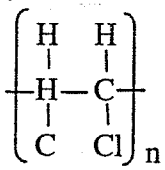
NSW INDEPENDENT TRIAL EXAMS – 2001
CHEMISTRY - SUGGESTED ANSWERS

SECTION I - PART A

1	B	2	B	3	C	4	B	5	D	6	C	7	A	8	D
9	B	10	C	11	D	12	A	13	C	14	D	15	B		

SECTION I - PART B

16. (a) polyvinyl chloride 1
polychloroethene 1

(b)  1

(c) eg: for electrical conduit 1
eg: easily moulded or good insulator 1

17. (a) the HPO_4^{2-} ion 1

(b) $HPO_4^{2-} + H^+ \Leftrightarrow H_2PO_4^-$ or $HPO_4^{2-} + H_2O \Leftrightarrow H_2PO_4^- + OH^-$ 1
$HPO_4^{2-} + OH^- \Leftrightarrow PO_4^{3-} + H_2O$ or $HPO_4^{2-} + H_2O \Leftrightarrow PO_4^{3-} + H_3O^+$ 1

(c) The species PO_4^{3-} or $H_2PO_4^-$ 1
If both ions are present in roughly equal concentrations, addition of either H^+ or OH^- ions has negligible effect on the pH, as the added ions are neutralised by the either the base species or the acid species respectively 1

18. eg. 3

Mercury battery	Dry Cell
Used for watches, cameras, hearing aids	Used for torches, small electrical appliances
Expensive to produce	Inexpensive to produce
Pollution problem due to Hg	No real pollution problem with Mn or Zn or C
Stable voltage over time	Low energy drain only
Frequent use	infrequent use

3 separate points for **3 mks**. Must show point for both batteries for comparison.

19. • advantage such as water soluble, less CO formation, renewable 1
• disadvantage such as lower energy density, cost, use of cropland/soil to grow plants, disposal of waste fermentation products 1

20. (a) $C_6H_{12}O_6$ (180 g.mol^{-1}) → $2C_2H_6O + 2CO_2$
Moles CO_2 = 1000/180 x 2 = 11.1 mol 1
Volume CO_2 = 11.1 x 24.5 = 272 L 1

(b) Mass of CO_2 = 11.1 x 44 = 489 g 1

21. (a) Need to know the normal (saturation) value of dissolved oxygen OR the minimum value of DO for fish to survive. **1**

(b) To obtain a representative value of the DO available, away from surface layer where value is higher due to contact with air. **1**

(c) (i) turbidity blocks light and inhibits photosynthesis
OR turbidity may be due to suspended organic material raising BOD **1**

(ii) oxygen's solubility in water decreases as the temperature increases **1**

22. (a) Iron provides a surface on which the molecules of N_2 and H_2 can be dissociated and condensed into NH_3 molecules, ie. accelerates the reaction. **2**

(b) Temp of 400°C to speed up the reaction and reach equilibrium faster. However this temp will favour a decrease in NH3 yield. If temp is too low then a higher yield but at a slower rate, so a compromise needed in conditions. **2**

(c) Increasing the pressure shifts the equilibrium to the right, and produces more ammonia. **1**

Higher pressure also accelerates the reaction by increasing the concentrations of the reactants (increased frequency of molecular collisions with the catalyst) **1**

23. (a) using a hotplate, heating mantle or water bath for heating **1**

using a condenser arranged vertically above the reaction flask **1**

(b) refluxing keeps the volatile reactants and products in the reaction vessel, while maintaining them at boiling temperature to speed the reaction. **1**

(c) sulfuric acid provides hydrogen ions that catalyse the reaction **1**

concentrated sulfuric acid absorbs water which is a product of the reaction, thus shifting the equilibrium towards the product. **1**

(d) $CH_3OH + CH_3COOH \rightarrow CH_3COOCH_3 + H_2O$ **2**

24. (a) flammability of liquids A and B)
toxicity of vapours of A, B, bromine) any 2 **2**
exposure of body to UV light)

