



OVERMUGGED O LEVEL MOCK PAPER 2021
SECONDARY 4 EXPRESS
SECONDARY 5 NORMAL ACADEMIC

PURE CHEMISTRY
PAPER 1: MULTIPLE CHOICES

6092/01
September 2021
1 hour

INSTRUCTIONS TO CANDIDATES

There are **forty** questions in this paper. Answer **all** questions. For each question, there are 4 possible answers, **A, B, C and D**.

Choose the one you consider correct.

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

The use of an approved scientific calculator is expected, where appropriate.

**Questions in this mock paper may contain adapted questions from the Ten Year Series and Prelim Papers from various schools in Singapore.*

1. Below shows the properties of Gas X & Gas Y.

- Gas X is insoluble in water while Gas Y is soluble in water.
- Both gases have Mr greater than 40.

Which row shows the **correct collection method** for the gases?

	Gas X	Gas Y
(A)	Displacement of water	Downward delivery
(B)	Displacement of water	Upward delivery
(C)	Upward delivery	Displacement of water
(D)	Downward delivery	Displacement of water

Gases which are insoluble in water can be collected via displacement of water.

Gas Y is denser than air hence downward delivery is required.

A

2. Which gas is neither an element nor a compound?

- (A) Water vapour
- (B) Air
- (C) Ammonia
- (D) Nitrogen gas

Air is a mixture of gas.

B

3. The table below shows the melting and boiling points of some pure substances.

Substance	Melting point / °C	Boiling point / °C
W	-45	23.5
X	-138	-36
Y	220	587
Z	-141	-121

The following analyses were made:

- (i) Substance W is likely a volatile compound.
- (ii) Substance X exists as a gas at room temperature and pressure.
- (iii) Substance Y exists as a solid at room temperature and pressure.
- (iv) Substance Z is likely to exist as a diatomic molecule at room temperature and pressure.

Which of the following statements are **true**?

- (A) ii only
- (B) i & ii only
- (C) i, ii & iii only
- (D) All of the above

D

Be^{3+} has 5 protons,
6 neutrons and 2
electrons.

4. Which of the following statement is **true** for Boron (B^{3+}) ion?

- (A) The ion contains 10 sub-atomic particles in the nucleus.
- (B) A boron atom has to gain 3 protons to gain a charge of 3+.
- (C) An isotope of boron will have a different number of protons.
- (D) There are more neutrons than electrons in the B^{3+} ion.

D

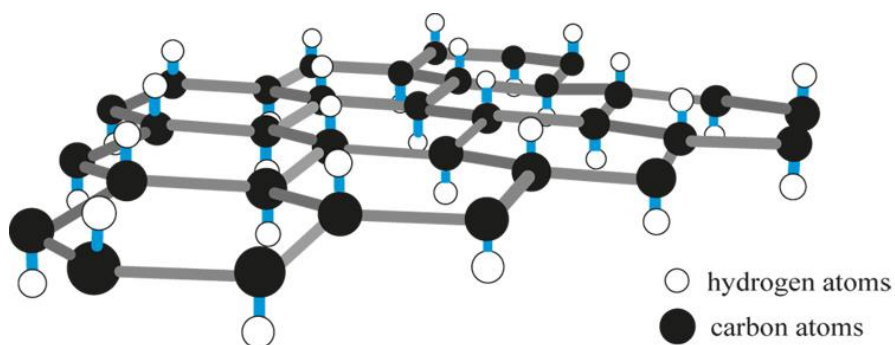
5. Which compound contains both **ionic** and **covalent** bonds?

- (A) Aluminium oxide
- (B) Lead chloride
- (C) Sodium nitrate
- (D) Hydrogen bromide

Within NO_3^- , covalent bonds exist between the N and O atoms while an ionic bond exists between the Na^+ and NO_3^- ions.

C

6. Graphane, an allotrope of carbon, has a similar structure to graphite, except that it has one hydrogen atom bonded to each carbon atom as shown in the diagram below.



What properties will graphane have?

- (i) It will be able to conduct electricity in solid state.
- (ii) It will have high melting & boiling points.
- (iii) The layers can slide over one another easily.
- (iv) It has a simple molecular structure.

