[92/237]

1979

SCOTTISH CERTIFICATE OF EDUCATION

CHEMISTRY

Higher Grade—PAPER I

Thursday, 10th May—9.30 a.m. to 11.00 a.m.

READ CAREFULLY

1. **Check that the answer sheet provided is made out in your name and is for Chemistry.**
2. **Fill in the details required in the answer sheet. (This is needed for checking purposes.)**
3. **In this paper a question is answered by indicating the choice A, B, C or D (or E in the case of questions 49 and 50) by a stroke made with a pencil in the appropriate place in the answer sheet—see the sample question below.**
4. **For each question choose ONE answer which you think is correct.**
5. **Reference may be made to the booklet of Mathematical Tables and Science Data provided.**
6. **Rough working, if required, should be done only on this question paper, NOT on the answer sheet.**

SAMPLE QUESTION

To show that the ink in a ball-point pen consists of a mixture of dyes the method of separation would be

A fractional distillation

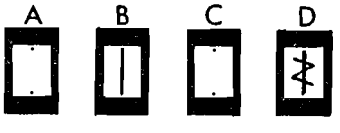
B chromatography

C fractional crystallisation

D filtration.

The correct answer is **B**—chromatography. A **heavy** vertical line should be drawn joining the two dots in the appropriate box in the column headed **B** as shown in the example on the answer sheet.

If after you have recorded your answer you decide that you have made an error and wish to make a change you should cancel the original answer and put a vertical stroke in the box you now consider to be correct. Thus if you want to change an answer **D** to an answer **B** your answer sheet would look like this:



If you want to change back to an answer which has already been scored out you should completely erase all marking with a rubber and re-mark your choice.

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1. How is a very reactive metal likely to be obtained commercially?

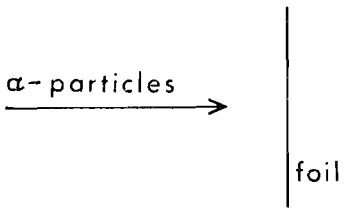
A The native metal would be purified.

B The ore would be roasted in air.

C The ore would be melted and electrolysed.

D The ore would be heated with coke.

2. When fast-moving alpha-particles are projected at thin gold foil as shown below, a few of them undergo a considerable deflection.



Which of the following most precisely describes what happens?

A They bounce off the surface of the foil.

B They collide with other alpha-particles.

C They are deflected by ions in the gold.

D They are deflected by the atomic nuclei in the gold.

3. Consider the following.

Particle	*Protons*	*Neutrons*	*Electrons*
P	26	30	23
Q	26	30	24
R	26	31	24
S	27	31	25

Which two are different oxidation (valency) states of the same isotope?

A P and Q

B Q and R

C R and S

D P and R

4. Which one of the following statements **must** be correct concerning the number of neutrons in an atom of **any** element?

A It is the same as the atomic number of the element.

B It is the same for all atoms of the element.

C It is less than the mass number of any atom of the element.

D It is less than the number of electrons in an atom of the element.

5. A positively charged particle with electronic configuration 2,8 could be

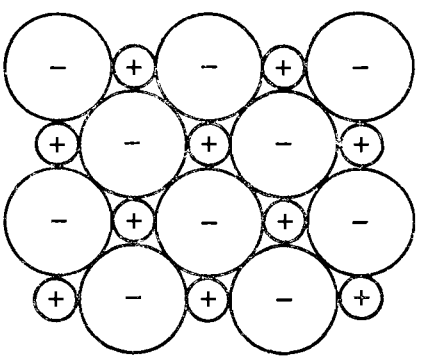
A a fluoride ion

B an aluminium ion

C a sodium atom

D a neon atom.

6. In the diagram below each sphere represents a particle about the size of an atom and the sign indicates the charge on the particle.



In which one of the following substances would the above model be a reasonable representation of the way the fundamental particles are arranged in the crystal?

A Diamond

B Carbon tetrabromide

C Calcium fluoride

D Lithium bromide

7. The electrical conductivities of which pair of solutions shown below should be measured in order to compare the mobilities of $H^+(aq)$ and $Na^+(aq)$?

A M/2 hydrochloric acid and M sodium chloride

B M hydrochloric acid and M sodium hydroxide

C M nitric acid and M sodium nitrate

D M/2 sulphuric acid and M sodium sulphate

8. A metal (melting point 98 °C, density 0·97 g cm^{-3}) was obtained by electrolysis of its molten chloride (melting point 804 °C, density 2·2 g cm^{-3}). During the electrolysis, in which of the following states would the metal occur?

