hours

Sec 2 Express

Candidates answer on the Question Paper.

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A

Answer **all** questions.

Section B

Answer question **8** and **three other** questions.

In calculations, you should show all the steps in your working, giving your answer at each stage.

Enter the numbers of the Section B questions you have answered on the dotted lines in the grid below.

You may proceed to answer Paper 2 as soon as you have completed Paper 1.

At the end of the examination, hand in your answers to Paper 1 and Paper 2 separately.

The number of marks is given in brackets [] at the end of each question or part question.

A copy of the Periodic table is inserted on page 17.

For Examiner's Use	
Section A	30
Section B	40
Q8	
.....	
.....	
.....	
Total	70

SECTION A (30 marks)

Answer **all** the questions in this section.

- 1 (a) Write down the processes of changing of states based on the following characteristics. [3]

	Characteristics	Name of process
(i)	The force of attraction between the particles change from strong to weak.	
(ii)	The average distance between particles increase but the particles still remain closely packed.	
(iii)	The particles change their motion from moving rapidly and randomly to sliding past one another.	

- (b) "Both boiling and evaporation are similar because the changing of state occurs throughout the liquid." [2]

Comment on validity of this statement.

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- 2 Table 2 shows four different particles.

Substance / Particle	Number of protons	Number of neutrons	Number of electrons
Barium ion			
Iodide ion			
Krypton particle			
Tin atom			

Table 2

- (a) Fill in all the missing information in Table 2. [3]
- (b) Explain why krypton particle cannot be an ion. [1]

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3 Read the adapted article from the Straits Times, dated 24 March 2017.

China's air quality was markedly worse in the first two months of the year than the same period of 2016 following a series of smog outbreaks in northern China, official data published on Friday (March 24) showed. China says it is winning its "war on pollution" after strengthening legislation, beefing up its monitoring capabilities and cracking down on hundreds of polluting firms, and it said average air quality improved noticeably in 2016.

But throughout January this year, high winter coal consumption combined with "unfavourable weather conditions" to create heavy smog build-ups throughout northern China, forcing dozens of cities in the region to issue "red alerts" designed to curb industrial activity and thin traffic. The air pollution is a major concern to the residents. Carbon monoxide is produced by motorcars at a rapid rate, contributing to the rise of global warming. Sulfur dioxide produced by factories cause harm to the environment, especially to the plantations and marine creatures in the rivers.

Data collected from 338 cities in the first two months of the year showed that concentrations of small breathable particles known as PM2.5, a key component of smog, rose 12.7 per cent year on year to 71 micrograms per cubic metre, the Ministry of Environmental Protection said in a notice. China's cities need to bring PM2.5 readings down to 35 micrograms per cubic metre in order to meet state air quality standards. Beijing has promised "extraordinary" measures this year to combat smog.

- (a) (i)** **Copy and write** the sentence which contains an **incorrect** information presented in the article. [1]

.....

.....

.....

- (ii)** Suggest one modification to the information in **(a)(i)** to make the article correct. [1]

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- (b)** Describe one way how sulfur dioxide affects the marine creatures. [1]

.....

.....

- (c)** Suggest one way how you can suggest to the government to reduce the nation's emission of carbon monoxide in the earth's atmosphere. [1]

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.....

- 4 **Fig. 4** shows the graph shows four different populations (grasshoppers, plants, snakes and sparrows) in the same ecosystem.

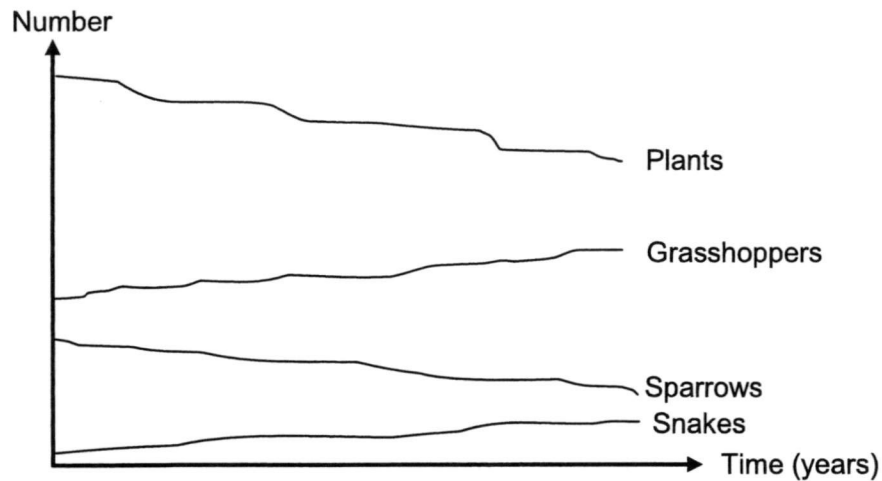


Fig. 4

- (a) Write down a food chain involving the four populations. [1]

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- (b) From the information in **Fig. 4**, explain why the population of grasshoppers increases despite a decrease in the population of the plants. [3]

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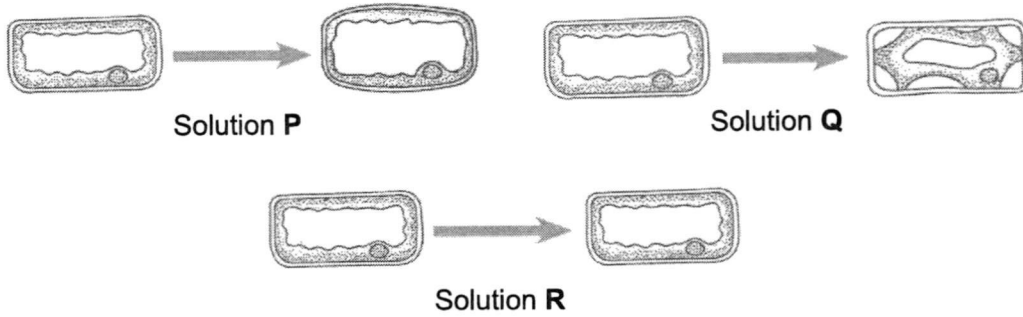
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- 5 Three similar plant cells are placed into three different solutions – 10% sucrose solution, 20% sucrose solution and distilled water. The outcomes are shown in the diagram below.



- (a) Which solution **P**, **Q** or **R** is distilled water? Explain.

[4]

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- (b) Explain why the size of the plant cell remains unchanged when it is placed into solution **R**.

[2]

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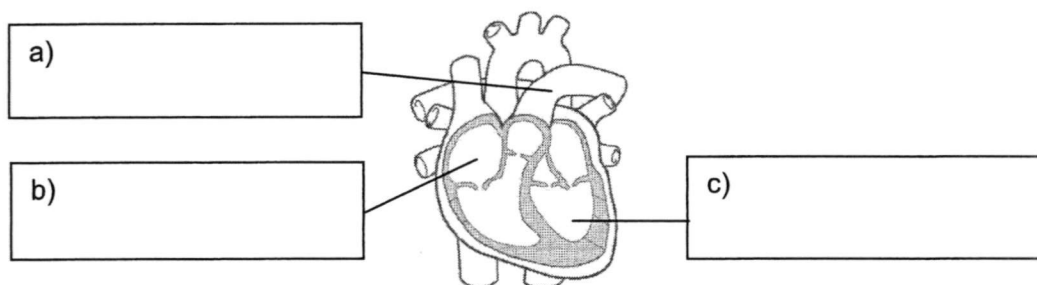
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6 Label the parts of the heart as shown in the diagram below.

[3]



7 (a) Describe the role of fats as an essential nutrient in our body.

[1]

.....

(b) Write down the enzyme to digest fats and the end products of the digestion of fats.

[3]

Enzyme:

End products:

END OF SECTION A

SECTION B (40 marks)

Answer **Q8** and any 3 other questions in this section.

- 8 (a) The diagram shows an experiment set up to investigate a change in mass of plants potted in damp soil over a period of time. Plants **A** and **B** are similar.

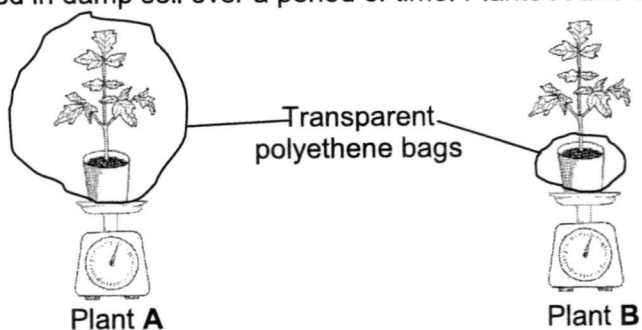


Fig. 11a shows the graph of loss in mass of the plants over the next five days.

