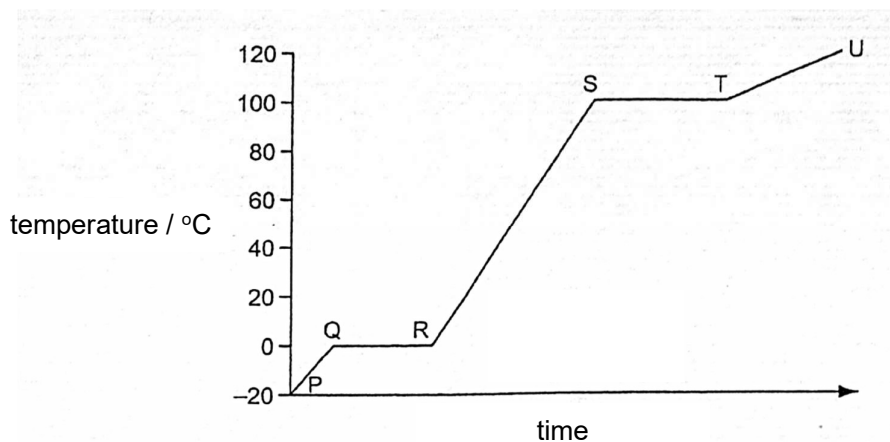


4E Chemistry Preliminary Examination 2024 Paper 1 Answers

1	2	3	4	5	6	7	8	9	10
B	B	A	A	D	A	C	C	B	B
11	12	13	14	15	16	17	18	19	20
A	C	B	D	D	A	A	B	D	D
21	22	23	24	25	26	27	28	29	30
C	D	A	A	A	D	A	D	A	A
31	32	33	34	35	36	37	38	39	40
C	B	D	C	D	B	C	D	C	A

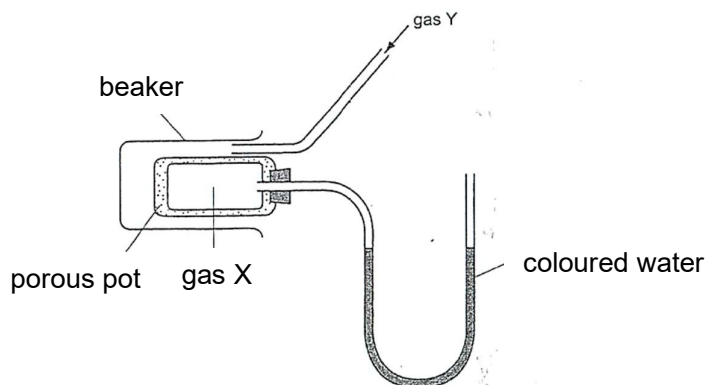
- 1 The graph shows the change in temperature with time when ice at -20°C is heated to 120°C .



Which row shows the correct change taking place between the points?

	points	change
A	P to Q	average energy of particles remain constant
B	Q to R	ice melting
C	R to S	the volume of steam is increasing
D	T to U	water boiling

- 2 The apparatus can be used to show the diffusion of gases.



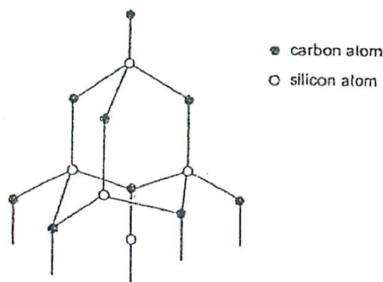
Which pair of gases X and Y would cause **no** movement of the coloured water?

	X	Y
A	C_2H_4	C_2H_6
B	C_2H_4	N_2
C	CO_2	C_2H_6
D	CO	NO_2

- 3 Which apparatus is most suitable to measure 27.8 cm^3 of a solution?

- A** burette
- B** beaker
- C** pipette
- D** measuring cylinder

- 4 Which mixture can be separated into its components by adding water, stirring and filtering?
- A calcium carbonate and sodium chloride
 - B magnesium and iron
 - C sodium chloride and copper(II) sulfate
 - D sulfuric acid and hydrochloric acid
- 5 Which ion has the most number of shells that contain electrons?
- A Al^{3+}
 - B Be^{2+}
 - C N^{3-}
 - D S^{2-}
- 6 The relative atomic mass of naturally occurring chlorine is **not** a whole number. What is the reason for this?
- A Chlorine atoms can have different numbers of neutrons.
 - B Chlorine is unstable.
 - C Naturally occurring chlorine cannot be obtained pure.
 - D The mass of the electrons has been included.
- 7 Which statement explains why potassium chloride, KCl , has a lower melting point than calcium oxide, CaO ?
- A Potassium chloride is covalent but calcium oxide is ionic.
 - B Potassium is more reactive than calcium.
 - C The attraction between the potassium ions and chloride ions is weaker than that between the calcium ions and oxide ions.
 - D The melting point of potassium is lower than that of calcium.
- 8 The diagram shows the structure of a compound of carbon and silicon, $(\text{SiC})_n$.



