UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the May/June 2012 question paper

for the guidance of teachers

0620 CHEMISTRY

0620/32 Paper 3 (Extended Theory), maximum raw mark 80

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1 **(a)** neon has full outer shell / energy level / valency shell / octet / 8 (electrons) in outer shell / neon does not need to lose or gain electrons; [1]
fluorine atoms have 7 electrons / needs 1 to fill / has incomplete shell / forms bonds with other fluorine atoms / fluorine (atoms) form covalent bonds / shares electrons; [1]

(b) atomic number / proton number / number of protons (in one atom); [1]

(c) weak intermolecular (or between molecules) forces / Van der Waals forces between molecules / low amount of energy required to break bonds between molecules; [1]
strong bonds don't break / covalent bonds don't break / (unnamed) bonds within molecules / between atoms don't break; [1]

(d) 1 non-bonding pair on each nitrogen atom; [1]
6 electrons between nitrogen atoms; [1]

2 **(a)** weak forces between layers or between (hexagonal) rings / weak bonds between layers or between (hexagonal) rings / Van der Waals forces between layers or between (hexagonal) rings; [1]
(layers/rings) slip/slide (over each other) / move over each other [1]

(b) strong bonds (between atoms) / covalent bonds (between atoms); [1]
all bonds are covalent/strong / each atom covalently bonded / carbon (atoms) is bonded to four others / bonds are directional / (atoms are arranged) tetrahedrally; [1]
accept: carbon has four bonds

(c) graphite has delocalised / mobile / free electrons; [1]
diamond (outer shell) electrons used / fixed / localised in bonding / no delocalised electrons / no mobile electrons / no free electrons; [1]

3 **(a)** flexible / easily form different shapes / easily moulded / bends (without cracking); [1]
non-biodegradable / unreactive / don't corrode / prevent corrosion / prevent oxidation (of the conducting metal) / water resistant / waterproof; [1]

(b) improve appearance / decorative / makes appearance shiny; [1]
prevent corrosion / rusting / protect steel / chromium will not corrode / chromium is not oxidised / chromium protected by an oxide layer; [1]

(c) low density / light / protected by oxide layer / no need to paint / resists corrosion / (high) strength / strong;; **any two** [2]
note: high strength to weight ratio = 2

(d) high mpt / withstands high temperature / good conductor (of heat) / heats up quickly / malleable / ductile / resists corrosion / good appearance / unreactive (or example of lack of reactivity e.g. does not react with food or water or acid or air);; **any two** [1]

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(e) (lattice) positive ions / cations / metal ions and sea of electrons / delocalised or free or mobile or moving electrons; [1]
attraction between positive ions and electrons; [1]

4 (a) (i) oxygen; [1]
carbon dioxide / fluorine / carbon monoxide; [1]

(ii) decrease mpt (of alumina/Al_2O_3) / lower (operating) temperature (from 1900/2100 (°C) to 800/1000 (°C) / reduce energy (accept heat or electrical) requirement; [1]
improve conductivity / dissolves the Al_2O_3 / acts as solvent; (**allow:** makes aluminium oxide conduct / to conduct electricity / making ions free to move) [1]

(iii) Al_2O_3 (accept alumina) reacts / dissolves / forms a salt and water / is neutralised; [1]
(Fe_2O_3 removed by) filtration / centrifugation / decantation; [1]

(b) (i) electrolysis / electrolyte / electrodes / anode / cathode / electricity / cell; [1]
chlorine formed at anode (positive electrode); (**note:** can be awarded from a correct or incorrect equation with Cl_2 as the only substance on the right as long as anode is mentioned.) [1]
hydrogen formed at cathode (negative electrode); (**note:** can be awarded from a correct or incorrect equation with H_2 as the only substance on the right as long as cathode is mentioned.) [1]
one correct half equation either $2Cl^- \rightarrow Cl_2 + 2e$ or $2H^+ + 2e \rightarrow H_2$ [1]
solution remaining contains Na^+ and OH^- / sodium and hydroxide ions / NaOH / sodium hydroxide left behind/remains in solution; [1]

note: if a mercury cathode is specified
electrolysis / electrolyte / electrodes / anode / cathode / electricity / cell; [1]
chlorine formed at anode (positive electrode); (**note:** can be awarded from a correct or incorrect equation with Cl_2 as the only substance on the right as long as anode is mentioned.) [1]
sodium formed at cathode; (**note:** can be awarded from a correct or incorrect equation with Na as the only substance on the right as long as cathode is mentioned.) [1]
one correct half equation at anode i.e. $2Cl^- \rightarrow Cl_2 + 2e$ or at cathode $Na^+ + e \rightarrow Na$ (**accept:** equivalent with NaHg amalgam) [1]
NaOH/sodium hydroxide is formed by sodium/sodium mercury amalgam reacting with or when added to water; [1]
note: award the fourth and fifth mark if correct equation given for reaction between sodium or sodium mercury amalgam reacting with water i.e.
$2Na(Hg) + 2H_2O \rightarrow 2NaOH + H_2 + (2Hg)$

