

3051/1

BGCSE

School Number	Candidate Number
Surname and Initials	

CHEMISTRY

PAPER 1 3051/1

Friday 28 MAY 2004 12.30 – 1.45 P.M.

Additional materials:
Periodic Table

MINISTRY OF EDUCATION NATIONAL EXAMINATIONS

BAHAMAS GENERAL CERTIFICATE OF SECONDARY EDUCATION

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Answer ALL the questions on this paper.

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Relative atomic masses are given in the Periodic Table of elements provided.

The volume of one mole of gas at room temperature and pressure (r.t.p.) is 24,000 cm³ and at standard temperature and pressure (s.t.p.) is 22,400 cm³.

This question paper consists of 12 printed pages and 4 blank pages.

1. Matter is neither created nor destroyed in a chemical reaction is one way of wording the
- A law of Conservation of Mass.
 - B law of Definite Proportions.
 - C law of Multiple Proportions.
 - D law of Conservation of Energy.
2. Which pairing can be called allotropes?
- A silicon and carbon
 - B sulphur and brimstone
 - C lead and copper
 - D diamond and graphite
3. Why can ethanol and water be separated by fractional distillation?
- A chemically similar
 - B different densities
 - C different boiling points
 - D do not react with each other
4. Which process can be used to decide whether chlorophyll is a single colour or a mixture of colours?
- A chromatography
 - B crystallization
 - C distillation
 - D filtration
5. Which property would suggest that an element should be classified as a non-metal?
- A reacts with oxygen to form a basic oxide
 - B atom loses electrons to form a stable ion
 - C ion is attracted to the anode of an electrolysis apparatus
 - D is a good conductor of heat

6. Which statements can be used to describe **both** sodium and potassium?

- I . They have high melting points.
- II They can be easily cut with a knife.
- III They will conduct electricity.

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

7. Which statement is always true about a strong acid?

- A It fumes in moist air.
- \ B It ionizes completely in water.
- C It forms a viscous solution.
- D It has a pH value near to 14.

Use the given information for questions 8, 9, 10 and 11.
The choices may be used **once, more than once or not at all.**

- A alkali metals
- B alkaline earth metals
- C halogens
- D noble gases

8. the most unreactive family of elements

A B C **D**

9. form negative ions

A B **C** D

10. exist naturally as coloured elements

A **B** C D

11. contain the element found in aragonite

A B C D

Use the named solids A, B, C or D to answer questions 12, 13 and 14.
The choices may be used once, more than once or not at all.

Which solid

- A graphite
- B iodine
- C sodium hydroxide
- D sucrose

12. gives off a purplish vapour when it sublimes? A B C D
13. can conduct electricity in the solid state? A B C D
14. when dissolved in water the reaction is highly exothermic? A B C D
15. Which named particle has a mass closest to the mass of a proton?
- A alpha particle
 - B deuterium
 - C electron
 - D neutron
16. What is the approximate percentage composition by mass of the element oxygen in the compound HClO_4 ?
- A 4 %
 - B 16 %
 - C 64 %
 - D 67 %
17. What is the oxidation state of chromium, Cr, in the compound potassium dichromate, $\text{K}_2\text{Cr}_2\text{O}_7$?
- A +2
 - B +4
 - C +6
 - D +12

18. An element has these properties:
shiny, brittle, poor electrical conductivity and a high melting point

This element can be best classified as a(n)

- A alkali metal.
- B halogen.
- C metalloid.
- D transition metal.

Use the given information to answer questions 19, 20 and 21. The choices may be used once, more than once or not at all.

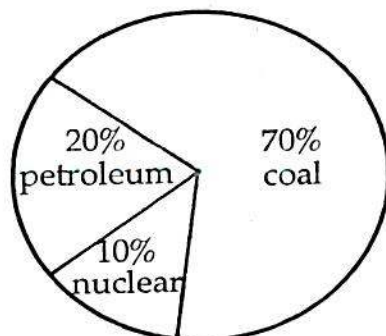
Which solution

- A HNO_3
- B CH_3COOH
- C $\text{Cu}(\text{NO}_3)_2$
- D NaOH

19. will be coloured blue? A B D
20. contains a weak acid? A C D
21. will contain molecules with the given formula? A C D
22. Which molecular formula corresponds to a molecule with an empirical formula of CH_2 ?
- A CH_4
 - B C_2H_2
 - C C_2H_6
 - D C_3H_6

23. What is most likely to occur when carbon dioxide is bubbled through distilled water at room temperature?
- A solid carbon will precipitate
 - B the pH value of the solution will become smaller
 - C the carbon and hydrogen in the mix will form methane
 - D there will be no change in the nature of the distilled water

24. The diagram shows the sources of energy a country uses to generate electricity.



What is the total percentage of fuels used which, when burned, could cause acid rain?