(b) B = cyclohexane **1**

the reaction with bromine is <u>substitution</u> $C_6H_{12} + Br_2 \rightarrow C_6H_{11}Br + HBr$ **1**

UV light is needed to provide required activation energy

25. (a) the copper ion accepts the lone electron pair from the ammonia molecule. **1**

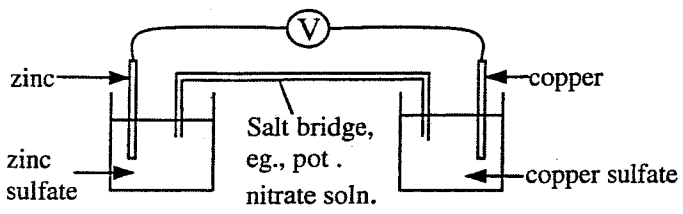
(b) no because copper ions have no hydrogen atoms to donate as protons. **1**

26. (a) A copper deposit forms on the zinc.)
The blue colour of the solution fades)
The temperature increases) any 2 **2**
Some of the zinc dissolves)

(b) oxidation $Zn_{(s)} \rightarrow Zn^{2+} + 2e^-$ **1**

reduction $Cu^{2+} + 2e^- \rightarrow Cu_{(s)}$ **1**

(c)



2

(d) 1.10 V **1**

27. (a) volumetric flask **1**

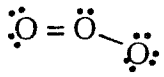
(b) phenolphthalein **1**

The pH at the equivalence point of a reaction between a weak acid and a strong acid is greater than 7 **1**

(c) discarding the first titration and calculating the mean of the other three as 33.6 mL **1**

calculating the concentration of diluted vinegar as 0.128 mol L^{-1} **1**

calculating the concentration of undiluted vinegar as 0.64 or 0.640 mol L^{-1} **1**

28. (a)  **1**

(b) refrigerants in air conditioners and refrigerators)
propellants in aerosol cans (eg: deodorants and insecticides)) any 2 **1**
solvents for cleaning, electric circuits and dry cleaning)
blowing agents to make expanded plastics, eg: polystyrene foam)

(c) the decrease in the mean total ozone corresponds to the increasing levels of CFC's in the southern hemisphere **1**

(d) $CH_3Cl_{(g)} + UV \rightarrow CH_{3(g)} + Cl_{(g)}$ **1**

$Cl_{(g)} + O_{3(g)} \rightarrow ClO_{(g)} + O_{2(g)}$ **1**

CFC broken down in atm by UV light forming chlorine radical which attacks ozone molecule producing chlorine oxide. Chlorine oxide produces more chlorine radicals which further attack more ozone molecules. (1 mk) for description.
The net result is that one chlorine atom can destroy thousands of ozone molecules, ie: only a small amount of CFC's need to be present for large amounts of ozone destruction to occur. **3**

SUGGESTED ANSWERS TO OPTIONS

QUESTION 29 – INDUSTRIAL CHEMISTRY

(a) (i) Pickling of iron and steel before galvanising or electroplating. The surface layer of iron oxide must be removed. **1**

(ii) Sulfur has a relatively low melting temperature and lacks reactivity with water. **1**
Superheated liquid water is pumped down a pipe into the sulfur deposit where it melts the sulfur **1**
A second pipe pumps compressed air into the mixture of molten sulfur and water.
A froth of water, air and liquid sulfur forms and is forced to the surface **1**
At the surface the air escapes, water runs off and the sulfur is collected **1**

(iii) The equilibrium yield and rate of production of SO_3 will increase with increased pressure. An increase in pressure shifts the equilibrium position to the right. **1**
A temperature decrease will favour an increased equilibrium yield of SO_3, but the rate of production of SO_3 will be decreased. **1**
In order to resolve this conflict a catalyst is used to increase the reaction rate so that it is still possible to use lower temperatures and still achieve an acceptable reaction rate. **1**
The equilibrium yield of SO_3 is improved by using an excess of the cheaper reactant, oxygen in the form of air. This excess shifts the equilibrium position to the right. **1**

Question 29 – Industrial Chemistry continued

(b) (i) Brine which contains sodium ions, chloride ions and water is pumped into the electrolytic cell **1**

