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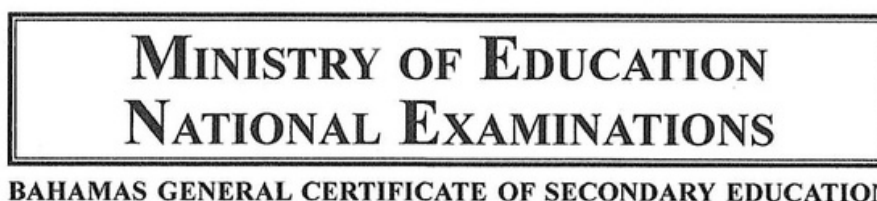
School Number	Candidate Number
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COMBINED SCIENCE

PAPER 3 3102/3

Wednesday **3 JUNE 2020** 9:00 A.M.–10:30 A.M.

Additional materials:
Graph paper



INSTRUCTIONS AND INFORMATION FOR CANDIDATES

Do not open this booklet until you are told to do so.

Write your school number, candidate number, surname and initials in the spaces provided in this question booklet.

Answer **ALL** questions in **Section A** (1 – 4) in the spaces provided.

Answer **ANY TWO** (2) out of the **THREE** (3) questions from **Section B** on the lined pages provided in this booklet.

Candidates are advised to spend no more than 35 minutes on Section A.

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

A copy of the Periodic Table is printed on page 2.

Calculators are permitted, however **NO** graphing calculators are allowed.

For Examiner's Use	
SECTION A	
1	
2	
3	
4	
SECTION B	
5	
6	
7	
TOTAL	

This question paper consists of 14 printed pages, 4 lined pages and 2 blank pages.



The Periodic Table of the Elements

Group																				
I	II											III	IV	V	VI	VII	0			
1 H Hydrogen																				
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 Sulphur 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	64 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	101 Ru Ruthenium 44	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	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86			
Fr Francium 87	Ra Radium 88	Ac Actinium 89																		
*58-71 Lanthanoid series †90-103 Actinoid series																				
140 Ce Cerium 58 141 Pr Praseodymium 59 144 Nd Neodymium 60 150 Sm Samarium 62 152 Eu Europium 63 157 Gd Gadolinium 64 159 Tb Terbium 65 162 Dy Dysprosium 66 165 Ho Holmium 67 167 Er Erbium 68 169 Tm Thulium 69 173 Yb Ytterbium 70 175 Lu Lutetium 71																				
232 Th Thorium 90 238 Pa Protactinium 91 238 U Uranium 92 238 Np Neptunium 93 238 Pu Plutonium 94 238 Am Americium 95 238 Cm Curium 96 238 Bk Berkelium 97 238 Es Einsteinium 99 238 Fm Fermium 100 238 Md Mendelevium 101 238 No Nobelium 102 238 Lr Lawrencium 103																				

a

X

b

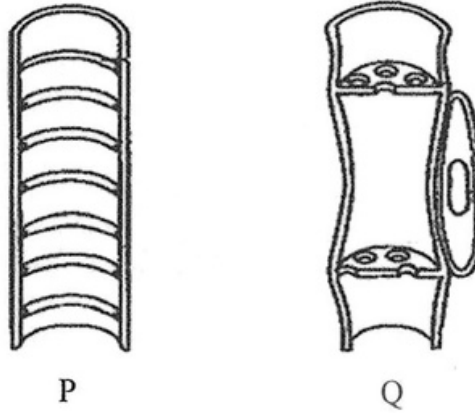
Key

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

SECTION A

Answer **ALL** questions in this Section.

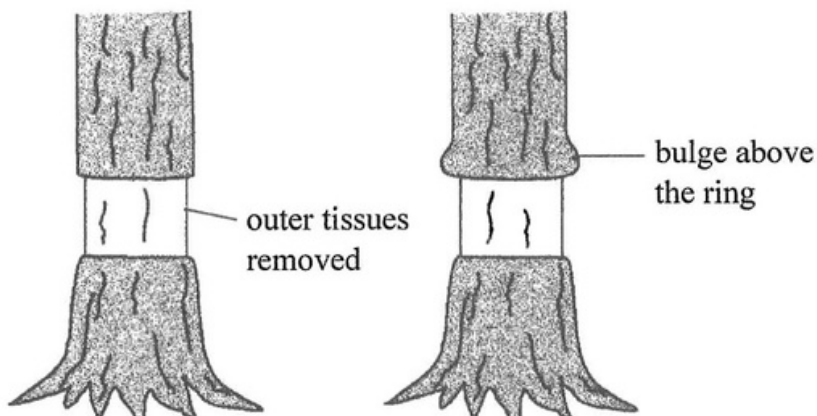
1. The diagram represents **TWO** types of tissues found in the vascular bundle of a plant stem.