- A 20%
B 80%
C 90%
D 100%
25. Which is a formula for an organic compound?
- A SiO_2
B NH_3
C H_2O
D CH_4
26. The reactivity and chemical behaviour of an atom is governed by many factors. Which determines the reactivity of an atom?
- A the number of electrons in the atom's valence shell
B the number of neutrons in the atom's nucleus
C the number of protons in the atom's nucleus
D the number of protons lost during the chemical reaction
27. Which quantity is the measure of mass per unit volume?
- A density
B molarity
C partial pressure
D relative atomic mass

28. Which is the best description of the particle arrangement in chlorine-37?

	protons	electrons	neutrons
A	17	37	20
B	17	17	20
C	37	37	20
D	37	17	0

29. What type of bonding is found in potassium bromide?

- A covalent
- B dative
- C ionic
- D metallic

30. Which structure will have an electronic configuration identical to a neon $2, 8$ atom?

- A the helium atom
- B the fluoride ion
- C the potassium ion
- D the argon atom

31. Which chemical compound forms the largest part of the conch's shell, the very large snail-like mollusc found in Bahamian waters?

- A calcium carbonate
- B calcium phosphate
- C sodium carbonate
- D sodium hydrogen carbonate

32. Which compound has the same relative formula mass, M_r , as carbon dioxide?

- A water
- B sulphuric acid
- C propane
- D limestone

The table lists the results produced when some ions react with the given test reagents.

Use the information from the table to answer questions 33 and 34.

test reagent	excess NaOH (aq)	hydrochloric acid	aqueous ammonia
A	white precipitate	white precipitate	white precipitate
B	white precipitate	no precipitate	white precipitate
C	no precipitate	no precipitate	no precipitate
D	no precipitate	no precipitate	white precipitate

33. Which result corresponds to the aluminium ion? A B C D

34. Which result corresponds to the lead(II) ion? A B C D

35. Which ions are found in an aqueous solution of sodium sulphate?

- A $\text{Na}^{2+}, \text{SO}_4^{2-}, \text{H}^+, \text{OH}^-$
- B $\text{Na}^+, \text{SO}_4^{2-}, \text{H}^+, \text{OH}^-$
- C $\text{Na}^{2-}, \text{SO}_4^{2+}, \text{H}^-, \text{OH}^+$
- D $\text{Na}^+, \text{SO}_4^-, \text{H}^-, \text{OH}^+$

36. The proton numbers of elements are shown.

Which element is a metal?

element	proton number
A	34
B	35
C	36
D	37

37. The symbol is ${}_{15}^{31}\text{P}$

How many electrons does the outer shell of this atom contain?

- A 1
- B 3
- C 5
- D 6

38. Which element is located in Group 2, Period 3 of the Periodic Table?

- A boron
- B helium
- C lithium
- D magnesium

39. What is the formula of the compound formed by element X, in group 2 and element Y, in group 7?

- A XY
- B XY₂
- C X₂Y
- D X₇Y₂

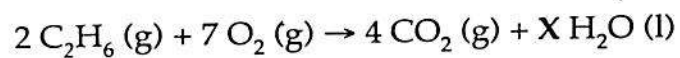
X²⁺ Y⁻¹

40. A thermometer shows the temperature 0° Celsius. If a thermometer marked with the Kelvin scale was used instead, what would the reading be?

- A 0
- B +212
- C +273
- D -273

Use the information in the equation to answer questions 41, 42 and 43.

The complete combustion of ethane can be represented by the equation:



41. What is the numerical value of X that balances the equation?
- A 1
 - B 2
 - C 3
 - D 6
42. How many moles of carbon dioxide would be produced from just one mole of ethane?
- A 1
 - B 2
 - C 3
 - D 4
43. At room temperature and pressure what volume of oxygen gas is needed to completely burn the 2 moles of ethane gas?
- A 24.0 dm³
 - B 48.0 dm³
 - C 144.0 dm³
 - D 168.0 dm³

44. A hydrocarbon mixture consists of the compounds shown in the table.

compound	boiling point/°C
heptane	98
hexane	69
hexene	64
octane	126
pentane	36
pentene	30

The mixture is fractionally distilled.

The fraction boiling between 60 °C and 80 °C is collected.

Which compounds will be in the distillate?

