Cambridge Assessment International Education

Cambridge IGCSE®

CHEMISTRY **0620/04**

Paper 4 Theory (Extended) **For examination from 2020**

MARK SCHEME

Maximum Mark: 80

Specimen

This document consists of **6** printed pages.

mark scheme abbreviations

;	separates marking points
/	alternative responses for the same marking point
not	do not allow
allow	accept the response
ecf	error carried forward
avp	any valid point
ora	or reverse argument
owtte	or words to that effect
underline	actual word given must be used by candidate (grammatical variants excepted)
( )	the word / phrase in brackets is not required but sets the context
max	indicates the maximum number of marks
Any [number] from:	accept the [number] of valid responses
note:	additional marking guidance

1 **(a)** **A** [1]

(b) **D and F** note: both needed for mark [1]

(c) **E** [1]

(d) **B** [1]

(e) **C** [1]

2 **(a)** **(i)** same number of protons and electrons [1]

(ii) all have the same number of protons / same proton number / same atomic number [1]

(iii) same number of protons / same proton number / same atomic number; [1]
different number of neutrons / different nucleon number / different mass number; [1]

(b) **(i)** 2, 8, 5 [1]

(ii) non-metal because it accepts electrons / needs 3e to complete outer energy level / because it is in Group V or 5e in outer shell [1]
note: need both non-metal and reason for one mark

3 **(a)** **(i)** 6e between two nitrogen atoms; note: can be any combination of dots or crosses [1]
1 lone pair on each nitrogen atom; [1]

(ii)

	solid	gas	
pattern:	regular / lattice	random / irregular / no pattern;	[1]
distance:	close	far apart / spread out;	[1]
movement:	vibrate / fixed position	moving;	[1]

note: comparison must be made

(b) particles have more energy / move faster; [1]
collide harder / collide more frequently / more collisions / collide with more force; [1]
allow: molecules instead of particles

(c) **(i)** nitrogen has smaller M_r; [1]
nitrogen (molecules) move faster (than chlorine molecules) / ora; [1]
note: comparison must be made

(ii) (at higher temperature) molecules move faster / have more energy [1]

4 **(a)** **(i)** Any two from:
chromium
is harder;
has higher density;
has higher melting point / boiling point;
stronger;
ora; [2]
note: comparison must be made

(ii) Any two from:
sodium is more reactive;
chromium has more than one oxidation state, sodium has one;
chromium forms coloured compounds, sodium compounds are white;
sodium reacts with cold water, chromium does not;
chromium forms complex ions, sodium does not;
chromium has catalytic properties, sodium does not; [2]
note: difference must be clear

(b) **(i)** Any two from:
appearance / shiny / more attractive / decoration;
resists corrosion / resists rusting;
hard surface; [2]

(ii) $Cr_2(SO_4)_3$ [1]
ignore: correct charges on ions

(iii) $Cr^{3+} + 3e \rightarrow Cr$ [2]
note: one mark for equation and one mark for correct balancing

(iv) oxygen / O_2 [1]

(v) to replace chromium ions (used to plate steel) / chromium ions used up; [1]
copper ions replaced from copper anode; [1]

5 one redox equation from: [1]
$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
$2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$
$Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$
$C + O_2 \rightarrow CO_2$
$CO_2 + C \rightarrow 2CO$

one acid/base equation: [1]
$CaO + SiO_2 \rightarrow CaSiO_3$
$CaCO_3 + SiO_2 \rightarrow CaSiO_3 + CO_2$

Any three additional equations or comments from: [3]
carbon <u>burns</u> or <u>reacts</u> to form carbon dioxide;
this reaction is <u>exothermic</u> or <u>produces heat</u>;
carbon dioxide is <u>reduced</u> to carbon monoxide;
carbon monoxide <u>reduces</u> hematite to iron;
carbon <u>reduces</u> hematite to iron;
limestone removes silica to form slag;
limestone <u>decomposes</u>;

6 **(a)** filter / centrifuge / decant; [1]
(partially) evaporate / heat / boil; [1]
allow to crystallise / cool / let crystals form; [1]
dry crystals / dry between filter paper / leave in a warm place to dry; [1]

(b) **(i)** number of moles of HCl used = 0.04   2 = 0.08; [1]
number of moles $CoCl_2$ formed = 0.04; [1]
number of moles $CoCl_2.6H_2O$ formed = 0.04; [1]
maximum yield of $CoCl_2.6H_2O$ = 9.52; [1]
allow: 9.5
allow: ecf on number of moles of HCl

number of moles of HCl used = 0.08 note: must use their value
allow: ecf
number of moles of $CoCO_3$ in 5.95 g of cobalt(II) carbonate = 5.95/119 = 0.05; [1]

(ii) 0.05 > 0.04 or stated in words;
allow: ecf on number of moles of $CoCl_2$ formed [1]

7 **(a)** rates equal; [1]
concentrations do not change / macroscopic properties remain constant; [1]

(b) endothermic **and** because this direction is favoured by high temperatures; [1]
note: reason is required

(c) **(i)** move to left hand side / reactants favoured **and** because bigger volume / more moles on left hand side [1]
note: reason is required

(ii) less (yellow) solid / more (dark brown) liquid / green gas visible / turns darker brown / smell chlorine [1]
allow: ecf from **(c)(i)**

(d) (bond breaking =) 151 + 242 = <u>393</u>; [1]
(bond making =) 208   2 = <u>–416</u>;   not: 416 [1]
(overall =) 393 – 416 = <u>–23</u>;   allow: ecf [1]
note: sign must be given

(e) Any two from:
diagram shows exothermic reaction;
activation energy shown;
reactants and products labelled / both axes labelled;
note: labelling is one mark only
allow: ecf from **(d)** [2]

8 **(a)** Any three from:
same general formula;
consecutive members differ by CH_2;
similar chemical properties;
same functional group;
physical properties vary in a predictable way / give trend such as mp increases with n; [3]

(b) **(i)** they have the <u>same molecular formula</u>; [1]
not: general formula
different structures / structural formulae; [1]

(ii) CH_3-CH_2-$CH(OH)$-CH_3 / $(CH_3)_3C$-OH [1]
allow: butan-2-ol and 2-methylpropan-2-ol

(c) **(i)** (acidified) potassium manganate(VII) [1]
allow: oxygen / air / (acidified) potassium chromate(VI)

(ii) carboxylic acid [1]
allow: aldehyde / ketone

(iii) CH_3-CH_2-CH_2-$COOH$ / C_3H_7COOH / $C_4H_8O_2$ [1]
allow: C_4H_7OOH
allow: ecf on **(c)(ii)**

(d) **(i)** measure <u>volume</u> of gas; [1]
measure time; [1]

(ii) increase in temperature / more yeast present / yeast multiplies [1]

(iii) glucose used up; [1]
concentration of ethanol high enough to kill yeast; [1]

9 **(a)** addition: polymer is the only product / only one product; [1]
condensation: polymer and water formed / small molecule formed; [1]

(b) Any two from:
ingestion can be fatal to animals / owtte;
animals can be caught in plastics e.g. fishing line / owtte;
combustion releases toxins / owtte;
land-fill uses natural resources / owtte;
allow: any appropriate example [2]

(c) CH_2=$CHOCOCH_3$ [1]
note: double bond does not need to be shown

(d) -$OC(CH_2)_4CONH(CH_2)_6NH$-
amide linkage correct; [1]
correct repeat units; [1]
continuation bonds shown; [1]