- (a) Give **TWO** structural differences between Tissue P and Tissue Q.

[2]

- (b) A stem had its outer tissues removed. After a few days, there was a bulge on the stem as shown in the diagram below.



- (i) Explain the effect of the removal of the outer tissue on the plant, in the short term and long term.

Short Term _____ [2]

Long Term _____ [2]

- (c) Explain why manufactured food in plants is transported as sugar instead of starch.

_____ [2]

- (d) Give one similarity and one difference between the transport system in mammals and the transport system in plants.

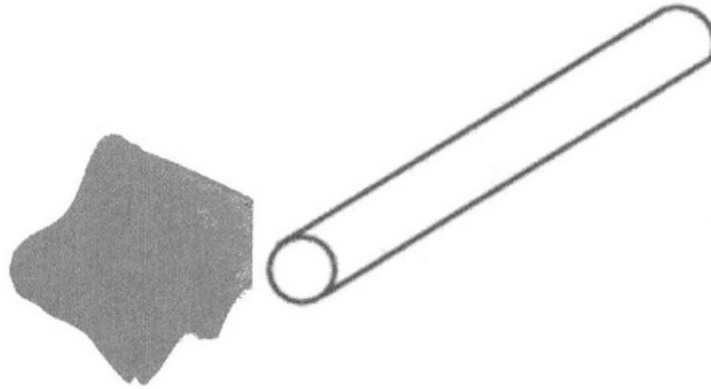
Similarity _____ [1]

Difference _____ [1]

TOTAL MARKS [10]



2. A plastic rod is rubbed with a dry cloth.



- (a) State the charge on the rod after rubbing it with the dry cloth.

_____ [1]

Explain how this happens in term of particles.

_____ [2]

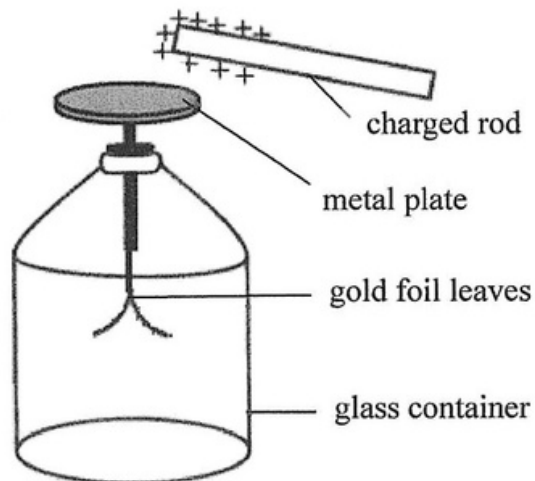
- (b) What charge is left on the cloth?

_____ [1]

- (c) What happens if the charged rod is brought close to a negatively charged object?

_____ [1]

The diagram below shows an electroscope and a positively charged rod.



- (d) What is the function of the electroscope?
_____ [1]
- (e) Explain why the gold leaf opens when the positively charged rod touches the metal plate.

_____ [2]
- (f) What happens if you now remove the positive rod, and touch the metal plate with a negatively charged rod?
_____ [1]
- (g) A positively charged metal can is discharged by *earthing* it. Does the can gain or lose electrons?
_____ [1]

TOTAL MARKS [10]