- A heptane and hexane
 - B hexane and hexene
 - C hexene and octane
 - D pentane and pentene
45. Which term best describes slag, a material involved in the extraction of iron in the blast furnace?
- A by-product
 - B main product
 - C naturally occurring starting material
 - D synthetic starting material

Questions 46, 47 and 48 refer to this word equation. The schematic shows a series of steps that produce useful substances. Other substances may be produced in each step but those substances have been omitted.



46. What does **step 1** require?

- A heat
- B hydrogen
- C oxygen
- D yeast

47. What is the other product in **step 1**, besides ethanol?

- A carbon dioxide
- B hydrogen
- C oxygen
- D water

48. What type of reaction is involved in **step 3**?

- A decomposition
- B oxidation
- C polymerisation
- D reduction

49. Nitrogen, phosphorus and potassium are elements needed by plants and supplied in fertilizers.

Which compound contains **two** of these elements?

- A ammonium nitrate
- B ammonium phosphate
- C potassium chlorate
- D sodium nitrite

50. Which gas is responsible for the earth's greenhouse effect?

- A carbon dioxide
- B ozone
- C carbon monoxide
- D methane

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The volume of one mole of gas at room temperature and pressure (r.t.p.) is 24,000 cm³ and at standard temperature and pressure (s.t.p.) is 22,400 cm³.

The Periodic Table of the Elements

		Group										
		II	III	IV	V	VI	VII	0				
1	H Hydrogen											
2	He Helium											
3	Li Lithium											
4	Be Beryllium											
5	B Boron	11 B Boron	12 C Carbon	13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon			
6	C Carbon											
7	N Nitrogen											
8	O Oxygen											
9	F Fluorine											
10	Ne Neon											
11	Na Sodium											
12	Mg Magnesium											
13	Al Aluminum											
14	Si Silicon											
15	P Phosphorus											
16	S Sulfur											
17	Cl Chlorine											
18	Ar Argon											
19	K Potassium											
20	Ca Calcium											
21	Sc Scandium											
22	Ti Titanium											
23	V Vanadium											
24	Cr Chromium											
25	Mn Manganese											
26	Fe Iron											
27	Co Cobalt											
28	Ni Nickel											
29	Cu Copper											
30	Zn Zinc											
31	Ga Gallium											
32	Ge Germanium											
33	As Arsenic											
34	Se Selenium											
35	Br Bromine											
36	Kr Krypton											
37	Rb Rubidium											
38	Sr Strontium											
39	Y Yttrium											
40	Zr Zirconium											
41	Nb Niobium											
42	Mo Molybdenum											
43	Tc Technetium											
44	Ru Ruthenium											
45	Rh Rhodium											
46	Pd Palladium											
47	Ag Silver											
48	Cd Cadmium											
49	In Indium											
50	Tl Thallium											
51	Pb Lead											
52	Hg Mercury											
53	Tl Thallium											
54	Pb Lead											
55	Ba Barium											
56	La Lanthanum											
57	Ce Cerium											
58	Pr Praseodymium											
59	Nd Neodymium											
60	Pm Promethium											
61	Sm Samarium											
62	Eu Europium											
63	Gd Gadolinium											
64	Tb Terbium											
65	Dy Dysprosium											
66	Ho Holmium											
67	Er Erbium											
68	Tm Thulium											
69	Yb Ytterbium											
70	Lu Lutetium											
71	Hf Hafnium											
72	Ta Tantalum											
73	W Tungsten											
74	Re Rhenium											
75	Os Osmium											
76	Ir Iridium											
77	Pt Platinum											
78	Au Gold											
79	Hg Mercury											
80	Tl Thallium											
81	Pb Lead											
82	Bi Bismuth											
83	Po Polonium											
84	At Astatine											
85	Rn Radon											
86	Ra Radium											
87	Ac Actinium											
88	Th Thorium											
89	Pa Protactinium											
90	U Uranium											
91	Np Neptunium											
92	Pu Plutonium											
93	Am Americium											
94	Cm Curium											
95	Bk Berkelium											
96	Cf Californium											
97	Es Einsteinium											
98	Fm Fermium											
99	Md Mendelevium											
100	No Nobelium											
101	Lr Lawrencium											
102	Lu Lutetium											
103	Hf Hafnium											
104	Ta Tantalum											
105	W Tungsten											
106	Re Rhenium											
107	Os Osmium											
108	Ir Iridium											
109	Pt Platinum											
110	Au Gold											
111	Hg Mercury											
112	Tl Thallium											
113	Pb Lead											
114	Bi Bismuth											
115	Po Polonium											
116	At Astatine											
117	Rn Radon											
118	Ra Radium											
119	Ac Actinium											
120	Th Thorium											
121	Pa Protactinium											
122	U Uranium											
123	Np Neptunium											
124	Pu Plutonium											
125	Am Americium											
126	Cm Curium											
127	Bk Berkelium											
128	Cf Californium											
129	Es Einsteinium											
130	Fm Fermium											
131	Md Mendelevium											
132	No Nobelium											
133	Lr Lawrencium											

anthanoid series
Actinoid series

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

X

1. A student tries to make four gases. He wants to collect them in gas jars over water.

Which of the gases will he not be able to collect?