A As a solid on the surface of the electrolyte

B As a liquid on the surface of the electrolyte

C As a solid at the bottom of the electrolyte

D As a liquid at the bottom of the electrolyte

9. 64 g of copper is added to 1 litre of M silver nitrate solution. Which one of the following statements represents one of the results of this action?

A The resulting solution is colourless.

B All the copper dissolves.

C 64 g of silver is displaced.

D 1 mole of silver is displaced.

10. Which one of the following statements about hydrogen chloride is true?

A It is a weak acid in dilute solution.

B Its molecules are polar covalent.

C It is insoluble in organic solvents.

D It is used industrially to produce sodium chloride.

11. An element conducts electricity. When it is burned in oxygen and the product is added to water the resulting solution has a pH greater than 7.

The element could be

A carbon

B sodium

C sulphur

D aluminium.

12. What minimum volume of 4 M hydrochloric acid is required to dissolve 0·1 mole of magnesium according to the following equation?

$$Mg + 2H^+ \rightarrow Mg^{2+} + H_2$$

A 25 cm^3

B 50 cm^3

C 100 cm^3

D 200 cm^3

13. Which one of the following reactions would **NOT** produce sulphur dioxide?

A Burning sulphur in air

B Adding dilute sulphuric acid to sodium sulphate

C Adding dilute hydrochloric acid to sodium sulphite

D Roasting iron sulphide in air

14. If one mole of sodium hydroxide was added to one mole of sulphurous acid the salt formed would be

A sodium sulphite

B sodium sulphide

C sodium hydrogensulphate

D sodium hydrogensulphite.

15. An aqueous solution X was tested as follows.

(*a*) Adding dil. HCl produced no visible reaction.

(*b*) Adding $BaCl_2$ + HCl produced a white precipitate.

Which of the following conclusions best fits these observations?

Solution X contains

A chloride but no sulphate ions

B sulphate but no chloride ions

C chloride but no carbonate ions

D sulphate but no carbonate ions.

16. Dilute sulphuric acid (2 M) is dropped on to a mixture of magnesium and magnesium carbonate. Which one of the following would be the most likely composition of the gas evolved?

A Carbon dioxide only

B Hydrogen only

C Hydrogen and carbon dioxide

D Carbon dioxide and sulphur dioxide

[Turn over

17. If 0·1 mole of equally fine granules of the following metals were reacted with equal volumes of excess 2 M hydrochloric acid, which one should give off the most hydrogen?

A Aluminium

B Magnesium

C Lithium

D They should all give off the same volume.

18. Which one of the following does **NOT** apply to carbon monoxide? (You may wish to refer to page 36 of the Data Book.)

A It is easily liquefied.

B It is less dense than air.

C It is a powerful reducing agent.

D It combines with haemoglobin in blood.

19. Hydrochloric acid solution and nitric acid solution are poured into separate beakers. Which one of the following substances will react with only **ONE** of the two acid solutions?

A Magnesium

B Copper

C Lead carbonate

D Calcium oxide

20. Sparks were passed through some ammonia gas which had been collected in a tube over liquid paraffin. What happened to the level of the liquid paraffin?

A It rose because the products occupied a smaller volume than the ammonia.

B It fell because the products occupied a larger volume than the ammonia.

C It remained at the same level.

D It rose because one of the products dissolved in the liquid paraffin.

21. When a certain gas is bubbled through dilute hydrochloric acid the pH increases. The gas could be

A hydrogen

B ammonia

C carbon monoxide

D sulphur dioxide.

22. The reaction

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$$

is an example of

A photosynthesis

B hydrolysis

C combustion

D hydration.

23. The action of digestive enzymes on fats is an example of

A hydrolysis

B hydrogenation

C dehydration

D dehydrogenation.

24. Which one of the following compounds would liberate 1 mole of hydrogen gas when 1 mole of it reacts with 2 moles of sodium?

A C_2H_5OH

B CH_2OHCH_2OH

C CH_3COOH

D CH_3CHO

25. Which one of the following properties identifies a substance as a thermosetting polymer?

A It is resoftened on heating.

B It is a straight chain hydrocarbon.

C It is formed by addition polymerisation.

D None of these.

Questions 26 and 27 refer to the following four classes of polymers.

A Natural addition polymers

B Natural condensation polymers

C Synthetic addition polymers

D Synthetic condensation polymers

Place each of the following in its appropriate class.