- (A) ii only
- (B) i & ii only
- (C) ii & iii only
- (D) All of the above

With the hydrogen atom bonded to the carbon atom, the **fourth electron is no longer delocalised** and graphane will not be able to conduct electricity unlike graphite.

C

7. Refer to the periodic table below.

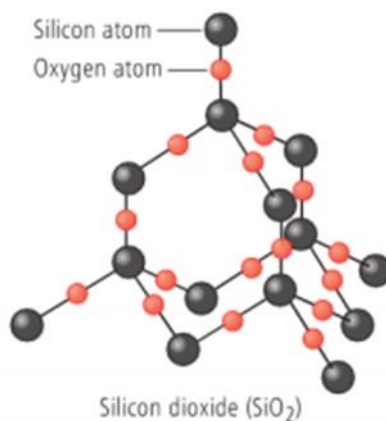
[illegible]

Which of the following statement is **true**?

- (A) Ion B will have the same number of electrons as element D.
(B) An ionic compound with chemical formula A_2C can be formed.
(C) An isotope of element D can have the same proton number as element B.
(D) The electrostatic forces of attraction between A and D will be strong than C and B.

B

8. Refer to the molecular structure below.



Which of the following statement is **correct**?

- (A) One silicon atom is covalently bonded to 2 oxygen atom.
(B) The ratio of silicon atom to oxygen atom is 1:2.
(C) SiO_2 is a basic oxide.
(D) SiO_2 when dissolved in water is able to conduct electricity.

B

9. When 100g of impure limestone acid, 12.0dm³ of a colourless gas is produced. Which is the percentage purity of the limestone?

- (A) 25%
- (B) 50%
- (C) 75%
- (D) 100%

Step 1: Write out the balanced equation.



Step 2: Calculate the moles of CO₂ produced.

$$\text{moles of CO}_2 \text{ produced} = 12.0 / 24 = 0.50 \text{ mol}$$

Step 3: Determine the molar ratio.

$$\text{Moles of CO}_2 : \text{Moles of CaCO}_3$$

$$\begin{array}{ccc} 1 & : & 1 \\ 0.50 & : & 0.50 \end{array}$$

Step 4: Calculate the mass of CaCO₃ reacted

$$\text{Mass} = \text{mole} \times \text{Mr} = 0.50 \times 100 = 50\text{g}$$

$$\text{Percentage purity} = 50/100 \times 100\% = 50\%$$

nitric
pressure.

B

10. 3.0dm³ of sulfur dioxide react with 2.0dm³ of oxygen to form sulfur trioxide. All compounds exist as gas at room temperature and pressure.

What is the volume of remaining gas after the reaction?

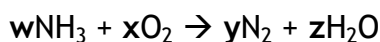
- (A) 2.0 dm³
- (B) 2.5 dm³
- (C) 3.0 dm³
- (D) 3.5 dm³

Chemical equation: 2SO₂ + O₂ → 2 SO₃

SO₂ is the limiting reagent and O₂ is in excess.

D

11. A mixture of ammonia and oxygen was passed over heated platinum. Nitrogen and water were formed.



What are the values of w, x, y & z?

	w	x	y	z
(A)	2	2	1	4
(B)	2	3	1	3
(C)	4	3	2	6
(D)	4	2	2	6

C

12. How much sulfuric acid is needed to neutralise exactly 25.0cm³ of 1.0 mol/dm³ of potassium hydroxide?

- (A) 10.0cm³ of 2.0 mol/dm³ sulfuric acid
- (B) 12.5cm³ of 1.5 mol/dm³ sulfuric acid
- (C) 5.0cm³ of 2.5 mol/dm³ sulfuric acid
- (D) 50.0cm³ of 1.0 mol/dm³ sulfuric acid

C

13. Rubidium, Rb, is a **Group I element**.

Which method is **most likely** to be used in its **extraction**?

- (A) Electrolysis of aqueous rubidium chloride
- (B) Electrolysis of molten rubidium chloride
- (C) Heating of rubidium ore with carbon
- (D) Heating of rubidium ore with hydrogen

B

14. Aqueous ammonia was added to a solution. A white precipitate was formed which dissolves in excess aqueous ammonia.

When acidified barium nitrate was added to the solution, a white precipitate is formed.