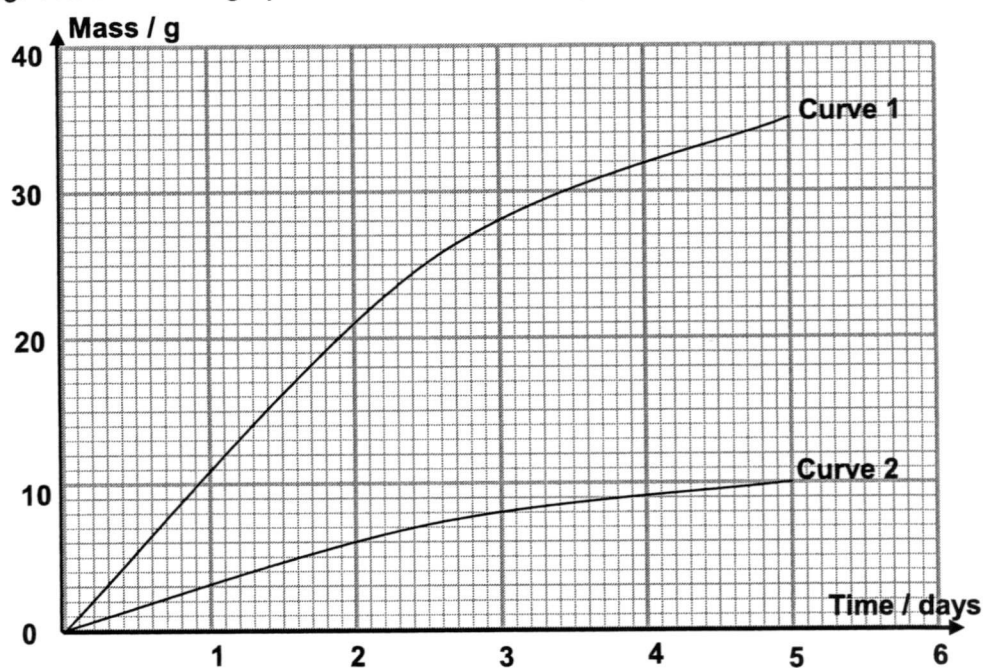


Fig. 8a

- (i) Name the process responsible for the loss in mass of the plants. [1]

.....

- (ii) Which plant gives the result shown by **Curve 1**? Explain your choice. [3]

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- 8 (a) (iii) List down two methods to increase the rate of loss in mass of Plant A without removing the transparent polythene bag. [2]

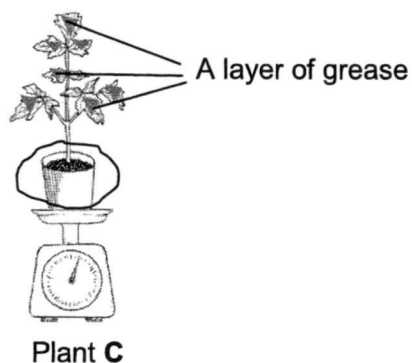
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- (iv) Another experiment is set up as shown below.



The set-up for Plant C is similar to the set-up for Plant B, but there is a layer of grease applied on the top and bottom sides of all the leaves.

- Predict and draw** the curve of Plant C on the graph in Fig. 8a. [1]

- (v) Explain the position of the curve of Plant C in (a)(iv). [2]

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- (b) Name two instruments which can help to measure the rate of water loss in plants. [1]

.....

- 9 (a) **Fig. 9a** shows the amount of a particular nutrient (either carbohydrates, fats or proteins) present as it enters a human alimentary canal. Organs **A**, **B**, **C** and **D** are parts of the alimentary canal.

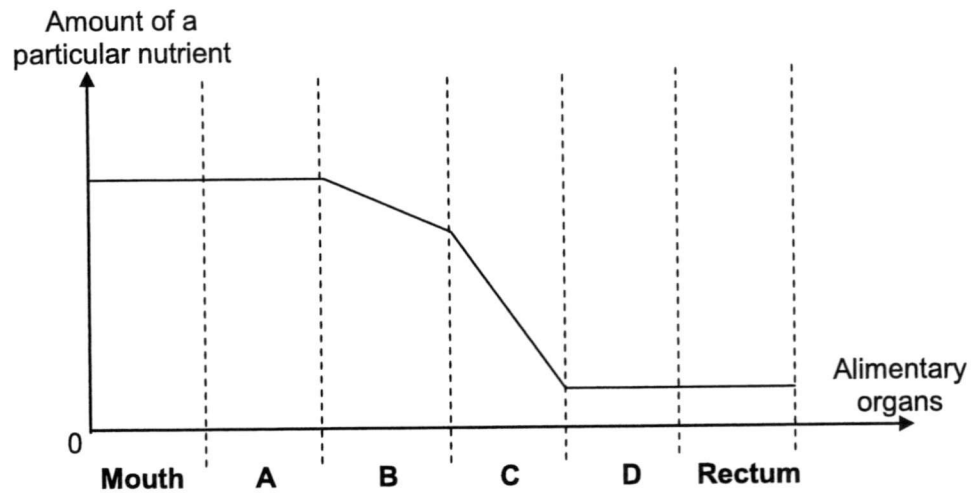


Fig. 9a

- (i) Name the organs **A**, **B**, **C** and **D**. [2]

A: **B:**

C: **D:**

- (ii) From the graph, state the identity of the nutrient. [1]

.....

- (iii) Explain why the amount of the identified nutrient decreases further in organ **C**. [4]

.....

.....

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.....

- (iv) Explain why the amount of the identified nutrient is above zero in the rectum. [1]

.....

.....

- 9 (b) Liver is an essential organ in our body as it aids in digestion. [2]

Describe how liver aids in digestion.

.....

.....

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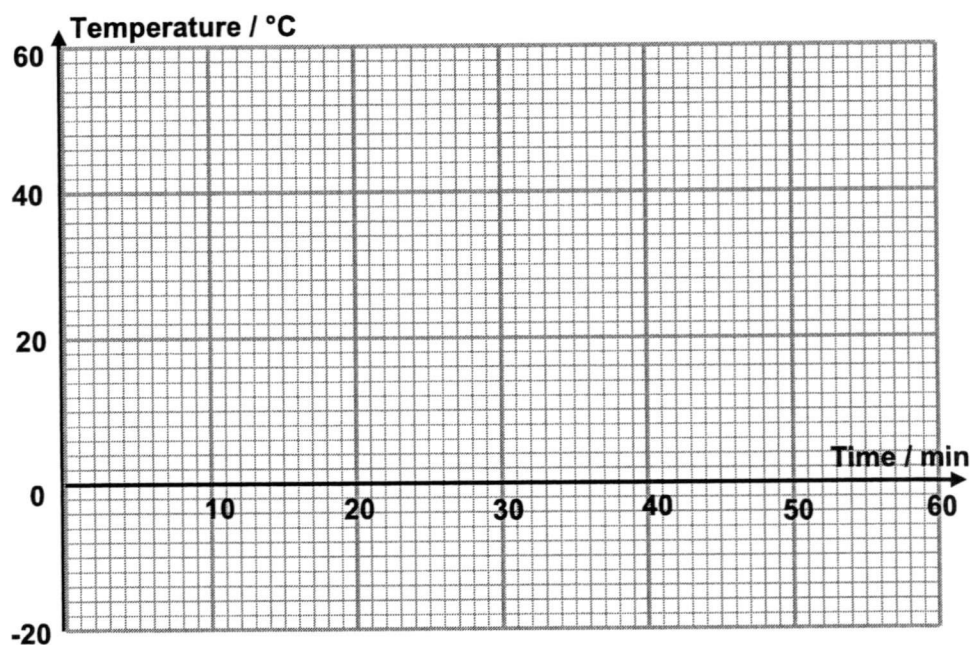
- 10 Bromine is an element with atomic number 35. It is a red-brown liquid at room temperature that evaporates readily to form gas of similar colour.

An enclosed container of bromine gas experienced a continuous cooling process.

Its temperature was initially at 60 °C and the gas was cooled to 59 °C at a constant rate after 2 minutes. Bromine maintained this temperature for another 13 minutes before its temperature decreased at a constant rate till the 40th minute.

At the 40th minute, the temperature of bromine was -7 °C for a duration of 15 minutes. Then bromine was cooled to -20 °C at a constant rate for another 5 minutes.

- (a) On the graph provided, draw the graph of temperature against time for the cooling of bromine with the given information above. [2]



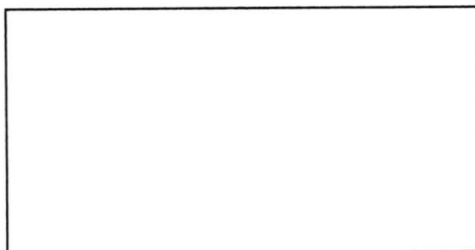
- (b) Write down the melting point and boiling point of bromine. [2]

Melting point: Boiling point:

- (c) Write down the state(s) of bromine at the 50th minute. [1]

.....