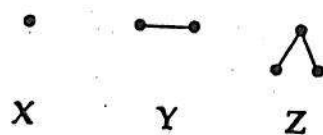
- A ammonia
- B chlorine
- C hydrogen
- D oxygen

2. A student wishes to remove the cloudiness from limewater. He also wants to separate the colours from red rose petals.

Which letter below correctly shows the methods he must use?

	removal of cloudiness from lime-water	separation of colours from red rose petals
A	distillation	filtration
B	chromatography	distillation
C	filtration	chromatography
D	sublimation	distillation

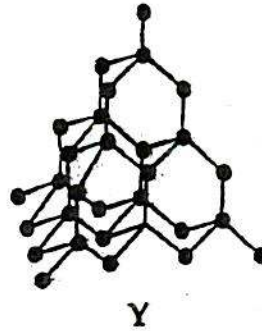
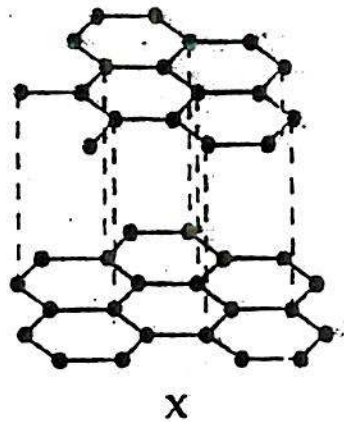
3. The diagrams show models of molecules.



Which substances could the models represent?

	X	Y	Z
A	helium	chlorine	water
B	helium	hydrogen chloride	methane
C	hydrogen	chlorine	water
D	hydrogen	hydrogen chloride	methane

4. The diagrams show the structures of two forms, X and Y, of a solid element.



What are suitable uses of X and Y, based on their structures?

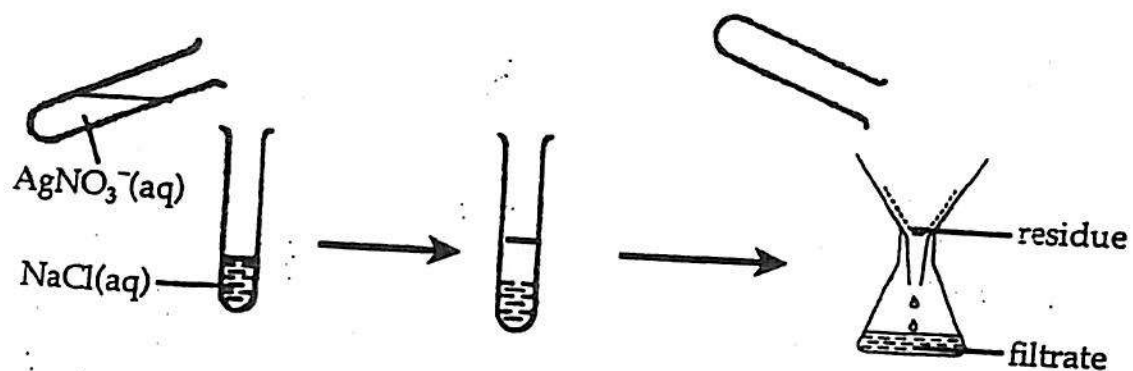
	use of solid X	use of solid Y
A	drilling	drilling
B	drilling	lubricating
C	lubricating	drilling
D	lubricating	lubricating

5. Enzymes are used in some washing powders.

How would a chemist classify enzymes used for this purpose?

- A a biological catalyst
- B a bleaching agent
- C a type of detergent
- D a type of salt

Use the information in the diagram to answer questions 6 and 7.



The two solutions react completely, to give a solid and a solution.