Identify the **salt** present in the solution.

- (A) Lead chloride
- (B) Lead sulfate
- (C) Zinc chloride
- (D) Zinc sulfate

D

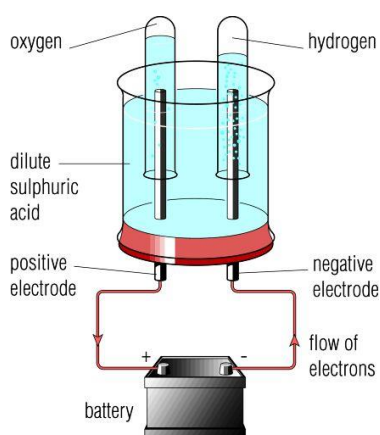
15. In an electrolysis set-up using inert electrodes, both **iron (II) chloride** and **copper (II) fluoride** was added to a dilute aqueous solution.

What will be the reaction at the respective electrodes?

	Anode	Cathode
A	$4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^-$	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$
B	$2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$	$\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$
C	$2\text{F}^- \rightarrow \text{F}_2 + 2\text{e}^-$	$\text{Fe}^{2+} + 2\text{e}^- \rightarrow \text{Fe}$
D	$4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^-$	$\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$

D

16. The diagram shows the electrolysis of dilute sulfuric acid.



Which of the following statement is **false**?

- (A) OH^- ions are oxidised at the anode.
- (B) Hydrogen ions are discharged at the positive terminal.
- (C) There are twice as much volume of hydrogen gas produced than oxygen gas.
- (D) The pH of the solution decreases.

B

17. In which reaction is dilute hydrochloric acid **not behaving like an acid**?

- (A) $\text{HCl (aq)} + \text{NaOH (aq)} \rightarrow \text{NaCl (aq)} + \text{H}_2\text{O (l)}$
- (B) $\text{HCl (aq)} + \text{AgNO}_3 \text{ (aq)} \rightarrow \text{AgCl (s)} + \text{HNO}_3 \text{ (aq)}$
- (C) $2\text{HCl (aq)} + \text{CuO (s)} \rightarrow \text{CuCl}_2 \text{ (aq)} + \text{H}_2\text{O (l)}$
- (D) $2\text{HCl (aq)} + \text{Zn (s)} \rightarrow \text{ZnCl}_2 \text{ (aq)} + \text{H}_2 \text{ (g)}$

B

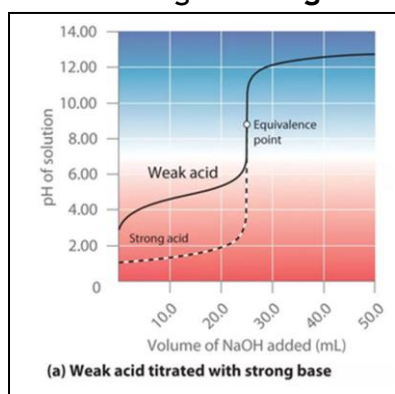
18. Refer to the table below.

The colours of indicators in acidic and basic solutions

Indicator	Colour on acid side	pH at colour change	Colour on basic side
methyl orange	red	3–5	yellow
litmus	red	5–8	blue
phenolphthalein	colourless	8–10	pink

Suggest the **appropriate indicator** for a neutralisation reaction when **weak acid** is added via a burette into a conical flask containing a **strong alkaline**.

- (A) methyl orange
- (B) litmus
- (C) phenolphthalein
- (D) None of the above



C

19. A salt Y, upon warming with excess aqueous sodium hydroxide, produced a gas that turned damp red litmus paper blue.

When no more gas is produced, aluminium powder was added and gas Z was produced.

Identify salt Y and gas Z.