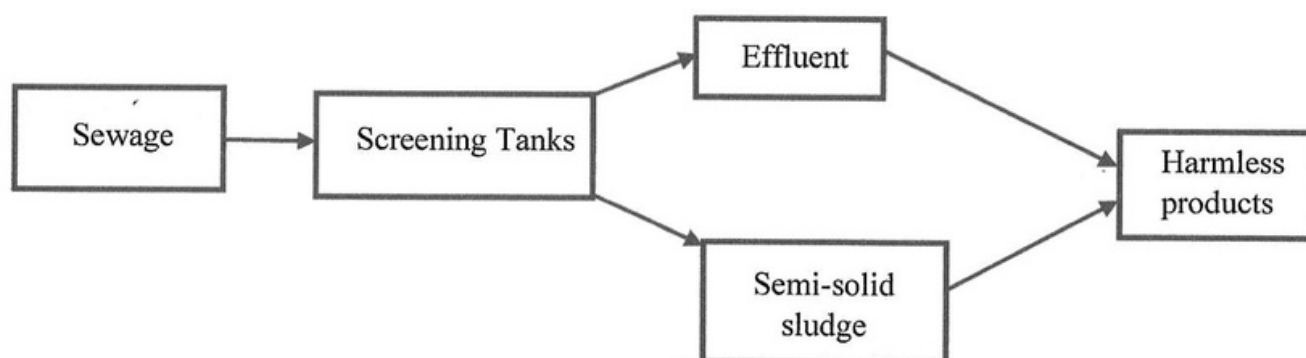


3. Sewage is a type of wastewater and must be treated before it can be released into the environment.

- (a) State **TWO** negative consequences of releasing untreated sewage into rivers and streams.

[2]

In a sewage treatment facility, the sewage is first screened by passing it through a mesh. This produces a liquid effluent and a semi-solid sludge. The liquid effluent is treated by a wide range of microorganisms to produce products which are harmless or helpful to the environment. Some of these microorganisms need a lot of oxygen in order to be effective.



- (b) (i) What is the name given to the separation technique in which the sewage is screened?

[1]

- (ii) Why is the separation technique identified in (b)(i) above, used in the treatment of sewage?

[1]

- (iii) Explain why some of the microorganisms have to be provided with a lot of oxygen.

[2]

[Turn over

- (iv) Suggest a reason why a wide range of micro-organisms are essential for the complete breakdown of sewage.

_____ [1]

- (v) Suggest the name of **TWO** useful products obtained from the treatment of sewage.

_____ [2]

- (c) The treatment of sewage is an important example of the recycling of materials.

Give **ONE** reason why metals should also be recycled.

_____ [1]

TOTAL MARKS [10]

4. Magnesium ribbon burns in oxygen from the air to form magnesium oxide while releasing light and heat.

- (a) Write a balanced equation for the reaction of magnesium with oxygen from the air to form magnesium oxide.

_____ [2]

- (b) (i) Calculate the relative molecular mass of the compound formed.

[1]



- (ii) What is the total number of atoms used on the reactant side of the equation?

_____ [1]

- (iii) Using the **Law of Conservation of Matter**, describe the relationship between the number of each type of atom on the reactant and product sides of the equation.

_____ [1]

- (c) Calcium reacts with dilute hydrochloric acid to form a metal salt and hydrogen gas shown in the chemical equation below.

Complete balancing the equation and write the formula of the metal salt formed.



- (d) Ammonium hydroxide reacts with copper(II) sulphate to produce ammonium sulphate and copper(II) hydroxide.

Write the chemical formula of the compounds produced in the reaction.

Product 1 _____ [1]

Product 2 _____ [1]

- (e) The chemical formula of a compound is Ba(NO₃)₂.

Name the compound.

_____ [1]

TOTAL MARKS [10]

5. A student investigated the effect of pH on the rate of reaction of a *named enzyme* on 1% starch solutions. The student tested samples from each test tube with iodine solution at intervals. The reaction was complete when the colour of the iodine remained yellow–brown.

The results are shown in the table below.

pH	Rate of reaction (arbitrary units)
4.0	0.0
4.5	1.0
5.0	2.5
5.5	6.0
6.0	10.0
6.5	13.0
7.0	16.5
7.5	14.5
8.0	6.5
8.5	3.5
9.0	0

- (a) Plot a suitable graph of the results with pH on the x axis and the rate of reaction on the y axis. [4]
- (b) (i) Explain why the yellow–brown colour appeared when the reaction was completed. [2]
- (ii) Name the enzyme used in the experiment. [1]
- (iii) Name the parts of the digestive system where this enzyme works. [2]
- (iv) What is the one end product of this enzymatic activity? [1]
- (v) State the term used to describe the enzyme at pH 4 and pH 9. [1]
- (vi) Briefly explain why this occurs. [3]