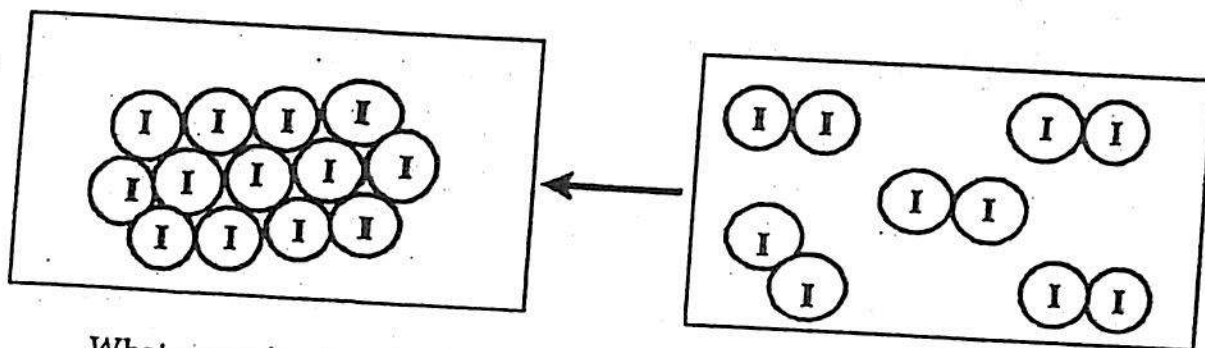
6. What is the residue in the filter paper?

- A $\text{NaNO}_3(\text{s})$
- B $\text{AgCl}(\text{s})$
- C $\text{NaNO}_3(\text{aq})$
- D $\text{AgCl}(\text{aq})$

7. What is the filtrate in the beaker?

- A sodium chloride
- B silver chloride
- C sodium nitrate
- D silver nitrate

8. The diagram shows particles changing phases.



What name is given to the phase change occurring to the iodine molecules?

- A sublimation
- B melting
- C condensation
- D boiling

9. The particles in a liquid and the particles in a gas behave differently. Compared to the particles in a gas at the same temperature, the particles in a liquid

- A fill the container they occupy more completely.
- B have a less regular arrangement.
- C have stronger forces of attraction between them.
- D move faster.

10. When a solid dissolves in water, which observation suggests that the process is endothermic?

- A The solution gives off a gas.
- B The solution changes colour.
- C The temperature of the solution decreases.
- D The temperature of the solution increases.

11. Compared to the charge and mass of a proton, an electron has

- A the same charge and a smaller mass.
- B the same charge and the same mass.
- C an opposite charge and a smaller mass.
- D an opposite charge and the same mass.

Use the list of compounds to answer questions 12 to 14. These compounds may be used once, more than once or not at all.

- A sulphur dioxide
- B phosphoric acid
- C carbonic acid
- D potassium nitrate

Which compound

12. is an acid anhydride;

A B C D

13. is used to make detergent;

A B C D

14. has a molecular formula containing the fewest oxygen atoms?

A B C D

15. Which chemical concept is used to explain the effect of temperature on rates of reaction?
- A Atomic Theory
 - B Boyle's Law
 - C Charles' Law
 - D Kinetic Theory
16. Which gas would diffuse through an air-filled pipe at the same rate as carbon dioxide, $M_r = 44$?
- A hydrogen chloride
 - B hydrogen gas
 - C nitrogen gas
 - D propane
17. Which element has an allotrope that is electrically conductive?
- A carbon
 - B chlorine
 - C oxygen
 - D sulphur
18. Which pair contains two particles with the same electronic configuration?
- A atoms of oxygen and fluorine
 - B cations of calcium and magnesium
 - C hydrogen cation and helium atom
 - D ions of potassium and chlorine
19. Which represents the electronic configuration of the sodium atom?
- A 1, 1
 - B 1, 3
 - C 2, 8, 1
 - D 2, 8, 8, 1

20. Which part of the Periodic Table contains the element copper?

- A alkali earth metals
- B alkali metals
- C noble gases
- D transition metals

21. Which statements are correct about elements in Group VIII of the Periodic Table?

- 1 Their atoms all have equal numbers of protons and neutrons.
- 2 They are all less reactive than nitrogen.
- 3 The valency shells of their atoms are all full of electrons.

- A 1 and 2
- B 1 and 3
- C 2 and 3
- D 1, 2 and 3

22. All the Group II elements react with all dilute acids to give the same gas as a product.

Which gas will be given off when a Group II element reacts with dilute chloric acid HClO_3 ?