	Salt Y	Gas Z
(A)	NH_4NO_3	Ammonia gas
(B)	$(\text{NH}_4)_2\text{SO}_4$	Nitrogen gas
(C)	$(\text{NH}_4)_2\text{SO}_4$	Ammonia gas
(D)	NH_4NO_3	Nitrogen gas

A

20. Which pair of reactants can safely prepare sodium nitrate?

- (A) sodium and nitric acid
- (B) sodium and potassium nitrate
- (C) sodium hydroxide and zinc nitrate
- (D) sodium hydroxide and nitric acid

D

21. Which of the following process is endothermic?

- (i) Melting & boiling
- (ii) Neutralisation
- (iii) Displacement of less reactive metal from compound.
- (iv) Thermal decomposition

- (A) i only
- (B) i & ii only
- (C) i & iv only
- (D) All of the above

C

22. The reaction for Haber process is as shown below.



Which of the following statement is true?

- (A) The bond breaking of the reactants is more than the bond forming of the product.
- (B) The more the reaction occurs, the lower the activation energy.
- (C) Pressure increases as the reaction progresses.
- (D) The total energy level of the system has decreased after the reaction.

D

23. A catalyst can be used to **increase the rate of reaction**.

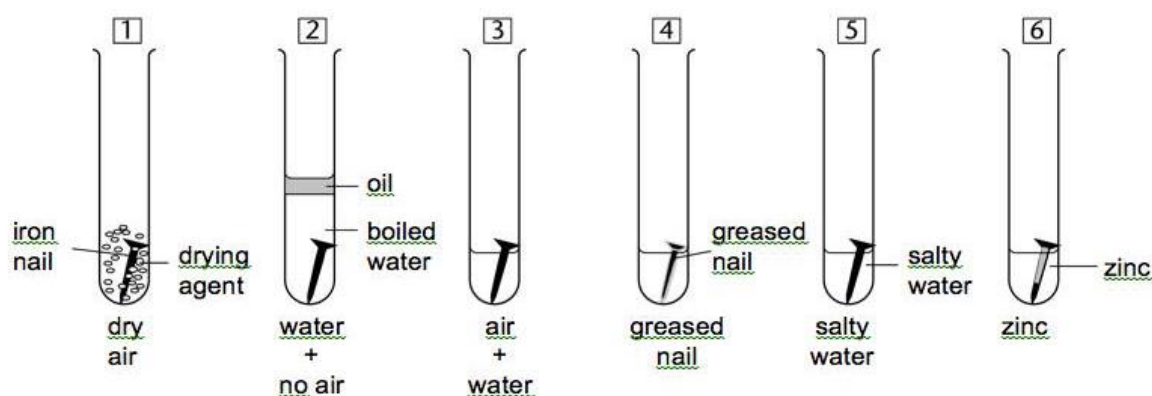
Which of the following statement is **true**?

- (i) Catalyst speeds up the rate of reaction and increases the yield.
- (ii) Catalyst decrease the activation energy by absorbing energy released.
- (iii) A catalyst helps to lower the activation energy and allow more reactants to undergo effective collisions.
- (iv) A catalyst only works for endothermic reactions.

- (A) iii only
- (B) i & ii only
- (C) i & iii only
- (D) All of the above

A

24. Refer to the following set-ups that are left in this state for three days.



Choose the **correct set of results**.

	Will not rust	Will rust	Rust the fastest
(A)	1,2,4	5,6	3
(B)	1,2,4,6	5	3
(C)	1,2,4	3,6	5
(D)	1,2,4,6	3	5

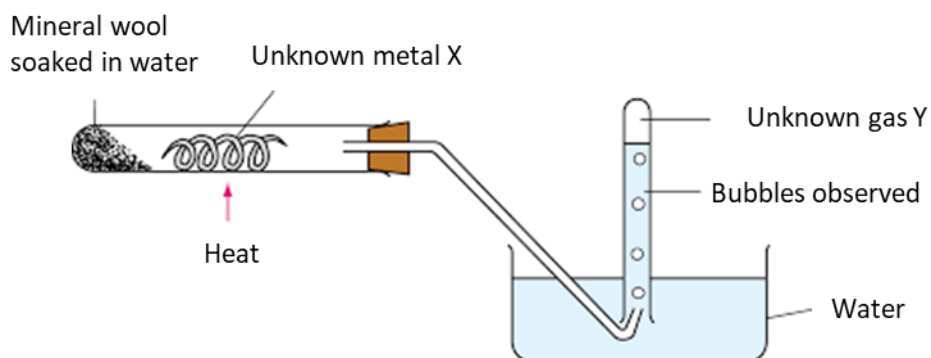
D

25. Which of the statement about the **trend** when moving **down Group VII** is **false**?

- (A) Down Group VII, colour intensity increases.
- (B) Down Group VII, melting and boiling point increases.
- (C) Down Group VII, density increases.
- (D) Down Group VII, reactivity increases.