At the positive electrode (anode), chloride ions are oxidised to chlorine gas

$Cl^- \rightarrow \frac{1}{2} Cl_2 + e$ **1**

At the negative electrode (cathode), water molecules are reduced to hydroxide ions and hydrogen gas. $H_2O + e \rightarrow OH^- + \frac{1}{2} H_2$ **1**

The membrane allows only Na^+ ions to move from one electrode chamber to the other. The OH^- ions formed at the cathode are prevented from reaching to the anode. **1**

Cl^- ions in the anode chamber cannot move to the cathode and contaminate the NaOH produced. **1**

(ii) Asbestos fibres used to make diaphragm cells cause degenerative disease called asbestosis. Mercury discharged in waste materials from mercury cells can enter aquatic food chain and be concentrated by animals like shellfish. Eating contaminated shellfish may cause poisoning. **2**

(c) (i) Sodium hydroxide and glyceryl tristearate **2**

(ii) The soap molecule consists of a non-polar, hydrophobic oily part and a hydrophilic polar ethanoate part **1**

Soap molecules concentrate on the surface with their hydrophobic ends in the air and their hydrophilic ends in water forming a monolayer so that the water is better able to wet material and dirt. **1**

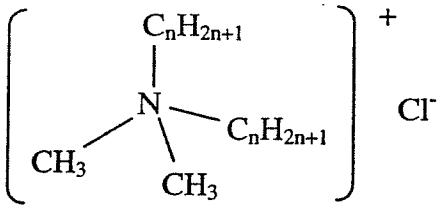
Groups of soap molecules coalesce into microscopic droplets whose surfaces contain COO^- ions which attract to water molecules. This keeps these colloidal droplets in suspension as an emulsion. **1**

Solid dirt is mainly non-polar greasy particles. They are attracted to the non-polar oily hydrophobic ends of the soap molecule making the dirt particles easier to lift off materials or the skin. **1**

(iii) Cationic detergents have a positively charged hydrophilic head. **1**

They are chemically related to $NH_4^+Cl^-$ but with the four hydrogen atoms replaced by alkyl groups. **1**

eg:



They are used in nappy washes, shampoos, or hair and fabric conditioners. **1**

QUESTION 30 – SHIPWRECKS & SALVAGE

(a) (i) •Low temperatures reduce the rate of chemical corrosion
•High pressures do assist with the quantity of dissolved oxygen in the water but due to the extreme depth and little mixing of surface and bottom water, oxygen has to diffuse to the bottom – this results in a relatively low oxygen level compared with the atmosphere thereby causing a slow rate of corrosion **2**

(ii) A ship such as the cherry Venture that is exposed to the oxygen-rich atmosphere environment under with warm, wet/moist conditions will corrode significantly faster than a ship such as the Titanic that is totally submerged in low temperature, low oxygen conditions. **2**

(iii) Anaerobic bacteria feeding an organic material release hydrogen ions into the water, increasing the acidity of the water around the wreck. The increased H^+ ion concentration accelerates corrosion of steel. OR
Anaerobic bacteria that utilize sulfate ions as their oxidising agent release H_2S that reacts with iron forming sulfides. **2**

(iv) •A leather object that has been in the sea for 600 years will be saturated with soluble salts such as sodium chloride.
•If it is brought to the surface where the water molecules evaporate, after supersaturation occurs, solid crystals of the salts will begin to form.
•These crystals will increase in size and damage the cell structure of the leather, distorting its shape, changing its texture and possibly cracking its surface. **2**

(b) (i) Nickel is the anode, silver the cathode **1**
$Ni_{(s)} + 2Ag^+ \rightarrow Ni^{2+} + 2Ag_{(s)}$ **1**

(ii) The mass of nickel deposited (or silver dissolved) is proportional to the amount of charge passed through the cell. **1**

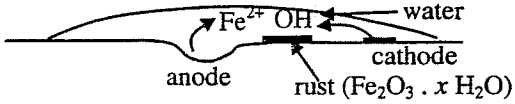
(iii) $E^\circ = 0.80 - (-0.24) = 1.04$ V is the minimum voltage required. **1**