- A oxygen
- B hydrogen
- C chlorine
- D carbon dioxide

23. Which line correctly shows the trend in the numbers of particles in the atoms of the elements of Period II of the Periodic Table, going from left to right?

	protons	electrons	neutrons
A	decrease by one	decrease by one	decrease by one
B	increase, but varies	increase, but varies	decrease, but varies
C	increase by one	increase, but varies	increase by one
D	increase by one	increase by one	increase, but varies

24. What is the atomic number of an ion with 5 protons, 6 neutrons and a charge of +3?
- A 1
 - B 3
 - C 5
 - D 6
25. What is the mass number of an atom, which contains 28 protons, 28 electrons and 31 neutrons?
- A 28
 - B 56
 - C 59
 - D 87
26. Which listed atom in the Periodic Table has the greatest ability to attract electrons?
- A silicon
 - B sulphur
 - C nitrogen
 - D chlorine
27. Which element is extracted from its ore using the Blast Furnace process?
- A aluminium
 - B iron
 - C sodium
 - D sulphur
28. What does a solution consist of?
- A a solvent and a solute
 - B a filtrate and a residue
 - C crystals and hydrates
 - D solids and liquids

The list identifies the symbols of four elements. Use the list to answer questions 29 to 31. The choices may be used once, more than once or not at all.

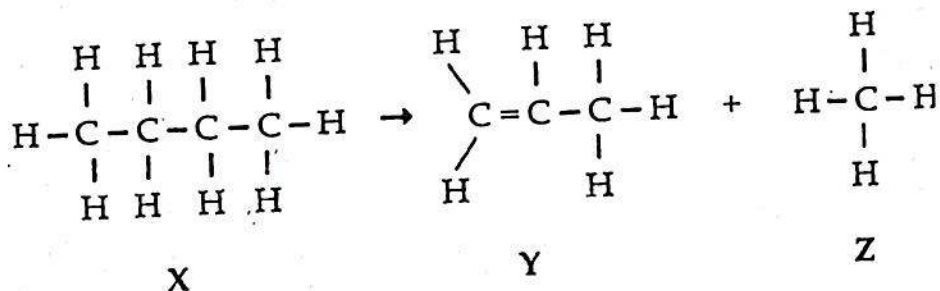
- A Ca
- B S
- C Fe
- D N

Which element

29. is in all proteins; A B C D
30. can form cations with different valences; A B C D
31. is an industrial catalyst? A B C D
32. Which element can usually be found in nature in a free (uncombined) state?

- A aluminium
- B barium
- C calcium
- D gold

33. The equation shows the cracking of a hydrocarbon.

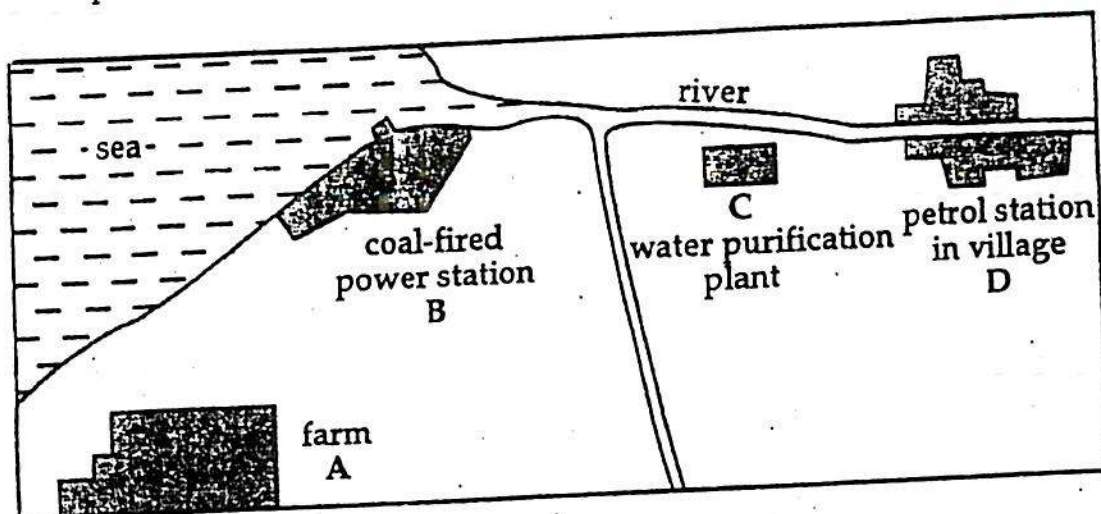


Which molecule or combinations of molecules is unsaturated?