D

26. Refer to the set-up below.

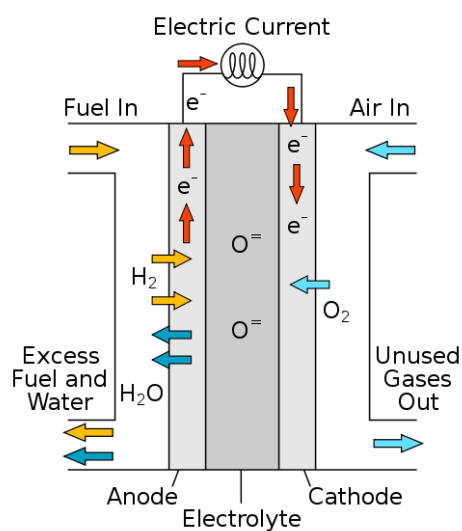


Which is the **identity of metal X and gas Y**?

	Metal X	Gas Y
(A)	Copper	Oxygen gas
(B)	Copper	Hydrogen gas
(C)	Zinc	Oxygen gas
(D)	Zinc	Hydrogen gas

D

27. Refer to the diagram below of a hydrogen fuel cell.



What is the **overall equation** for the reactions taking place in a hydrogen fuel cell?

- (A) $2H_2 + O_2 \rightarrow 2H_2O$
- (B) $2H_2O \rightarrow 2H_2 + O_2$
- (C) $2H_2(g) + 4OH^-(aq) \rightarrow 4H_2O(l) + 4e^-$
- (D) $O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$

A

Refer to the periodic table below to answer questions 28 & 29.

A blank periodic table grid with 18 columns and 7 rows. The grid is divided into four main sections: a small top-left section (2x2), a small top-right section (2x2), a large middle section (16x4), and a large bottom section (16x4). The letters A, B, C, and D are placed in the following positions: A is in the second row, first column of the middle section; B is in the third row, second column of the middle section; C is in the second row, eighth column of the middle section; D is in the second row, tenth column of the middle section.

28. Which of the following statement is **true**?

- (i) Elements A and C will form an ionic compound.
(ii) Element D can form a diatomic molecule.
(iii) Element B and C will form a compound with a formula B_2C_3 .
(iv) The compound formed between A and D is an alkaline.

- (A) ii only
(B) i & ii only
(C) i, ii & iii only
(D) All of the above

B

29. Which elements will have the same number of electron shells as a potassium ion?

- (A) B only
(B) A & B only
(C) A, C & D only
(D) All of the above

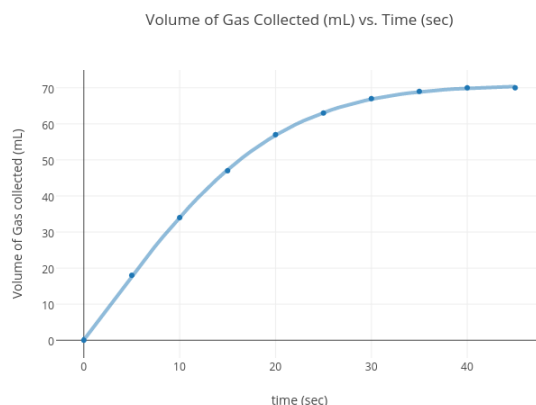
C

30. Which of the following pollutant is **incorrectly matched** with its source and effect?

	Pollutant	Source	Effect
(A)	Methane	Decay of living organisms	Global warming
(B)	Nitrogen dioxide	Lightning strikes	Acid rain
(C)	Ozone	Photochemical smog	Damages crops
(D)	Carbon monoxide	Incomplete combustion in car engines	Greenhouse gas

D

31. The graph below shows the reaction between sodium hydroxide and excess ammonium chloride.



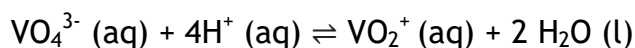
Which of the following statement is **true**?