26. Glycogen.

27. Polypropene.

28. Hydrogen has two main isotopes.

Isotope	*Symbol*	*Mass number*	*Atomic number*
Hydrogen	H	1	1
Deuterium	D	2	1

In a mass spectrometer, hydrogen gas containing the isotope deuterium produced five gaseous ions:

H^+, D^+, HD^+, H_2^+, and D_2^+ .

Which pair of lines in the spectrum will overlap?

A H^+ and D^+

B H_2^+ and D_2^+

C H_2^+ and D^+

D H_2^+ and HD^+

29. Naturally occurring nitrogen consists of two isotopes ^{14}N and ^{15}N. How many types of stable nitrogen molecules will occur in the air?

A 1

B 2

C 3

D 4

30. Radioactive $^{14}_{6}C$ decays by beta-particle emission. Which statement is true of the new nucleus produced?

A It has mass number 13.

B It has 6 protons.

C It has 7 neutrons.

D It is a carbon nucleus.

31. Which has the largest volume at s.t.p.?

A 1 g hydrogen

B 14 g nitrogen

C 20 g neon

D 35·5 g chlorine

32. If a steady current of 0·4 A was passed through molar silver nitrate solution for 40 minutes how many moles of silver would be liberated?

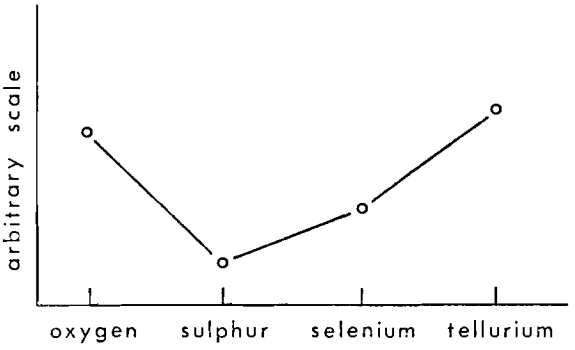
A 0·001

B 0·01

C 0·1

D 1

33. Which one of the following properties of the Group VI elements, or their compounds, would most likely be represented by the graph below?



A Natural abundance of the element

B Ease of formation of chains of atoms of the element

C The melting point of the element

D The boiling point of the hydride

34. From the information given below

$C(s) + O_2(g) \rightarrow CO_2(g)$; $\triangle H = -395$ kJ mol^{-1}

$CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$; $\triangle H = -282$ kJ mol^{-1}

what is the heat of formation of carbon monoxide?

A $+113$ kJ mol^{-1}

B -113 kJ mol^{-1}

C -677 kJ mol^{-1}

D $-197{\cdot}5$ kJ mol^{-1}

35. When 25 cm^3 of 2·0 M HCl was added to 25 cm^3 of 1·0 M NaOH, a rise in temperature of 5 °C was noted.

Which one of the following would give a greater rise in temperature?

A 25 cm^3 1·0 M HCl + 25 cm^3 1·0 M NaOH

B 25 cm^3 4·0 M HCl + 25 cm^3 1·0 M NaOH

C 25 cm^3 1·0 M HCl + 25 cm^3 2·0 M NaOH

D 25 cm^3 2·0 M HCl + 25 cm^3 2·0 M NaOH

[Turn over

36. Given the equations:

$Mg(s) + 2H^+(aq) \rightarrow Mg^{2+}(aq) + H_2(g)$ $\triangle H = a\ J\ mol^{-1}$

$Zn(s) + 2H^+(aq) \rightarrow Zn^{2+}(aq) + H_2(g)$ $\triangle H = b\ J\ mol^{-1}$

$Mg(s) + Zn^{2+}(aq) \rightarrow Mg^{2+}(aq) + Zn(s)$ $\triangle H = c\ J\ mol^{-1}$

then, according to Hess's Law

A $a - b = c$

B $a + b = c$

C $a + c = b$

D $a - c = b$

Questions 37 and 38 refer to the following types of structure:

A Three dimensional ionic lattice

B Three dimensional covalently linked structure

C Three dimensional structure of molecules linked by hydrogen bonds

D Linear polymeric structure, linked by van der Waal's forces

Which of these best describes the structure of

37. Ice.

38. Silicon dioxide.

39. Excess of 1 M hydrochloric acid is added to one of two identical samples of copper carbonate and an equal volume of 1 M sulphuric acid is added to the other. All other conditions are the same. Which of the following is different for the two reactions?