- (d) Draw the arrangement of bromine particles at the 22nd minute. [1]



- 10 (e)** Using the particulate nature of matter, explain what happened to the bromine particles as bromine maintained its temperature at 59 °C for a duration of 13 minutes during cooling. [4]

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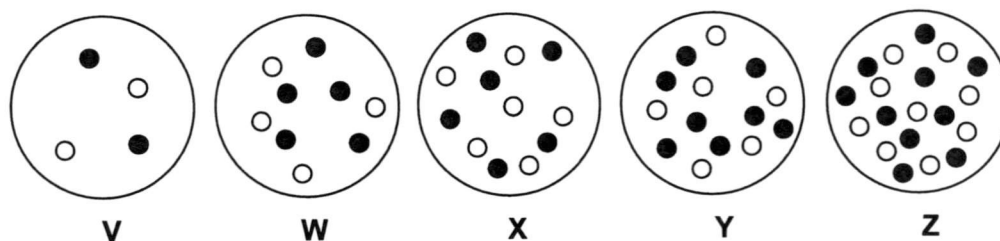
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- 11 (a) Study the nucleus of 5 different particles shown in diagram **Fig. 11a**. These particles are elements from the periodic table.



Legend:

○ – Proton
● – Neutron

Fig. 11a

- (i) Which particle (**V**, **W**, **X**, **Y** or **Z**) can never combine with another particle to form a molecule? [1]
-
- (ii) Which pair of particles (**V**, **W**, **X**, **Y** or **Z**) are isotopes? [1]
-
- (iii) Explain how you have identified the isotopes in (a)(iii). [1]
-
-
- (iv) Particle **W** combines with another particle (**V**, **W**, **X**, **Y** or **Z**) to form an ionic compound. Write down the chemical formula of this new compound. [2]
-
- (v) Using dot and cross diagram, draw the electronic structure of the compound in (a)(v). [3]

11 (b) Give a name of any example of the following.

(i) A molecule of an element

[1]

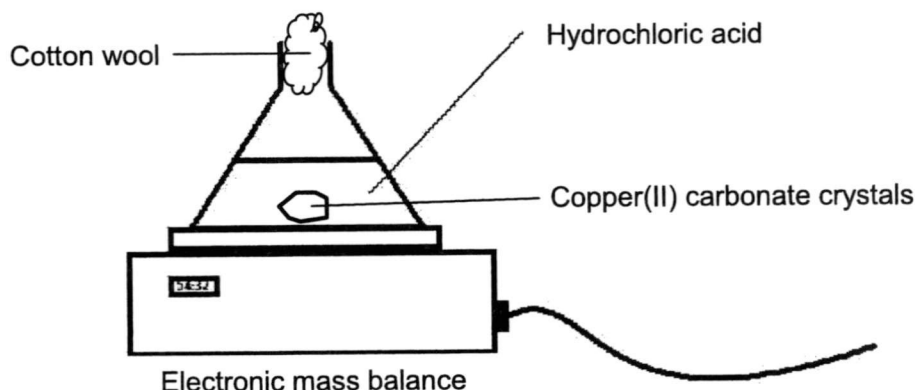
.....

(ii) A molecule of a compound

[1]

.....

- 12 (a) An experiment was carried out to investigate the speed at which copper(II) carbonate reacts in hydrochloric acid as shown in the diagram below. A conical flask containing the copper(II) carbonate crystals and excess hydrochloric acid was placed on top of an electronic mass balance. Mass was lost as bubbles of gas were formed and the gas escaped from the mixture.



The mass of the flask and the contents are recorded in the **Table 12a**.

Time (min)	0	1	2	3	4	5	6	7
Mass of flask & contents (g)	90.4	89.3	88.5	88.0	87.8	87.8	87.8	87.8
Total Loss in mass (g)	0	1.1						

Table 12a

- (i) Suggest why excess hydrochloric acid is added into the conical flask. [1]
-
-
- (ii) Complete the missing information in Table 12a. [1]
- (iii) At which minute did the chemical reaction stop? [1]
-
- (iv) Describe a suitable method to test the type of gas presence in the conical flask after the chemical reaction has stopped. [2]
-
-
-
-

- 12 (a) (v) Write down a balanced chemical equation for the reaction in the conical flask when the copper(II) carbonate mixed with hydrochloric acid. [3]

.....

- (b) Study this statement. [2]

"After mixing two substances together, we can conclude that a chemical reaction has occurred only when the mixture is hot."

Is this statement correct? Explain your answer.

.....

.....

.....

.....

END OF PAPER

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
3 Li lithium 7	4 Be beryllium 9	1 H hydrogen 1 proton (atomic) number atomic symbol name relative atomic mass										5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
												11 Na sodium 23	12 Mg magnesium 24	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	lanthanoids										81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium -	85 At astatine -	86 Rn radon -
87 Fr francium -	88 Ra radium -	actinoids										112 Cn copernicium -	114 Fl flerovium -	115 Lv livermorium -	116 Lv livermorium -	117 Ts tennessine -	118 Og oganesson -

lanthanoids																	
57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium -	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175			
89 Ac actinium -	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium -	94 Pu plutonium -	95 Am americium -	96 Cm curium -	97 Bk berkelium -	98 Cf californium -	99 Es einsteinium -	100 Fm fermium -	101 Md mendelevium -	102 No nobelium -	103 Lr lawrencium -			
actinoids																	

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

ANSWERS

Section A

1ai Boiling / Evaporation [1]**1aii** Melting [1]**1aiii** Condensation [1]

1b It is true that during boiling, the changing of state occurs throughout the liquid. [1]
 It is false about evaporation, as the changing of state only occurs at the surface of the liquid. [1]

2a

Substance / Particle	Number of protons	Number of neutrons	Number of electrons
Barium ion	56	81	54
Iodine ion	53	74	54
Krypton particle	36	48	36
Tin atom	50	69	50

[3] – 1 mark for every 4 blanks

2b Krypton is in Group O / the electronic structure of krypton is stable. [1]**3ai** Carbon monoxide is produced by motorcars at a rapid rate, contributing to the rise of global warming. [1]

3aii

- Carbon dioxide is produced by motorcars at a rapid rate, contributing to the rise of global warming.
- Carbon monoxide is produced by motorcars at a rapid rate, causing harm to the people's health (any similar point).

[1] – any 1 of the above

3b Sulfur dioxide forms acid rain which can change the pH of water bodies, affecting marine creatures. [1]**3c** Encourage car-pooling / reduce the number of car ownership / raise higher tax on car ownership

[1] – any relevant answer to reduce the amount of carbon monoxide emission

4a Plants → Grasshoppers → Sparrows → Snakes [1]**4b** The population of snakes, which are predators of sparrows increases. [1]

This causes the population of sparrows to decrease. [1]

As sparrows are predators of grasshoppers, population of grasshoppers increases. [1]

5a P [1]Cell sap in the vacuole has lower water potential than outside solution. [1]

More water enters via osmosis through the partially permeable membrane. [1]

Cell enlarges and becomes turgid. Cell wall prevents cell from bursting. (Must include both points) [1]

- 5b** The water potential in the cell is the same as that of the surrounding. [1]
No net movement of water molecules occur in and out of the cell. [1]
- 6a** Pulmonary artery [1]
6b Right atrium [1]
6c Left ventricle [1]
- 7a** It provides insulation for our body / provides us with additional energy [1]
- 7b** Enzyme: lipase [1]
End products: fatty acids [1], glycerol [1]

Section B

8ai Transpiration [1]

8aii Plant B [1]

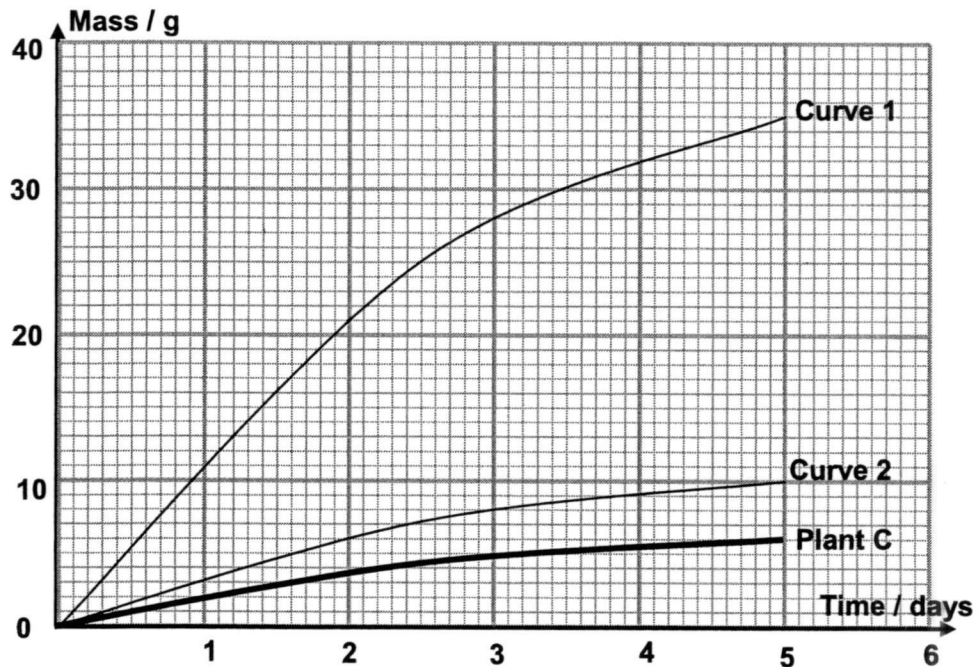
The surrounding of Plant B is less humid compared to the surrounding of Plant A. [1]
Rate of transpiration is greater in Plant B. [1]

8aiii Increase surrounding temperature. [1]

Increase the intensity of surrounding light to be slightly higher. [1]

{cannot accept expose to wind or reduce moisture since the bag is over the plant}

8aiv



[1] – Accept any graph below Curve 1, even if it is above Curve 2

8av Rate of transpiration is lower than Plant B/Curve 1 because the stomata of the leaves are blocked by the grease [1], reducing the rate of water vapour lost through stomata [1].