- (i) Rate of reaction is highest at the 5s mark.
- (ii) Sodium hydroxide is fully used up after 40s.
- (iii) The rate of reaction decreases after 15s and eventually comes to a stop.
- (iv) Ammonium hydroxide is fully used up after 40s.

- (A) ii only
- (B) i & ii only
- (C) i, ii & iii only
- (D) All of the above

C

31. Refer to the ionic equation when Vanadium reacts hydrochloric acid.



What is the role of Vanadium in this reaction?

- (A) Acid
- (B) Base
- (C) Oxidising agent
- (D) Reducing agent

VO_4^{3-} oxidation state remains at +5. This is a neutralisation reaction.

B

32. Identify the **bolded element** with the correct oxidation state within the compound.

	Compound	Oxidation state
(A)	$\text{Cu}\underline{\text{S}}\text{O}_4$	+8
(B)	$\text{K}_2\text{Cr}\underline{\text{C}}\text{r}_2\text{O}_7$	+6
(C)	$\underline{\text{C}}\text{O}_2$	0
(D)	$\text{Ca}\underline{\text{C}}\text{O}_3$	-4

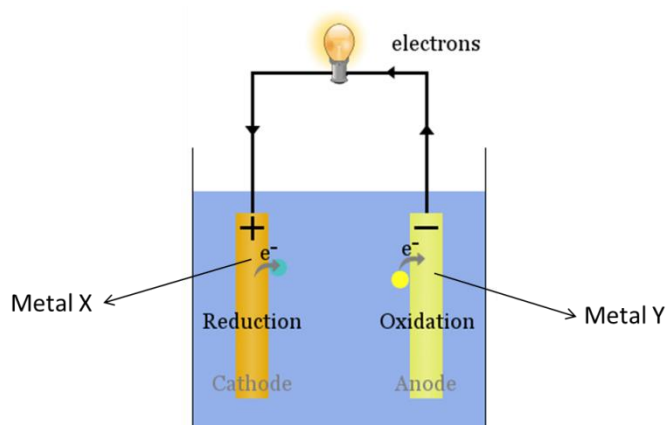
B

33. Which of the following pollutants is **not removed** by the catalytic converter in a car?

- (A) Carbon dioxide
- (B) Carbon monoxide
- (C) Nitrogen monoxide
- (D) Unburnt hydrocarbon

A
—

34. The diagram below shows a simple electric cell set-up.



Which pair of metals X & Y will produce the greatest voltage?

	Metal X	Metal Y
(A)	Copper	Aluminium
(B)	Iron	Magnesium
(C)	Iron	Zinc
(D)	Silver	Magnesium

D
—

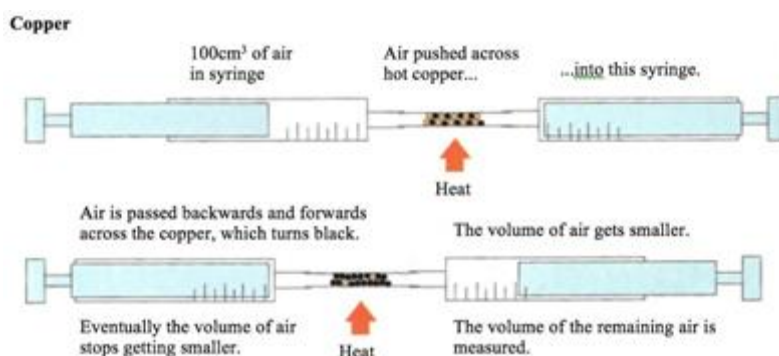
35. Which statement is **true** for **all** metals?

- (i) All metals have high melting & boiling points.
- (ii) All metals exist as solid state at room temperature and pressure.
- (iii) All metals are good conductors of heat and electricity.
- (iv) All metals can react with acid to produce hydrogen gas.