- A X only
- B Y only
- C X and Z
- D Y and Z

34. Which compound contains 40.0% oxygen by mass?
- A CaO
 - B NaOH
 - C CO
 - D Fe₂O₃
35. What is the empirical formula of the compound with a formula of P₄O₁₀?
- A PO
 - B PO₂
 - C P₂O₅
 - D P₈O₂₀
36. What is the mass of one mole of K₂CO₃?
- A 138 g
 - B 106 g
 - C 99 g
 - D 67 g
37. What is the formula of a compound formed by an alkaline-earth metal, M, and a halogen, X?
- A MX
 - B MX₂
 - C M₂X
 - D M₂X₃

38. Which place on the map is most likely to be producing large quantities of sulphur dioxide?



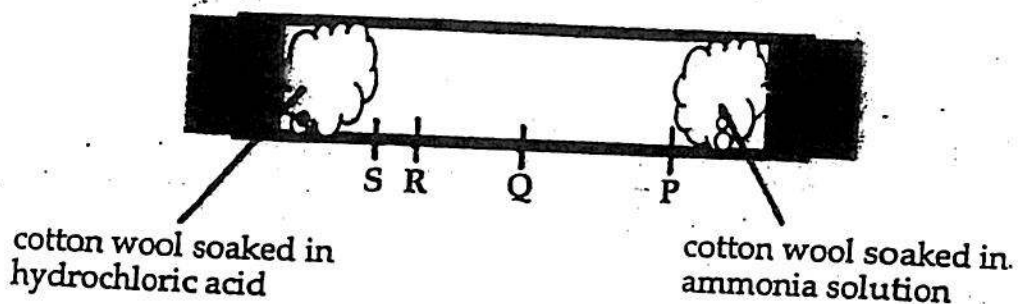
39. Which functional group is responsible for a compound being classified as an organic alcohol?

- A $-\text{COOH}$
- B $-\text{CH}_2\text{OH}$
- C $-\text{CH}_2\text{SH}$
- D $-\text{CHO}$

40. Which compound is correctly named?

- A NaOH (aq) , lye
- B HCl (g) , hydrochloric acid
- C CuO (s) , copper(I) oxide
- D CaO (s) , limestone

Two pieces of cotton wool, one soaked in hydrochloric acid, and the other soaked in concentrated ammonia solution, were placed at the ends of a glass tube which was then stoppered as shown.

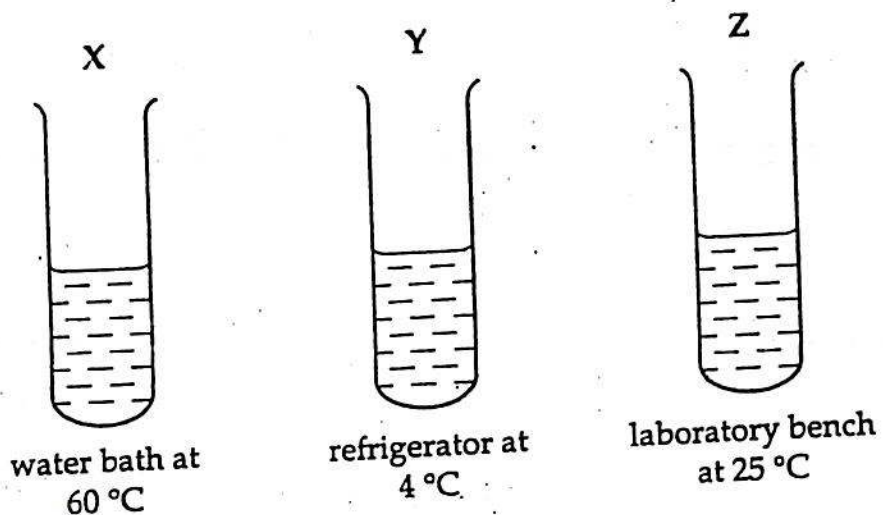


When the gases diffuse from each piece of cotton wool a white ring of ammonium chloride forms in the tube.

Use this information to answer questions 41 and 42.

41. What is the correct formula for ammonium chloride?
- A NH_3Cl
 - B NH_3Cl_2
 - C NH_4Cl
 - D NH_4Cl_2
42. At which point, marked on the tube, will the white ring of ammonium chloride most likely form?
- A P
 - B Q
 - C R
 - D S
43. What happens according to this redox reaction?
- $$2 \text{Mg} + \text{O}_2 \rightarrow 2 \text{MgO}$$
- A Mg is oxidized and acts as an oxidizing agent
 - B Mg is oxidized and acts as a reducing agent
 - C MgO is oxidized and acts as an oxidizing agent
 - D O_2 is oxidized and acts as a reducing agent

Three samples of the same sized marble chips are placed in three test-tubes, X, Y and Z with the same amount and concentration of hydrochloric acid. Additional conditions for each test-tube are included with each diagram.