8b Potometer and stopwatch [1]

9ai A: Oesophagus B: Stomach
C: Small intestine D: Large intestine
[2] – 1 mark for every 2 correct answers

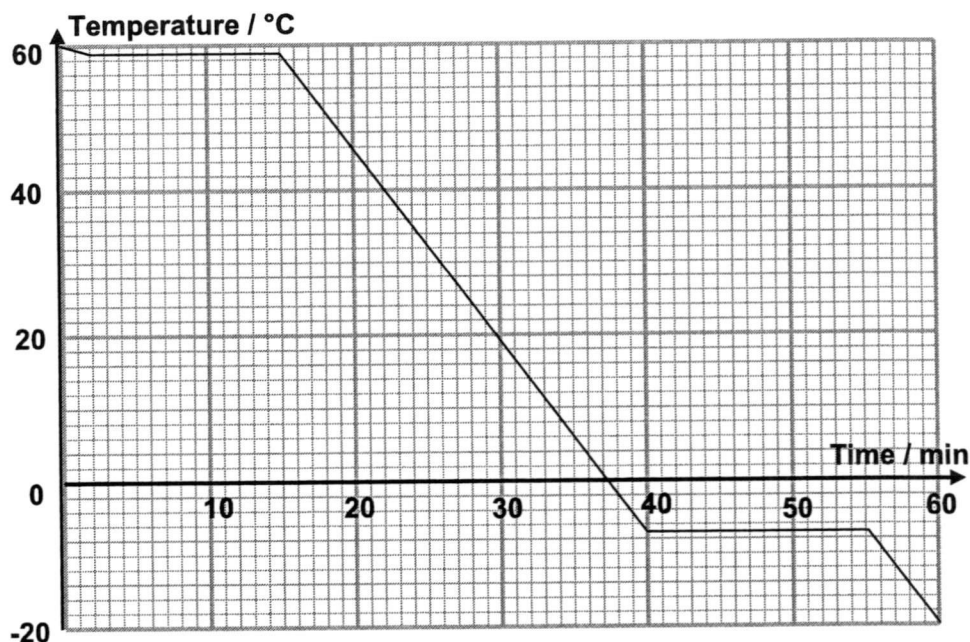
9aii Proteins [1]

9aiii In small intestine,
Trypsin [1] breaks down remaining proteins into polypeptides [1].
Erepsin/Peptidases [1] breaks down polypeptides into amino acids [1].

9aiv These are the undigested proteins left behind. [1]

9b Liver produces bile [1] which helps to emulsify fats to speed up action of lipase to act upon [1].

10a



[1] – similar shape (3 decreasing lines and 2 horizontal lines)

[1] – correct position of the graph

10b

Melting point: -7°C [1]

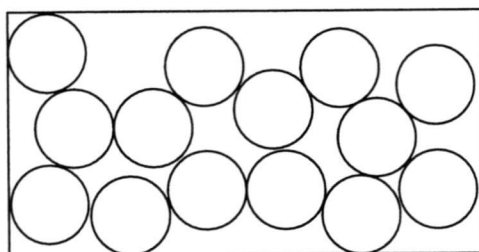
Boiling point: 59°C [1]

{max of 1 mark if both values are correct without unit}

10c

Liquid and gas [1]

10d



[1] – correct arrangement

10e

- At 59°C , heat is lost and kinetic energy of the particles decrease
- The particles slow down
- The forces of attraction between the particles become stronger / Particles unable to overcome the strong forces of attraction
- The particles move closer to one another

[4] – 1 mark for 1 correct point

Alternatively

- At 59°C , heat is lost and kinetic energy of the particles decrease
- The forces of attraction between the particles become from weak to strong
- The particles move from rapidly and in all directions to sliding past one another
- The particles become from far apart to closely packed

[4] – 1 mark for 1 correct point

11ai V [1]

11aii X and Y [1]

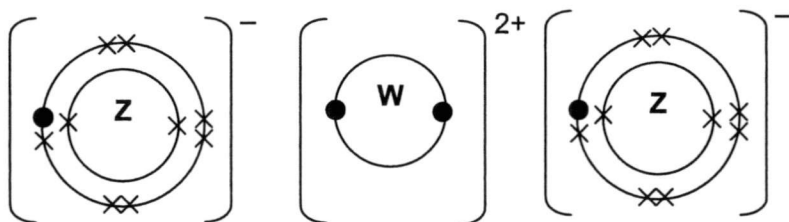
11aiii Both have the same number of protons and different number of neutrons. [1]

11aiv WZ_2 [2]

1 mark if Z is identified with incorrect number.

Max 1 mark if actual chemical symbol is used.

11av



[1] – correct structure for W

[1] – correct structure for Z

[1] – correct charges for W and Z

11bi Any molecule of an element e.g. hydrogen gas, oxygen gas, nitrogen gas [1]

11bii Any molecule of a compound e.g. water, carbon monoxide, carbon dioxide [1]

12ai It is to ensure all copper(II) carbonate crystals are completely reacted. [1]

Time (min)	0	1	2	3	4	5	6	7
Mass of flask & contents (g)	90.4	89.3	88.5	88.0	87.8	87.8	87.8	87.8
Total loss in mass (g)	0	1.1	1.9	2.4	2.6	2.6	2.6	2.6

[1] – all correct values

12aiii 4th minute [1]

12aiv Pass the gas into a solution of limewater. [1]

White precipitates formed in limewater indicates the presence of carbon dioxide. [1]

12av $\text{CuCO}_3 + 2\text{HCl} \rightarrow \text{CuCl}_2 + \text{H}_2\text{O} + \text{CO}_2$

[1] – correct LHS chemical formula

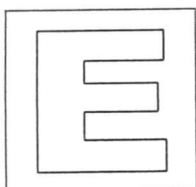
[1] – correct RHS chemical formula,

[1] – balanced equation

12b The statement is false [1].

- We can only conclude a chemical reaction occurs when new substances are formed.
- Chemical reaction can also occur if the process is endothermic, when heat is absorbed in the mixture, causing the mixture to be cold.

[1] – any 1 relevant point



GAN ENG SENG SCHOOL
End-of-Year Examination 2017



**CANDIDATE
NAME**

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CLASS

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**INDEX
NUMBER**

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SCIENCE

Paper 1 Multiple Choice

10 Oct 2017

Papers 1 & 2: 2 hours

Sec 2 Express

Additional Materials: OTAS

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, class and index number on the OTAS.

There are **thirty** questions in Section A. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the answer you consider correct and record your choice in soft pencil on the separate OTAS.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Read the instructions on the OTAS very carefully.

You may proceed to answer Paper 2 as soon as you have completed Paper 1.

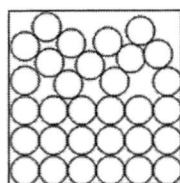
Any rough working should be done in this booklet.

A copy of the Periodic Table is inserted on page **12**.

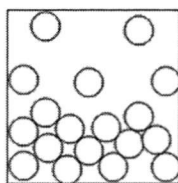
Total marks
30

Answer **all** the questions with the most suitable option **A, B, C** or **D**.

- 1 The diagrams show the arrangement of particles of an unknown compound undergoing changes in states at -7°C and 58°C .

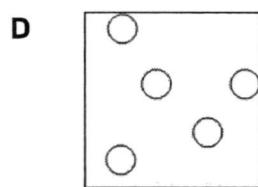
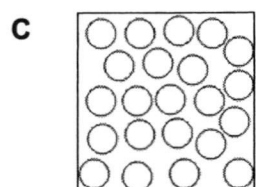
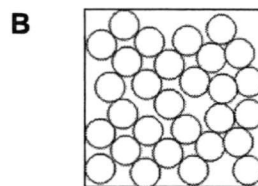
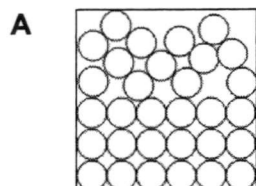


-7°C



58°C

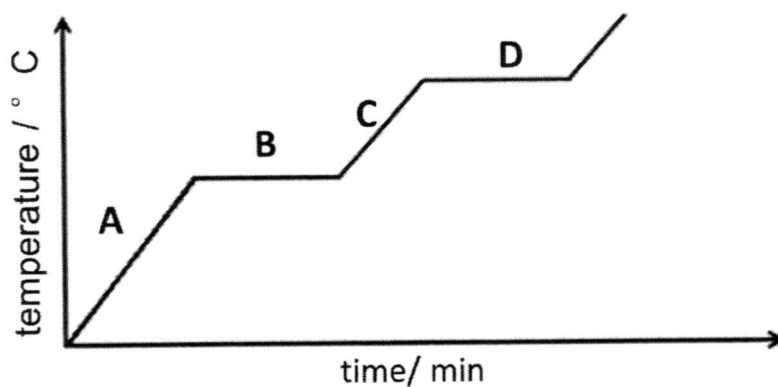
Which is the arrangement of particles of the unknown compound at 50°C ?