- (A) iii only
- (B) i & iii only
- (C) i, ii & iii only
- (D) All of the above

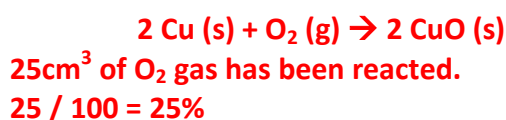
A
—

36. An experiment was done where by 100cm^3 of a sample of air was heated over a mass of copper until no further reaction.



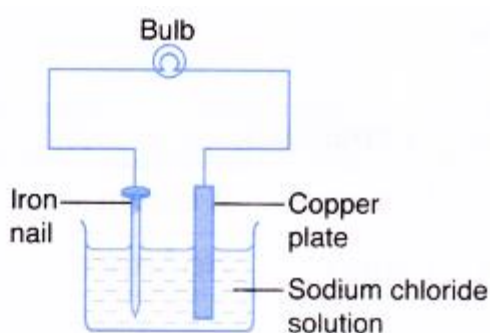
When the tube is cooled to room temperature, the **remaining volume of air is 75cm^3** . What is the **percentage of oxygen** in the syringe?

- (A) 15%
- (B) 20%
- (C) 25%
- (D) 30%



C

37. Refer to the set-up below.



Which of the following statement is **true**?

- (A) The iron nail will start to reduce in size.
- (B) Chlorine gas will be discharged.
- (C) The light bulb will not light up.
- (D) The copper plate will dissolve and copper will form on the iron nail.

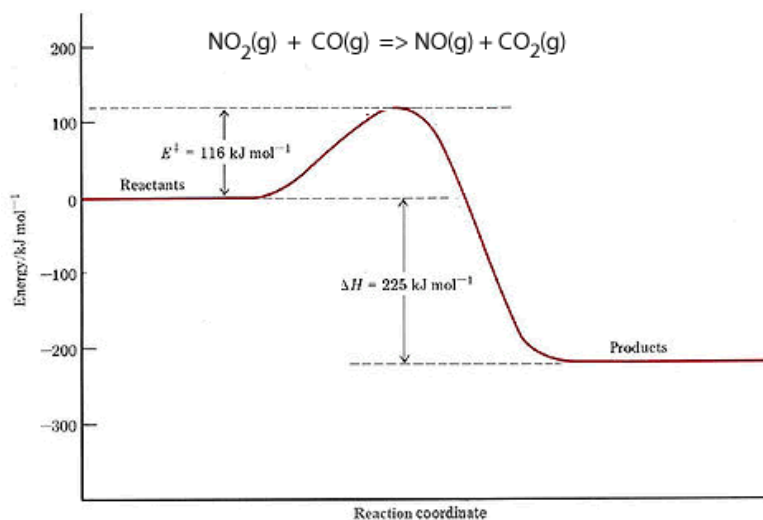
A

38. Which of the following statement is **true** for all exothermic reactions?

- (A) The energy taken in during bond breaking must be lower than the energy released during bond forming
- (B) A catalyst must be present for the reaction to occur.
- (C) The temperature of the surrounding will decrease.
- (D) The energy level of the system will increase.

A

39. The reaction between NO_2 and CO is as seen below.

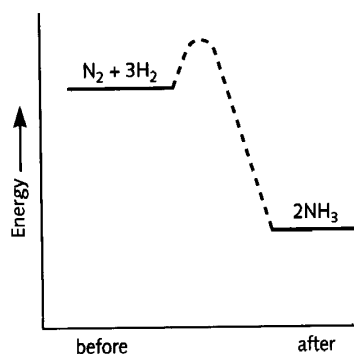


What is the **enthalpy change** of this reaction?

- (A) +116 kJ/mol
- (B) +225 kJ/mol
- (C) -225 kJ/mol
- (D) -341 kJ/mol

C

40. The Haber process chemical equation is as such:



The following bond energy values are as follows:

Bond	Bond energy value in kJ/mol
$\text{N}\equiv\text{N}$	945
$\text{N}-\text{H}$	390
$\text{H}-\text{H}$	x

Given that the **enthalpy change** of the reaction is -92kJ/mol , find x.

- (A) 434 kJ
- (B) 317 kJ
- (C) 496 kJ
- (D) 1303 kJ

A