What will be a property of $(\text{SiC})_n$?

- A acts as a lubricant
 - B conducts electricity
 - C insoluble in water
 - D low melting point
- 9 The element R has three electrons in its outer shell. What is the formula of the oxide of element R?
- A RO_3
 - B R_2O_3
 - C R_2O_5
 - D R_3O_2

- 10** Over 71 000 kg of oil-soaked sand was scooped up from the three Sentosa beaches, one day after tonnes of fuel leaked into the sea from an oil spill. The contaminated sand was sent to an industrial waste processing facility.

The oily sand is fed into a thermal desorption unit and heated up to 600°C. The resulting vapour of oil and water is collected and stored separately.

The treated sand is then reused as sandbags for flood control.

What is the reason that the sand can withstand heating up to 600°C in the thermal desorption unit?

- A** Sand is a mixture of different minerals that undergo chemical reactions at high temperatures.
 - B** Sand is composed mainly of silicon dioxide, which forms strong covalent bonds with a very high melting point.
 - C** Sand contains minerals that vaporise at high temperatures, leaving behind clean sand.
 - D** Sand has a crystalline structure with weak intermolecular forces that allows it to resist heat.
- 11** What is the ratio of the volume of 4 g of hydrogen to the volume of 32 g of methane, both volumes at r.t.p.?
- A** 1 to 1
 - B** 1 to 2
 - C** 1 to 8
 - D** 2 to 1
- 12** A beaker contains 15 cm³ of 0.3 mol/dm³ sulfuric acid.
- Which volume of 0.3 mol/dm³ sodium hydroxide must be added to exactly neutralise all the acid?
- A** 12 cm³
 - B** 15 cm³
 - C** 30 cm³
 - D** 45 cm³
- 13** How many moles of iron can be extracted from 116 g of Fe₃O₄?
- A** 1.0 mol
 - B** 1.5 mol
 - C** 2.0 mol
 - D** 3.0 mol
- 14** What is the mass of water produced when 32 g of oxygen reacts with 6 g of hydrogen?
- A** 1 g
 - B** 2 g
 - C** 18 g
 - D** 36 g

15 The following statements about dilute sulfuric acid are all correct.

- 1 A white precipitate is formed when aqueous barium chloride is added.
- 2 The solution turns anhydrous copper(II) sulfate from white to blue.
- 3 Addition of Universal Indicator shows that the solution has a pH value of less than 7.0.
- 4 The solution reacts with copper(II) oxide forming a blue solution.

Which statement confirms the acidic nature of the solution?

- A** 1 and 2
B 1 and 3
C 2 and 4
D 3 and 4

16 Which ionic equation represents the neutralisation of aqueous sodium hydroxide with dilute nitric acid?

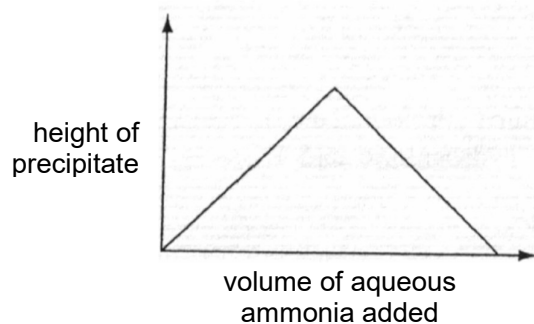
- A** $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$
B $\text{Na}^+ + \text{NO}_3^- \rightarrow \text{NaNO}_3$
C $\text{Na}^+ + \text{HNO}_3 \rightarrow \text{NaNO}_3 + \text{H}^+$
D $\text{NaOH} + \text{H}^+ \rightarrow \text{Na}^+ + \text{H}_2\text{O}$

17 A white solid is often seen around the stoppers of bottles containing sodium hydroxide solution.

Which substance has reacted with sodium hydroxide to form the solid?

- A** carbon dioxide in the air
B glass
C oxygen in the air
D water in the solution

18 An aqueous solution of a salt, Y, is placed in a test tube and aqueous ammonia is gradually added. The height of the precipitate in the test tube is plotted against the volume of aqueous ammonia solution added.



What is Y?