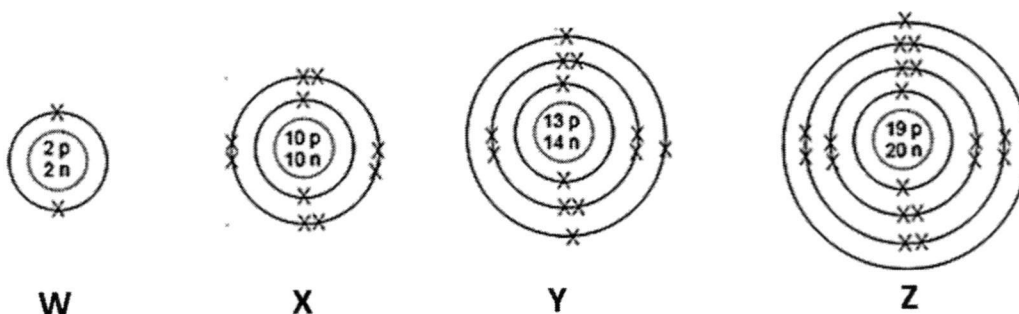
- 2 Which substance has particles vibrating about their fixed positions at 10°C and are far apart at 200°C ?

	melting point/ $^{\circ}\text{C}$	boiling point/ $^{\circ}\text{C}$
A	-189	-186
B	-10	58
C	36	344
D	20	120

- 3 The graph shows how the temperature of a solid substance changes when it is heated. At which point on the graph does the substance consist of a mixture of liquid and gas?



- 4 The electronic structure of atoms **W**, **X**, **Y** and **Z** are shown below.



Which of the following statements is true?

- A** Atom **Y** and **Z** lies in the same period of the Periodic Table.
B Atom **Y** will combine with oxide ions to form Y_2O_3
C Atom **W** lies in Group II of the Periodic Table.
D Atom **X** has a nucleon number of 10.
- 5 Which statement about noble gases is true?
- A** They all have eight electrons in their valence shell.
B The number of protons in the atoms equals the number of neutrons.
C The valence shell of their atoms are completely filled with electrons.
D They exist as molecules containing two or more atoms chemically combined together.

- 6 Which one of the following is an isotope of carbon?

	<u>Neutrons</u>	<u>Protons</u>	<u>Electrons</u>
A	6	7	7
B	8	6	6
C	6	8	8
D	8	8	6

- 7 Which of the following is a correct chemical equation for the reaction below?

lead(II) nitrate + magnesium chloride $\rightarrow$ lead(II) chloride + magnesium nitrate

- A** $2\text{PbNO}_2 + \text{MnCl}_2 \rightarrow 2\text{PbCl} + \text{Mn}(\text{NO}_2)_2$
B $2\text{PbNO}_2 + \text{MgCl}_2 \rightarrow 2\text{PbCl} + \text{Mg}(\text{NO}_2)_2$
C $\text{Pb}(\text{NO}_3)_2 + \text{MnCl}_2 \rightarrow \text{PbCl}_2 + \text{Mn}(\text{NO}_3)_2$
D $\text{Pb}(\text{NO}_3)_2 + \text{MgCl}_2 \rightarrow \text{PbCl}_2 + \text{Mg}(\text{NO}_3)_2$

- 8 Two reactions were carried out in the laboratory.

Reaction 1: solid sodium hydroxide added to dilute hydrochloric acid

Reaction 2: dilute sulfuric acid added to solid magnesium

In what ways are the two reactions similar?

- I. A salt is formed.
 II. Water is formed.
 III. A gas is produced.

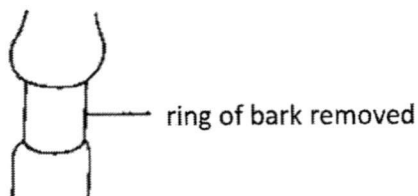
- A** I only
B I and III
C II and III
D I, II and III

- 9 Which change(s) require(s) light energy to occur?

- I. photosynthesis
 II. photography
 III. respiration

- A** I only
B III only
C I and II only
D II and III only

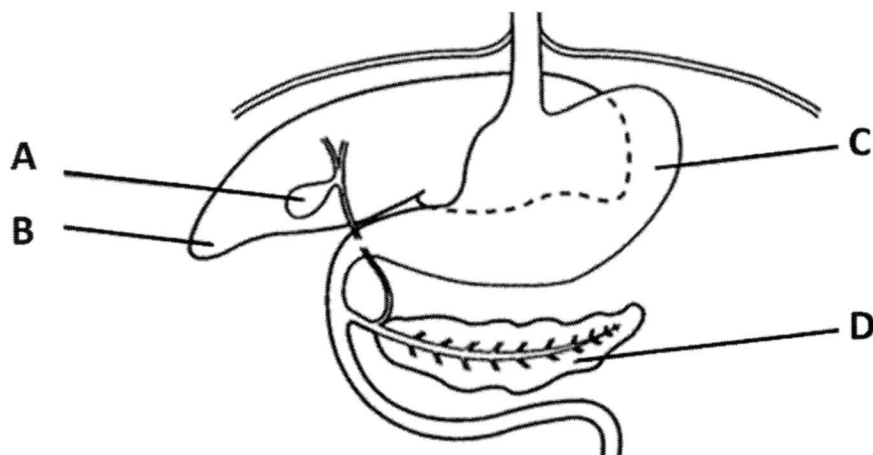
- 10 A piece of potato strip was weighed. It was then placed in a test tube containing dilute salt solution. After a few hours, the mass of the potato strip was found to increase. Which scenario had happened to the potato strip?
- A Water moved into the potato strip through osmosis.
 - B Water moved into the potato strip through diffusion.
 - C Mineral salts moved into the potato strip through osmosis.
 - D Mineral salts moved into the potato strip through diffusion.
- 11 Cyanide is a substance that can stop respiration from taking place. Which of the following processes can be stopped if a cell is exposed to cyanide?
- I. Diffusion
 - II. Osmosis
 - III. Active transport
- A I only
 - B III only
 - C I and II only
 - D II and III only
- 12 A ring of bark is removed from a balsam plant.



What causes the swelling in the stem above the removed ring?

- A Accumulation of salts and water due to the removal of the xylem tissue.
- B Accumulation of salts and water due to the removal of the phloem tissue.
- C Accumulation of food materials due to the removal of the xylem tissue.
- D Accumulation of food materials due to the removal of the phloem tissue.

- 13 The diagram below shows part of the human alimentary canal. Which part stores the fluid which emulsifies fats?



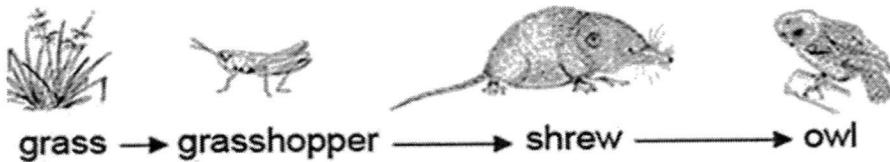
- 14 The table below shows the proteins, fats and carbohydrates content in 20 g of rice and white fish.

food	proteins / g	fats / g	carbohydrates / g
rice	0.5	0.1	9.2
white fish	2.1	0.005	0.0

What will be the main end-products of digestion of a meal of rice and white fish?

- A amino acids and fatty acids
 B amino acids and glucose
 C fatty acids and glucose
 D glucose and glycerol
- 15 Where does chemical digestion take place?
- I. Mouth
 II. Stomach
 III. Small intestine
 IV. Large intestine
- A I and II only
 B III and IV only
 C I, II and III only
 D I, II, III and IV

16 Which is the primary consumer of this food chain?



- A grass
- B grasshopper
- C shrew
- D owl

17 Which statement best describes an ecosystem?

- A A group of organisms of the same species that live in an area.
- B Many groups of organisms of different species that live in an area.
- C Many groups of organisms of different species interacting with one another and the environment in which they all live in.
- D The study of the interactions among many groups of organisms of different species and the environment in which they all live in.