(iv) electrode area electrode separation electrolyte conc. applied voltage (any 3) **3**

(c) (i) Silver reacts with hydrogen sulfide, produced by bacteria, forming a black coating of silver sulfide $Ag_{(s)} + H_2S \rightarrow Ag_2S_{(s)} + H_{2(g)}$ **1**
Crystals of calcium carbonate grow on surfaces exposed to seawater which is at saturation level for this substance. **1**

(ii) The coins are treated with dilute acid to dissolve the calcium carbonate **1**
The coins are then treated electrolytically, as the cathode, silver sulfide being reduced to silver **1**

(d) Rusting occurs where steel is exposed to both air (oxygen) and moisture, and is accelerated by dissolved salts which provide an electrolyte. **2**
Rusting is an electrochemical process in which oxidation of iron $Fe \rightarrow Fe^{2+} + 2e^-$ is accompanied by reduction of oxygen, on a cathodic surface such as a carbon crystal.
$H_2O + \frac{1}{2} O_2 + 2e^- \rightarrow 2OH^-$ **2**



Fe^{2+} is directly oxidised, by oxygen to Fe^{3+} and insoluble rust is formed, by reaction with OH^-

(e) <u>either</u> an explanation of sacrificial protection using a metal such as zinc or magnesium <u>or</u> use of an applied voltage and inert anode to provide cathodic protection **2**

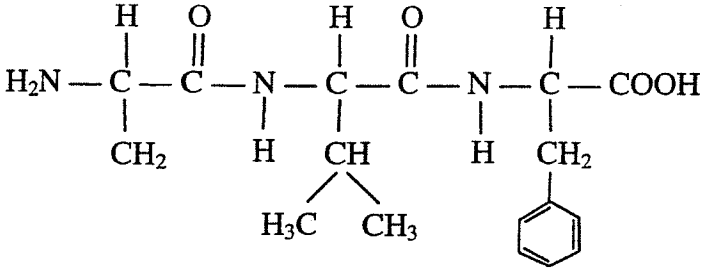
QUESTION 31 – BIOCHEMISTRY OF MOVEMENT

(a) (i) Stages 1, 2 and 3 — 1
(ii) glycolysis — 1
(iii) acetyl Co-A — 1
(iv) TCA cycle (Kreb Cycle / Citric acid Cycle) — 1
(v) matrix of mitochondrion — 1
(vi) elimination of the COOH groups as carbon dioxide gas — 1
(vii) $NAD^+ + H^+ + 2e^- \rightarrow NADH$ — 1
(viii) water — 1
(ix) oxidative phosphorylation — 1
(x) the inner membrane of mitochondrion — 1
(xi) the cells demand an urgent supply of energy but oxygen is absent or insufficient — 1

(b) (i) The thick filaments consist of bundles of a long, slender protein, myosin. The thin filament consists of two actin strands coiled about each other. — 1
(ii) Diagram 3 shows contraction of movement of the muscle fibre. The thick filaments slide into spaces between the thin filaments in each sacromere, causing shortening of the entire muscle fibre. The hydrolysis of ATP to ADP and phosphate furnishes the chemical energy for the filaments to slide. Chemical energy changes to kinetic energy. — 2

(c) (i) Type 1 muscle cells have many mitochondria, type 2 muscle cells have fewer mitochondria)
Type 1 muscle cells have fewer contractile filaments, type 2 muscle cells have many contractile filaments) any 2 — 2
Type 1 muscle cells are well supplied with blood, type 2 muscle cells have poor blood supply)
(ii) Type 2 muscle cells — 1
(iii) Type 1 muscle cells are used for light, endurance exercise
Type 2 muscle cells are used for heavy and sprinting style exercise — 1

(d) (i) fatty acid and glycerol — 1
(ii) fatty acids are oxidised to acetyl-CoA and enter TCA cycle — 1
glycerol is converted to pyruvate or other glycolytic intermediates and enter glycolysis — 1

(e) (i)  — 1

(ii) condensation — 1
(iii) water — 1
(iv) peptide bond — 1