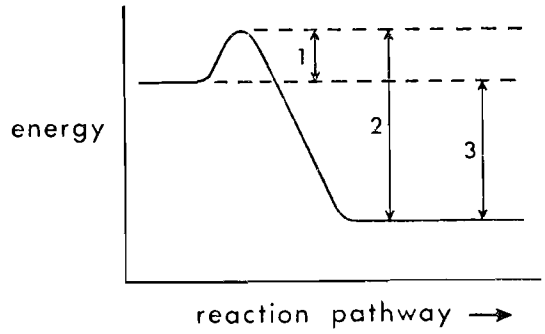
A The mass of copper carbonate dissolved

B The volume of gas liberated

C The mass of water formed

D The hydrogen ion concentration of the remaining solution

40.



Which of the following correctly represents the activation energy (E_a) and the enthalpy change ($\triangle H$) in the diagram above?

	E_a	$\triangle H$
A	2	3
B	1	2
C	1	3
D	2	1

41. Excess sodium chloride was shaken with water, giving a saturated solution with some solid sodium chloride on the bottom of the container. This system is in equilibrium, thus:

$$NaCl(s) \rightleftharpoons Na^+(aq) + Cl^-(aq)$$

What will happen if HCl(g) is passed through the solution?

A Chlorine gas will form.

B The pH will rise.

C Some sodium chloride will crystallise out.

D Some solid sodium chloride will dissolve.

42. The results of an experiment carried out at 19 °C involving the reaction between equal volumes of 0·5 M nitric acid and sodium thiosulphate solution of different concentrations are shown below:

Concentration of sodium thiosulphate solution	$\frac{M}{2}$	$\frac{M}{4}$	$\frac{M}{8}$	$\frac{M}{16}$
Time in seconds for the appearance of sulphur	13	25	51	104

On the evidence of these results alone, which of the following is correct?

A The more concentrated the thiosulphate solution, the longer the time before the sulphur appears.

B The more concentrated the nitric acid, the faster the reaction proceeds.

C The more concentrated the thiosulphate solution, the faster the reaction proceeds.

D The higher the temperature, the faster the reaction proceeds.

43. Which one of the following compounds is **NOT** an isomer of heptane?

A 2-methylhexane

B 2,2-dimethylpentane

C 2,3-dimethylbutane

D 2,3-dimethylpentane

44. Which hydrocarbon is **NOT** a member of the same homologous series as the others?

formula weight

A 44

B 72

C 84

D 100

45. Which of the following when added to water will **NOT** give a solution of pH greater than 7?

A Chloroethane

B Calcium hydride

C Ethylamine

D Sodium hydroxide

46. Which one of the following statements is true?

A Benzene has the same empirical formula as ethyne.

B Benzene contains more elements than ethyne.

C Benzene is more volatile than ethyne.

D Benzene undergoes addition reactions more readily than ethyne.

47. During the addition of magnesium granules to an excess of dilute hydrochloric acid, each of the following were measured and plotted against time on a graph.

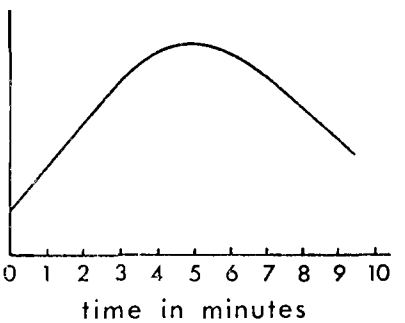
A Temperature of solution

B Volume of hydrogen produced

C pH of solution

D Conductivity of solution

If the reaction is complete in five minutes, which of the above, when plotted against time, would give a graph like the one below?



48. Three unlabelled bottles contain samples of 0·5 M hydrochloric, sulphuric and nitric acids. Which of the following procedures will positively identify them?

A Test with pH paper.

B Electrolyse and test the gases evolved.

C Add each to barium chloride solution, then add silver nitrate solution to acids which give no positive reaction.

D Measure the volume of 1 M sodium hydroxide solution required to neutralise 20 cm^3 samples of each acid.

[Turn over

In questions 49 and 50 more than one response may be correct.

Answer

A if responses 1, 2 and 3 are correct,

B if responses 1 and 3 are correct,

C if responses 2 and 4 are correct,

D if response 4 only is correct,

E if some other response or combination of responses is correct.

49. Radioactive calcium would differ from ordinary (non-radioactive) calcium in its

1 chemical properties

2 atomic number

3 electronic configuration

4 atomic weight.

50. In which of the following reaction(s) will the volume of the gaseous products be half that of the reactants, all measurements being made at s.t.p.?

1 $C + O_2 \rightarrow CO_2$

2 $N_2 + O_2 \rightarrow 2NO$

3 $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

4 $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

[END OF QUESTION PAPER]