18 Which of the following changes happen in both boys and girls during puberty?

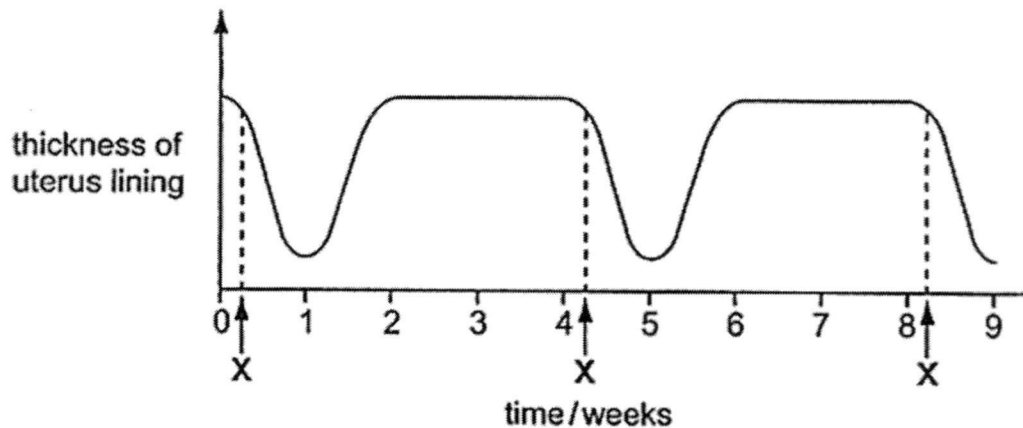
- I. Growth spurt occurs
- II. Increased production of sex hormones
- III. Pubic hair grows
- IV. Voice becomes deeper

- A I and IV only
- B II and III only
- C II and IV only
- D I, II and III only

19 How can AIDS be spread?

- A Resting on the same bed previously used by an infected person.
- B Sharing of medical needles with an infected person.
- C Being sneezed on by an infected person.
- D Sharing of food with an infected person.

- 20 The following graph shows changes in the thickness of the uterus lining of a lady over a period of 9 weeks.



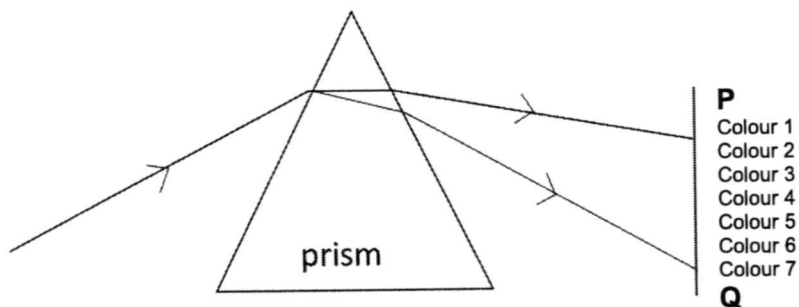
What happened at X?

- A fertilisation
 - B implantation
 - C menstruation
 - D ovulation
- 21 A cyan object was being placed in a room with yellow light. What colour would the object be to a person looking at it in the room?
- A Cyan
 - B Green
 - C Red
 - D Yellow
- 22 Which of the following is not a property of sound?
- A It can travel through vacuum.
 - B It is formed by movement of particles.
 - C It can be transmitted through a liquid.
 - D Particle can pass energy to the neighbouring particles.

- 23 Two instruments were played in the music room. A sound was played on a flute. Another sound of the same pitch was played on the trumpet. Which of the following correctly compares the two sound waves?

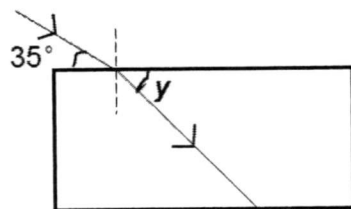
	frequency	speed
A	different	different
B	different	same
C	same	different
D	same	same

- 24 The figure below shows a beam of white light incident on a prism and is dispersed into a visible spectrum on board **PQ** with seven different colours in the order as shown below.



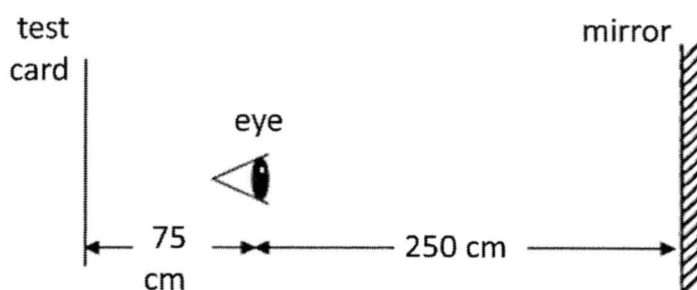
Joseph is thinking of choosing a colour for Board **PQ**. Which colour of board **PQ** does **not** reflect the true Colour 5?

- A Cyan
 - B Magenta
 - C White
 - D Yellow
- 25 Light enters from air into a glass block with refractive index of 1.55. Calculate y .



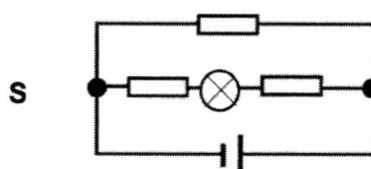
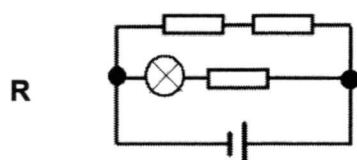
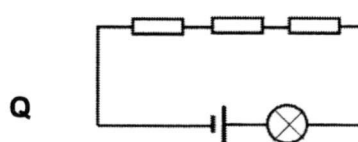
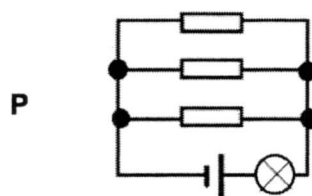
- A 22°
- B 32°
- C 58°
- D 68°

- 26 Joel went to an optician to test his eyesight. At the optical centre, Joel sat on the seat which was placed 250 cm away from the mirror placed in front of him. The test card was fixed 75 cm behind his seat.



What is the distance between Joel's eye and the image of the test card?

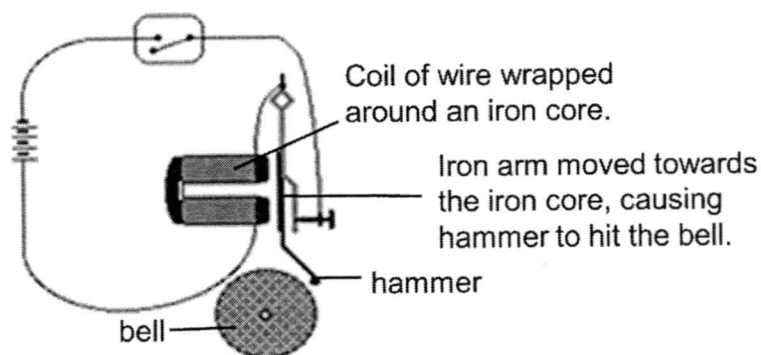
- A 250 cm
 B 500 cm
 C 575 cm
 D 650 cm
- 27 Each circuit is connected to identical light bulbs of $1\ \Omega$ each and resistor of $2\ \Omega$ each.



Arrange the circuits, in the ascending order of light intensity.

- A P, R, S, Q
 B P, S, R, Q
 C Q, R, S, P
 D Q, S, R, P

- 28 The diagram below shows a simplified doorbell that rings when the switch is closed in the circuit. This doorbell works based on one of the effects of an electric current.



Which of the following is the correct representation of this effect?

- A sound effect
- B magnetic effect
- C heating effect
- D chemical effect

For questions 29 and 30, refer to the data, which shows the number of hours and electrical energy consumed by Timothy's home appliances in a day.

Appliance	Electrical energy consumed per day (kWh)	Duration of usage per day (hour)
I	2.5	1
II	3.5	1
III	17.0	17
IV	21.0	14

- 29 Which one of the following appliances has the lowest power rating?
- A I
 - B II
 - C III
 - D IV
- 30 If the power supply company charges \$ 0.20 per kWh, what is the total cost of energy consumed by all the appliances in 30 days?
- A \$ 3534.00
 - B \$ 264.00
 - C \$ 117.80
 - D \$ 8.80