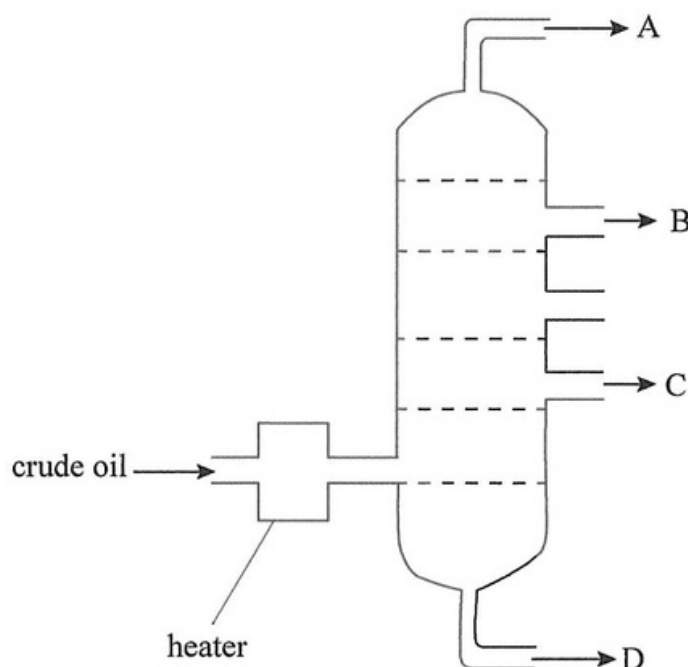


- (c) (i) State the optimum pH for the reaction and give a reason for your answer. [2]
- (ii) Excluding pH, state **TWO** factors that affects the enzyme activity. [2]
- (d) Opdaz is a new biological washing powder which is used to remove protein stains from clothes.
- (i) Name an enzyme that could be added to this washing powder to remove protein stains. [1]
- (ii) State the end product of enzyme digestion of protein. [1]

TOTAL MARKS [20]

6. Crude oil is a fossil fuel containing useful hydrocarbon fractions that can be obtained through fractional distillation.

- (a) (i) Define the term **hydrocarbon**. [1]
- (ii) Explain why crude oil can be separated using fractional distillation. [1]
- (iii) Describe how the hydrocarbon fractions of crude oil are obtained using fractional distillation. [3]
- (b) The diagram below shows how crude oil can be separated into its hydrocarbon fractions.



- (i) Identify the hydrocarbon fraction labelled **D**. [1]
- (ii) Give one use of fraction **D**. [1]



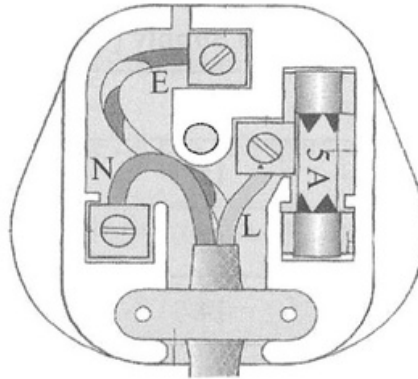
- (c) The table below shows estimated customer demand for the fractions in crude oil.

Crude oil Fraction	Fraction Supply (%)	Customer Demand (%)
LPG	2	4
Petrol	15	27
Diesel	14	21
Paraffin	14	9
Heating oil	19	14
Fuel oil and Bitumen	36	25

- (i) Plot all the information in the table in a bar chart. [4]
- (ii) Describe the trend in the supply and demand for petrol, diesel and fuel oil and bitumen. [2]
- (iii) Suggest a cause for this trend. [1]
- (iv) Which fraction(s) are most useful? [1]
- (d) Some of the hydrocarbon fractions from crude oil are used as fuels, for example, methane (CH_4).
- (i) Write a balanced equation for the reaction of methane (CH_4) burning in a plentiful supply of oxygen. [2]
- (ii) Name the poisonous gas produced when methane is burned in a limited supply of oxygen. [1]
- (iii) Name the environmental phenomenon caused by the increased burning of fossil fuels. [1]
- (iv) State **ONE** possible consequence of the phenomenon identified in (d)(iii) above. [1]

TOTAL MARKS [20]

7. The diagram below shows a three-pin plug.



- (a) State the name and colour of the three wires. [3]
- (b) Which of the wires named in question (a) is connected through the fuse? [1]
- (c) Explain why appliances with metal cases need to be earthed, but appliances with plastic cases do not. [2]
- (d) State how a fuse and a circuit breaker are alike and how they are different. [2]
- (e) What should you do if a circuit breaker trips again after being reset? [1]
- (f) Most domestic appliances are connected to 230 V mains supply with a 3 pin plug containing fuses of either a 3 A, 5 A or 13 A.
- (i) A food mixer has a normal current of 2A. What is the power of the mixer? [2]
- (ii) What fuse should be used in a pin plug for a 2.8 KW kettle? [2]
- (g) A table lamp has three bulbs, each of 40 W.
- (i) Find the energy in Joules and in KWh used by each bulb per hour. [3]
- (ii) If each unit cost 10 cents per KWh, find the total cost of lighting the table lamp for 24 hours. [4]

TOTAL MARKS [20]



Question

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