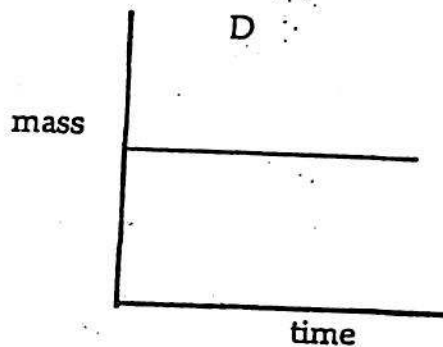
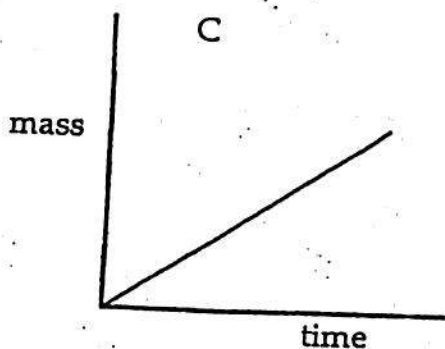
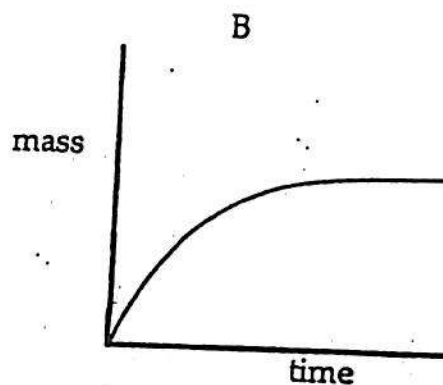
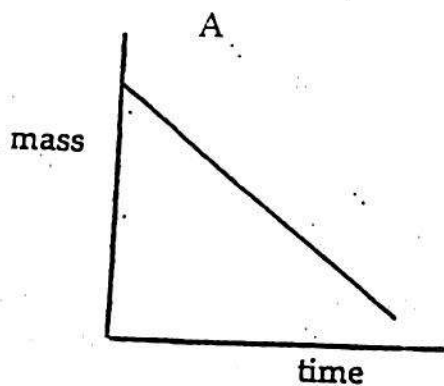


44. What is the correct order for the rates of reaction with the fastest rate first?

- A X, Y, Z
- B Y, Z, X
- C Z, X, Y
- D X, Z, Y

45. The mass of a catalyst was monitored throughout a reaction and the results plotted on a graph.

Which graph represents the correct relationship of mass against time?

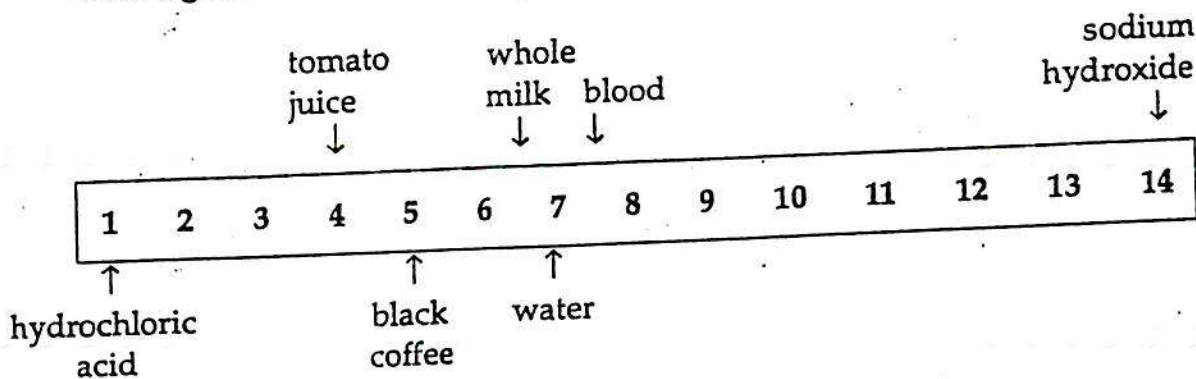


46. Which is a property of all reversible reactions that have reached equilibrium?

- A the amount of products exceeds the amount of reactants
- B the amount of products is equal to the amount of reactants
- C the forward reaction rate exceeds the backward reaction rate
- D the forward and backward reaction rates are equal

Use the diagram to answer questions 47 to 49.

The diagram shows the locations of some substances on the pH scale.



47. Which of the named substances is nearest to being neutral?

- A black coffee
- B whole milk
- C sodium hydroxide
- D tomato juice

48. Which listed substance exhibits the greatest acidity?

- A black coffee
- B blood
- C sodium hydroxide
- D tomato juice

49. Which substance would cause the Universal Indicator to turn dark blue?

- A sodium hydroxide
- B tomato juice
- C milk
- D hydrochloric acid

50. Which gas is responsible for the green-house effect?

- A carbon monoxide
- B carbon dioxide
- C sulphur dioxide
- D sulphur trioxide