The Periodic Table of Elements

Group																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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3 Li lithium 7	4 Be beryllium 9	5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20	11 Na sodium 23	12 Mg magnesium 24	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40	19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84	37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131	55 Cs caesium 133	56 Ba barium 137	57 - 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium -	85 At astatine -	86 Rn radon -	87 Fr francium -	88 Ra radium -	89 - 103 actinoids	104 Rf rutherfordium -	105 Db dubnium -	106 Sg seaborgium -	107 Bh bohrium -	108 Hs hassium -	109 Mt meitnerium -	110 Ds darmstadtium -	111 Rg roentgenium -	112 Cn copernicium -	113 Nh nihonium -	114 Fl flerovium -	115 Lv livermorium -	116 Ts tennessine -	117 Uu unseptennium -	118 Ug unoghexium -	119 Uuh unbihexium -	120 Uuo unbibium -	121 Uuq unbiquadium -	122 Uus unbiseptium -	123 Uut untribium -	124 Uuq unquadrium -	125 Uus unquintium -	126 Uuh unhexium -	127 Uub unbhectium -	128 Uut untribium -	129 Uuq unquadrium -	130 Uus unquintium -	131 Uuh unhexium -	132 Uub unbhectium -	133 Uut untribium -	134 Uuq unquadrium -	135 Uus unquintium -	136 Uuh unhexium -	137 Uub unbhectium -	138 Uut untribium -	139 Uuq unquadrium -	140 Uus unquintium -	141 Uuh unhexium -	142 Uub unbhectium -	143 Uut untribium -	144 Uuq unquadrium -	145 Uus unquintium -	146 Uuh unhexium -	147 Uub unbhectium -	148 Uut untribium -	149 Uuq unquadrium -	150 Uus unquintium -	151 Uuh unhexium -	152 Uub unbhectium -	153 Uut untribium -	154 Uuq unquadrium -	155 Uus unquintium -	156 Uuh unhexium -	157 Uub unbhectium -	158 Uut untribium -	159 Uuq unquadrium -	160 Uus unquintium -	161 Uuh unhexium -	162 Uub unbhectium -	163 Uut untribium -	164 Uuq unquadrium -	165 Uus unquintium -	166 Uuh unhexium -	167 Uub unbhectium -	168 Uut untribium -	169 Uuq unquadrium -	170 Uus unquintium -	171 Uuh unhexium -	172 Uub unbhectium -	173 Uut untribium -	174 Uuq unquadrium -	175 Uus unquintium -	176 Uuh unhexium -	177 Uub unbhectium -	178 Uut untribium -	179 Uuq unquadrium -	180 Uus unquintium -	181 Uuh unhexium -	182 Uub unbhectium -	183 Uut untribium -	184 Uuq unquadrium -	185 Uus unquintium -	186 Uuh unhexium -	187 Uub unbhectium -	188 Uut untribium -	189 Uuq unquadrium -	190 Uus unquintium -	191 Uuh unhexium -	192 Uub unbhectium -	193 Uut untribium -	194 Uuq unquadrium -	195 Uus unquintium -	196 Uuh unhexium -	197 Uub unbhectium -	198 Uut untribium -	199 Uuq unquadrium -	200 Uus unquintium -	201 Uuh unhexium -	202 Uub unbhectium -	203 Uut untribium -	204 Uuq unquadrium -	205 Uus unquintium -	206 Uuh unhexium -	207 Uub unbhectium -	208 Uut untribium -	209 Uuq unquadrium -	210 Uus unquintium -	211 Uuh unhexium -	212 Uub unbhectium -	213 Uut untribium -	214 Uuq unquadrium -	215 Uus unquintium -	216 Uuh unhexium -	217 Uub unbhectium -	218 Uut untribium -	219 Uuq unquadrium -	220 Uus unquintium -	221 Uuh unhexium -	222 Uub unbhectium -	223 Uut untribium -	224 Uuq unquadrium -	225 Uus unquintium -	226 Uuh unhexium -	227 Uub unbhectium -	228 Uut untribium -	229 Uuq unquadrium -	230 Uus unquintium -	231 Uuh unhexium -	232 Uub unbhectium -	233 Uut untribium -	234 Uuq unquadrium -	235 Uus unquintium -	236 Uuh unhexium -	237 Uub unbhectium -	238 Uut untribium 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-	435 Uus unquintium -	436 Uuh unhexium -	437 Uub unbhectium -	438 Uut untribium -	439 Uuq unquadrium -	440 Uus unquintium -	441 Uuh unhexium -	442 Uub unbhectium -	443 Uut untribium -	444 Uuq unquadrium -	445 Uus unquintium -	446 Uuh unhexium -	447 Uub unbhectium -	448 Uut untribium -	449 Uuq unquadrium -	450 Uus unquintium -	451 Uuh unhexium -	452 Uub unbhectium -	453 Uut untribium -	454 Uuq unquadrium -	455 Uus unquintium -	456 Uuh unhexium -	457 Uub unbhectium -	458 Uut untribium -	459 Uuq unquadrium -	460 Uus unquintium -	461 Uuh unhexium -	462 Uub unbhectium -	463 Uut untribium -	464 Uuq unquadrium -	465 Uus unquintium -	466 Uuh unhexium -	467 Uub unbhectium -	468 Uut untribium -	469 Uuq unquadrium -	470 Uus unquintium -	471 Uuh unhexium -	472 Uub unbhectium -	473 Uut untribium -	474 Uuq unquadrium -	475 Uus unquintium -	476 Uuh unhexium -	477 Uub unbhectium -	478 Uut untribium -	479 Uuq unquadrium -	480 Uus unquintium -	481 Uuh unhexium -	482 Uub unbhectium -	483 Uut untribium -	484 Uuq unquadrium -	485 Uus unquintium -	486 Uuh unhexium -	487 Uub unbhectium -	488 Uut untribium -	489 Uuq unquadrium -	490 Uus unquintium -	491 Uuh unhexium -	492 Uub unbhectium -	493 Uut untribium -	494 Uuq unquadrium -	495 Uus unquintium -	496 Uuh unhexium -	497 Uub unbhectium -	498 Uut untribium -	499 Uuq unquadrium -	500 Uus unquintium -	501 Uuh unhexium -	502 Uub unbhectium -	503 Uut untribium -	504 Uuq unquadrium -	505 Uus unquintium -	506 Uuh unhexium -	507 Uub unbhectium -	508 Uut untribium -	509 Uuq unquadrium -	510 Uus unquintium -	511 Uuh unhexium -	512 Uub unbhectium -	513 Uut untribium -	514 Uuq unquadrium -	515 Uus unquintium -	516 Uuh unhexium -	517 Uub unbhectium -	518 Uut untribium -	519 Uuq unquadrium -	520 Uus unquintium -	521 Uuh unhexium -	522 Uub unbhectium -	523 Uut untribium -	524 Uuq unquadrium -	525 Uus unquintium -	526 Uuh unhexium -	527 Uub unbhectium -	528 Uut untribium -	529 Uuq unquadrium -	530 Uus unquintium -	531 Uuh unhexium -	532 Uub unbhectium -	533 Uut untribium -	534 Uuq unquadrium -	535 Uus unquintium -	536 Uuh unhexium -	537 Uub unbhectium -	538 Uut untribium -	539 Uuq unquadrium -	540 Uus unquintium -	541 Uuh unhexium -	542 Uub unbhectium -	543 Uut untribium -	544 Uuq unquadrium -	545 Uus unquintium -	546 Uuh unhexium -	547 Uub unbhectium -	548 Uut untribium -	549 Uuq unquadrium -	550 Uus unquintium -	551 Uuh unhexium -	552 Uub unbhectium -	553 Uut untribium -	554 Uuq unquadrium -	555 Uus unquintium -	556 Uuh unhexium -	557 Uub unbhectium -	558 Uut untribium -	559 Uuq unquadrium -	560 Uus unquintium -	561 Uuh unhexium -	562 Uub unbhectium -	563 Uut untribium -	564 Uuq unquadrium -	565 Uus unquintium -	566 Uuh unhexium -	567 Uub unbhectium -	568 Uut untribium -	569 Uuq unquadrium -	570 Uus unquintium -	571 Uuh unhexium -	572 Uub unbhectium -	573 Uut untribium -	574 Uuq unquadrium -	575 Uus unquintium -	576 Uuh unhexium -	577 Uub unbhectium -	578 Uut untribium -	579 Uuq unquadrium -	580 Uus unquintium -	581 Uuh unhexium -	582 Uub unbhectium -	583 Uut untribium -	584 Uuq unquadrium -	585 Uus unquintium -	586 Uuh unhexium -	587 Uub unbhectium -	588 Uut untribium -	589 Uuq unquadrium -	590 Uus unquintium -	591 Uuh unhexium -	592 Uub unbhectium -	593 Uut untribium -	594 Uuq unquadrium -	595 Uus unquintium -	596 Uuh unhexium -	597 Uub unbhectium -	598 Uut untribium -	599 Uuq unquadrium -	600 Uus unquintium -	601 Uuh unhexium -	602 Uub unbhectium -	603 Uut untribium -	604 Uuq unquadrium -	605 Uus unquintium -	606 Uuh unhexium -	607 Uub unbhectium -	608 Uut untribium -	609 Uuq unquadrium -	610 Uus unquintium -	611 Uuh unhexium -	612 Uub unbhectium -	613 Uut untribium -	614 Uuq unquadrium -	615 Uus unquintium -	616 Uuh unhexium -	617 Uub unbhectium -	618 Uut untribium -	619 Uuq unquadrium -	620 Uus unquintium -	621 Uuh unhexium -	622 Uub unbhectium -	623 Uut untribium -	624 Uuq unquadrium -	625 Uus unquintium -	626 Uuh unhexium -	627 Uub unbhectium -	628 Uut untribium -	629 Uuq unquadrium -	630 Uus unquintium 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lanthanoids																	