- A** aluminium sulfate
B copper(II) sulfate
C iron(II) sulfate
D lead(II) nitrate

- 19 When heated, solid W gives off a gas. When this gas is bubbled through limewater, a white precipitate is formed.

The residue after heating solid W reacts with dilute acid and also with aqueous alkali.

What is W?

- A copper(II) carbonate
- B magnesium carbonate
- C sodium carbonate
- D zinc carbonate

- 20 A student carried out the following series of tests on an aqueous solution of sodium carbonate and recorded his results in the table below.

Which test should be repeated because of an **incorrect** observation entered in the table?

	test	observation
A	add barium chloride solution	white precipitate formed
B	add copper(II) sulfate solution	blue precipitate formed
C	add dilute hydrochloric acid	effervescence occurred
D	add sodium hydroxide solution	white precipitate formed

- 21 When testing for a chloride ion using silver nitrate, the solution must be acidified with dilute nitric acid.

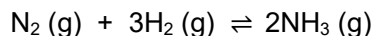
What is the purpose of the nitric acid?

- A to act as a catalyst
- B to oxidise the chloride ion
- C to prevent precipitation of silver carbonate
- D to prevent the decomposition of any silver chloride formed

- 22 Which method would **not** produce ammonia?

- A heating concentrated aqueous ammonia
- B heating ammonium chloride with calcium hydroxide
- C heating ammonium sulfate with sodium hydroxide
- D heating ammonium sulfate with dilute hydrochloric acid

- 23 Nitrogen and hydrogen react in a closed vessel.



How do the speeds of the forward and reverse reactions change, if the pressure in the vessel is increased but the temperature is kept constant?

	speed of forward reaction	speed of reverse reaction
A	increases	increases
B	decreases	does not change
C	does not change	increases
D	decreases	decreases

- 24 Which process does **not** involve either oxidation or reduction?

- A formation of ammonium sulfate from ammonia and sulfuric acid
- B formation of nitrogen monoxide from ammonia
- C formation of sulfuric acid from sulfur
- D formation of zinc from zinc blende (ZnS)

- 25** Acidified potassium manganate(VII) is added to solution of X. The mixture changes from purple to colourless. What could X be?

A ethanol
B iron(III) sulfate
C methyl orange
D sodium chloride

- 26** In an electrolysis experiment, the same amount of charge deposited 0.5 mol of metal X and 0.25 mol of metal Y.

If an ion of metal X has a 2+ charge, what was the charge on the ion of metal Y?

A 1+
B 2+
C 3+
D 4+

- 27** In which electrolysis experiment would there be no change in the concentration of the solution?

	electrolyte	electrodes
A	aqueous copper(II) sulfate	copper
B	aqueous copper(II) sulfate	carbon
C	concentrated aqueous sodium chloride	carbon
D	dilute sulfuric acid	platinum

- 28** P, Q and R are elements, in the same period of the Periodic Table.

P forms an acidic oxide, Q forms a basic oxide and R forms an amphoteric oxide.

If P, Q and R are placed in order of increasing atomic number (lowest atomic number first), which order is correct?

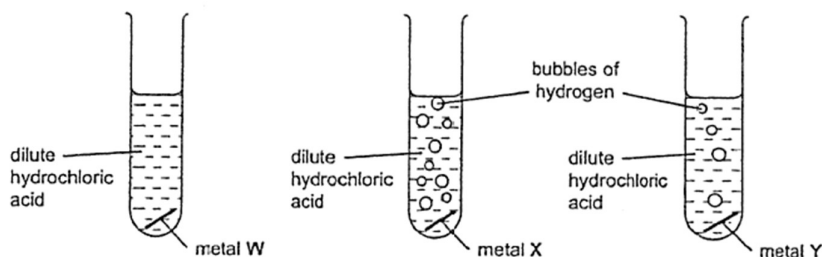
A P, Q, R
B P, R, Q
C Q, P, R
D Q, R, P

- 29** Manganese has various oxidation states and forms coloured compounds.
 The aqueous MnO_4^- ion is purple while the aqueous MnO_4^{2-} ion is green.
 The aqueous Mn^{3+} ion is red and the aqueous Mn^{2+} ion is pale pink in colour.

Which statement is correct?

A If a manganese compound in solution changes colour from pale pink to red, oxidation has taken place.
B Manganese has a high density.
C Manganese compounds are unlikely to be catalysts.
D Manganese has a low melting point.

- 30 The diagrams show the reactions of three metals with dilute hydrochloric acid.



What are metals W, X and Y?

	W	X	Y
A	copper	magnesium	zinc
B	copper	zinc	magnesium
C	magnesium	zinc	copper
D	zinc	magnesium	copper

- 31 Chromium is less reactive than iron. However, chromium is commonly used to plate steel objects in a method called chrome plating.