(ii) H_2 / H / hydrogen **and** making ammonia / making margarine / hardening fats / fuel / energy source / cryogenics / welding; [1]
Cl_2 / Cl / chlorine **and** (making) bleach / water treatment / kill bacteria (in water) / water purification / swimming pools / making solvents / making PVC / making weed killer / making disinfectants / making hydrochloric acid / HCl / making herbicides / pesticides / insecticides; [1]

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5 (a) (i) correct -O- linkage; [1]
correct unit and continuation -O-□- (minimum); [1]

(ii) any name or correct formula of a (strong) acid / H^+; [1]

(iii) contain carbon hydrogen and oxygen /C, H and O; [1]

(b) (i) glucose → ethanol + carbon dioxide [1]

(ii) yeast is catalyst / provides enzymes / speeds up reaction / too slow without yeast; [1]
yeast cells grow / multiply / reproduce / undergo budding / breed; [1]

(iii) heat or high temperature would kill yeast (cells) / heat or high temperature denatures enzymes; [1]
not: enzyme killed / denatures yeast
reduces rate of reaction / slows reaction / (yeast or enzyme) no longer catalyses / no catalyst / stops reaction / no more product; [1]

(c) (i) would produce carbon dioxide or carboxylic or organic acids (if oxygen is present) / to prevent aerobic respiration / so products are not oxidised / anaerobic bacteria can't live with oxygen; [1]

(ii) fossil fuels have a reduced need / conserved / no need to import / will last longer / cracking hydrocarbons to make methane no longer required;
(methane) is renewable / carbon neutral;
reduce pollution of water or sea / prevents visual pollution / prevents need for waste disposal or accumulation (**accept:** any methods of waste disposal) / so that waste is recycled; **any two** [2]

6 (a) (i) A C D B [1]

(ii) speed (or rate) increases as concentration increases / time decreases as concentration increases; [1]
rate or speed or time depends on (concentration) of H^+ or hydrogen ions; [1]
B is slow because propanoic acid is weak or doesn't dissociate or weakly ionises;
or
B is slow because HCl **and** H_2SO_4 are stronger or ionise or dissociate more than propanoic; [1]
D slower than C because C is more concentrated than D / ORA; [1]
A is fast because H^+ concentration high (**note:** this would also score second mark if not already awarded) / H_2SO_4 is diprotic or dibasic or $2H^+$; [1]
time is inversely proportional to rate / owtte / ORA; [1]
max [5]

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(b) change 1:
increase temperature / heat (the mixture); [1]
particles/molecules/ions have more energy or move faster; [1]
more (successful) collisions / more particles with E_a; [1]
change 2:
increase surface area / decrease particle size / use powdered (magnesium) / use smaller pieces / crush the magnesium; [1]
more collisions / more particles exposed to reaction; [1]
or
catalyst; [1]
more (successful) collisions; [1]
lowers E_a; [1]
max [5]

7 **(a)** **(i)** CH_2/H_2C [1]

(ii) same ratio of C:H (atoms) / all cancel to CH_2 / because general formula is C_nH_{2n} / same ratio of atoms or elements (in the compound) / C:H ratio is 1:2; [1]

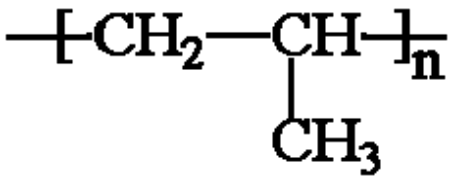
(b) **(i)** propanoic / propionic (acid); [1]
ethanoic / acetic (acid); [1]

(ii) formula of ethene / but-2-ene / any symmetrical alkene; [1]

(c) **(i)** $CH_3CH(Br)CH_2Br$ [1]

(ii) $CH_3CH(OH)CH_3$ / $CH_3CH_2CH_2OH$ / C_3H_7OH [1]

(d)



correct unit; [1]
accept: more than one repeat unit
continuation bonds at **both** ends; [1]

(e) if C_5H_{10} is given award 3 marks;;; [3]
if $C_{10}H_{20}$ is given award 2 marks;;
if 1:7.5:5 / 2:15:10 is given award 2 marks;;
in all other cases a mark can be awarded for moles of O_2 (= 2.4/32 =) 0.075 **AND** moles of CO_2 (= 2.2/44 =) 0.05;

$2C_5H_{10} + 15O_2 \rightarrow 10CO_2 + 10H_2O$ [1]
accept: multiples including fractions
allow: ecf for correct equation from any incorrect alkene

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8 **(a)** proton donor; [1]

(b) equal concentrations of both (solutions); [1]
add Universal indicator / determine pH / pH paper; [1]
ethylamine has lower pH / ORA; [1]
or
equal concentration of both (solutions); [1]
measure conductivity of aqueous ethylamine and sodium hydroxide; [1]
ethylamine will have lower conductivity / sodium hydroxide will have higher conductivity; [1]

(c) add strong(er) base / NaOH / KOH; [1]
warm / heat; [1]

(d) (ethylamine forms) hydroxide ions / OH^- (in water); [1]
hydroxide ions / OH^- reacts with iron(III) ions / Fe^{3+};
or
iron(III) hydroxide / $Fe(OH)_3$ (forms as a brown precipitate); [1]
note: balanced or unbalanced ionic equation i.e. $Fe^{3+} + (3)OH^- \rightarrow Fe(OH)_3$ scores both marks

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