57	La	lanthanum	139	58	Ce	cerium	140	59	Pr	praseodymium	141	60	Nd	neodymium	144	61	Pm
89	Ac	actinium	—	90	Th	thorium	232	91	Pa	protactinium	231	92	U	uranium	238	93	Np
actinoids																	
65	Tb	terbium	159	66	Dy	dysprosium	163	67	Ho	holmium	165	68	Er	erbium	167	69	Tm
71	Lu	lutetium	175	72	Yb	ytterbium	173	73	Lu	lutetium	175	74	Hf	hafnium	178	75	Ta
103	Lr	lawrencium	—	104	Rf	rutherfordium	—	105	Db	dubnium	—	106	Sg	seaborgium	—	107	Bh
105	Db	dubnium	—	106	Sg	seaborgium	—	107	Bh	bohrium	—	108	Hs	hassium	—	109	Mt
110	Ds	darmstadtium	—	111	Rg	roentgenium	—	112	Cn	copernicium	—	113	Nh	nihonium	—	114	Fl
116	Lv	livermorium	—	117	Ts	tennessine	—	118	Og	oganeson	—	119	Uu	unbinilium	—	120	Uub
127	Uut	ununseptium	—	128	Uuq	ununquadium	—	129	Uuh	ununhexium	—	130	Uus	ununseptium	—	131	Uuo
132	Uub	ununbium	—	133	Uut	ununtrium	—	134	Uuq	ununquadium	—	135	Uuh	ununhexium	—	136	Uus
137	Uub	ununbium	—	138	Uut	ununtrium	—	139	Uuq	ununquadium	—	140	Uuh	ununhexium	—	141	Uus
142	Uub	ununbium	—	143	Uut	ununtrium	—	144	Uuq	ununquadium	—	145	Uuh	ununhexium	—	146	Uus
147	Uub	ununbium	—	148	Uut	ununtrium	—	149	Uuq	ununquadium	—	150	Uuh	ununhexium	—	151	Uus
152	Uub	ununbium	—	153	Uut	ununtrium	—	154	Uuq	ununquadium	—	155	Uuh	ununhexium	—	156	Uus
157	Uub	ununbium	—	158	Uut	ununtrium	—	159	Uuq	ununquadium	—	160	Uuh	ununhexium	—	161	Uus
162	Uub	ununbium	—	163	Uut	ununtrium	—	164	Uuq	ununquadium	—	165	Uuh	ununhexium	—	166	Uus
167	Uub	ununbium	—	168	Uut	ununtrium	—	169	Uuq	ununquadium	—	170	Uuh	ununhexium	—	171	Uus
172	Uub	ununbium	—	173	Uut	ununtrium	—	174	Uuq	ununquadium	—	175	Uuh	ununhexium	—	176	Uus
177	Uub	ununbium	—	178	Uut	ununtrium	—	179	Uuq	ununquadium	—	180	Uuh	ununhexium	—	181	Uus
182	Uub	ununbium	—	183	Uut	ununtrium	—	184	Uuq	ununquadium	—	185	Uuh	ununhexium	—	186	Uus
187	Uub	ununbium	—	188	Uut	ununtrium	—	189	Uuq	ununquadium	—	190	Uuh	ununhexium	—	191	Uus
192	Uub	ununbium	—	193	Uut	ununtrium	—	194	Uuq	ununquadium	—	195	Uuh	ununhexium	—	196	Uus
197	Uub	ununbium	—	198	Uut	ununtrium	—	199	Uuq	ununquadium	—	200	Uuh	ununhexium	—	201	Uus
202	Uub	ununbium	—	203	Uut	ununtrium	—	204	Uuq	ununquadium	—	205	Uuh	ununhexium	—	206	Uus
207	Uub	ununbium	—	208	Uut	ununtrium	—	209	Uuq	ununquadium	—	210	Uuh	ununhexium	—	211	Uus
212	Uub	ununbium	—	213	Uut	ununtrium	—	214	Uuq	ununquadium	—	215	Uuh	ununhexium	—	216	Uus
217	Uub	ununbium	—	218	Uut	ununtrium	—	219	Uuq	ununquadium	—	220	Uuh	ununhexium	—	221	Uus
222	Uub	ununbium	—	223	Uut	ununtrium	—	224	Uuq	ununquadium	—	225	Uuh	ununhexium	—	226	Uus
227	Uub	ununbium	—	228	Uut	ununtrium	—	229	Uuq	ununquadium	—	230	Uuh	ununhexium	—	231	Uus
232	Uub	ununbium	—	233	Uut	ununtrium	—	234	Uuq	ununquadium	—	235	Uuh	ununhexium	—	236	Uus
237	Uub	ununbium	—	238	Uut	ununtrium	—	239	Uuq	ununquadium	—	240	Uuh	ununhexium	—	241	Uus
242	Uub	ununbium	—	243	Uut	ununtrium	—	244	Uuq	ununquadium	—	245	Uuh	ununhexium	—	246	Uus
247	Uub	ununbium	—	248	Uut	ununtrium	—	249	Uuq	ununquadium	—	250	Uuh	ununhexium	—	251	Uus
252	Uub	ununbium	—	253	Uut	ununtrium	—	254	Uuq	ununquadium	—	255	Uuh	ununhexium	—	256	Uus
257	Uub	ununbium	—	258	Uut	ununtrium	—	259	Uuq	ununquadium	—	260	Uuh	ununhexium	—	261	Uus
262	Uub	ununbium	—	263	Uut	ununtrium	—	264	Uuq	ununquadium	—	265	Uuh	ununhexium	—	266	Uus
267	Uub	ununbium	—	268	Uut	ununtrium	—	269	Uuq	ununquadium	—	270	Uuh	ununhexium	—	271	Uus
271	Uub	ununbium	—	272	Uut	ununtrium	—	273	Uuq	ununquadium	—	274	Uuh	ununhexium	—	275	Uus
276	Uub	ununbium	—	277	Uut	ununtrium	—	278	Uuq	ununquadium	—	279	Uuh	ununhexium	—	280	Uus
281	Uub	ununbium	—	282	Uut	ununtrium	—	283	Uuq	ununquadium	—	284	Uuh	ununhexium	—	285	Uus
286	Uub	ununbium	—	287	Uut	ununtrium	—	288	Uuq	ununquadium	—	289	Uuh	ununhexium	—	290	Uus
289	Uub	ununbium	—	290	Uut	ununtrium	—	291	Uuq	ununquadium	—	292	Uuh	ununhexium	—	293	Uus
294	Uub	ununbium	—	295	Uut	ununtrium	—	296	Uuq	ununquadium	—	297	Uuh	ununhexium	—	298	Uus
299	Uub	ununbium	—	300	Uut	ununtrium	—	301	Uuq	ununquadium	—	302	Uuh	ununhexium	—	303	Uus
304	Uub	ununbium	—	305	Uut	ununtrium	—	306	Uuq	ununquadium	—	307	Uuh	ununhexium	—	308	Uus
309	Uub	ununbium	—	310	Uut	ununtrium	—	311	Uuq	ununquadium	—	312	Uuh	ununhexium	—	313	Uus
315	Uub	ununbium	—	316	Uut	ununtrium	—	317	Uuq	ununquadium	—	318	Uuh	ununhexium	—	319	Uus
320	Uub	ununbium	—	321	Uut	ununtrium	—	322	Uuq	ununquadium	—	323	Uuh	ununhexium	—	324	Uus
325	Uub	ununbium	—	326	Uut	ununtrium	—	327	Uuq	ununquadium	—	328	Uuh	ununhexium	—	329	Uus
330	Uub	ununbium	—	331	Uut	ununtrium	—	332	Uuq	ununquadium	—	333	Uuh	ununhexium	—	334	Uus
335	Uub	ununbium	—	336	Uut	ununtrium	—	337	Uuq	ununquadium	—	338	Uuh	ununhexium	—	339	Uus
340	Uub	ununbium	—	341	Uut	ununtrium	—	342	Uuq	ununquadium	—	343	Uuh	ununhexium	—	344	Uus
345	Uub	ununbium	—	346	Uut	ununtrium	—	347	Uuq	ununquadium	—	348	Uuh	ununhexium	—	349	Uus
350	Uub	ununbium	—	351	Uut	ununtrium	—	352	Uuq	ununquadium	—	353	Uuh	ununhexium	—	354	Uus
355	Uub	ununbium	—	356	Uut	ununtrium	—	357	Uuq	ununquadium	—	358	Uuh	ununhexium	—	359	Uus
360	Uub	ununbium	—	361	Uut	ununtrium	—	362	Uuq	ununquadium	—	363	Uuh	ununhexium	—	364	Uus
365	Uub	ununbium	—	366	Uut	ununtrium	—	367	Uuq	ununquadium	—	368	Uuh	ununhexium	—	369	Uus
370	Uub	ununbium	—	371	Uut	ununtrium	—	372	Uuq	ununquadium	—	373	Uuh	ununhexium	—	374	Uus
375	Uub	ununbium	—	376	Uut	ununtrium	—	377	Uuq	ununquadium	—	378	Uuh	ununhexium	—	379	Uus
380	Uub	ununbium	—	381	Uut	ununtrium	—	382	Uuq	ununquadium	—	383	Uuh	ununhexium	—	384	Uus
385	Uub	ununbium	—	386	Uut	ununtrium	—	387	Uuq	ununquadium	—	388	Uuh	ununhexium	—	389	Uus
390	Uub	ununbium	—	391	Uut	ununtrium	—	392	Uuq	ununquadium	—	393	Uuh	ununhexium	—	394	Uus
395	Uub	ununbium	—	396	Uut	ununtrium	—	397	Uuq	ununquadium	—	398	Uuh	ununhexium	—	399	Uus
400	Uub	ununbium	—	401	Uut	ununtrium	—	402	Uuq	ununquadium	—	403	Uuh	ununhexium	—	404	Uus

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).