When chromium is electroplated onto a metal surface such as steel, it naturally oxidizes to form a thin layer of chromium oxide (Cr_2O_3) on the outer surface.

Which statement explains why chrome plating prevents rusting of the steel object?

- A Chromium reacts with water to form a stable oxide layer.
 B Chromium forms a thick layer of chromium metal, preventing oxygen from reaching the steel.
 C Chromium oxide forms a protective barrier against corrosion.
 D Chromium decreases the reactivity of the steel, this preventing rust formation.
- 32 What effect does a catalyst have on the activation energy, E_a , and the enthalpy change, ΔH , of a reaction?

	E_a	ΔH
A	decreases	decreases
B	decreases	unchanged
C	increases	increases
D	unchanged	decreases

- 33 Which statement about the fractional distillation of petroleum is correct?

- A At each level in the column, only one compound is collected.
 B The higher up the column, the greater the temperature.
 C The molecules collected at the bottom of the column are the most flammable.
 D The molecules reaching the top of the column have the smallest relative molecular masses.

- 34 Butane and methylpropane are isomers.
 What is the similarity and difference between the two isomers?

	similarity	difference
A	structural formula	empirical formula
B	molecular formula	general formula
C	molecular formula	structural formula
D	structural formula	molecular formula

35 Two gases, Q and R, have the following properties.

- Q dissolves in aqueous sodium hydroxide but R is insoluble.
- R burns in excess oxygen to give Q and water only.
- R does not decolourise aqueous bromine.

What are gases Q and R?

	Q	R
A	carbon monoxide	propene
B	carbon monoxide	propane
C	carbon dioxide	propene
D	carbon dioxide	propane

36 A substance reacts with each of potassium carbonate, sodium hydroxide and ethanol. What is the substance?

- A** aqueous ammonia
- B** ethanoic acid
- C** ethyl ethanoate
- D** hydrochloric acid

37 If one mole of each alcohol is burnt in excess oxygen, which alcohol will provide CO_2 and H_2O in a mole ratio of 3 : 4?

- A** CH_3OH
- B** $\text{C}_2\text{H}_5\text{OH}$
- C** $\text{C}_3\text{H}_7\text{OH}$
- D** $\text{C}_4\text{H}_9\text{OH}$

38 What is the formula of the ester formed when methanol reacts with butanoic acid ($\text{C}_3\text{H}_7\text{CO}_2\text{H}$)?

- A** $\text{C}_2\text{H}_5\text{CO}_2\text{C}_2\text{H}_5$
- B** $\text{C}_3\text{H}_7\text{CO}_2\text{C}_2\text{H}_5$
- C** $\text{CH}_3\text{CO}_2\text{C}_3\text{H}_7$
- D** $\text{C}_3\text{H}_7\text{CO}_2\text{CH}_3$

39 Which change will increase the speed of the reaction between 1 mole of each of two gases?

- A** a decrease in surface area of the catalyst
- B** a decrease in temperature
- C** a decrease in the volume of the reaction flask
- D** an increase in the volume of the reaction flask

40 Which atmospheric pollutants, emitted by internal combustion engines, are reacted together to be converted them to less harmful product?

- A** carbon monoxide and nitrogen dioxide
- B** carbon monoxide and unburnt hydrocarbons
- C** nitrogen dioxide and sulfur dioxide
- D** sulfur dioxide and unburned hydrocarbons

The Periodic Table of Elements

Group																		
	1 H hydrogen 1												13	14	15	16	17	18
													5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
	7	8	9	10	11	12						13 Al aluminum 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40	
												31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84	
	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						
	43 Tc technetium	44 Ru ruthenium	45 Rh rhodium	46 Pd palladium	47 Ag silver	48 Cd cadmium	49 In indium	50 Sn tin	51 Sb antimony	52 Te tellurium	53 I iodine	54 Xe xenon						
	75 Re rhenium	76 Os osmium	77 Ir iridium	78 Pt platinum	79 Au gold	80 Hg mercury	81 Tl thallium	82 Pb lead	83 Bi bismuth	84 Po polonium	85 At astatine	86 Rn radon						
	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 Mc moscovium	116 Lv livermorium	117 Ts tennessine	118 Og oganesson						
	61 Pm promethium	62 Sm samarium	63 Eu europium	64 Gd gadolinium	65 Tb terbium	66 Dy dysprosium	67 Ho holmium	68 Er erbium	69 Tm thulium	70 Yb ytterbium	71 Lu lutetium							
	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							

temperature and pressure (r.t.p.).