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  
(b) D and F  note: both needed for mark  
(c) E  
(d) B  
(e) C  

2 (a) (i) same number of protons and electrons  
(ii) all have the same number of protons / same proton number / same atomic number  
(iii) same number of protons / same proton number / same atomic number; different number of neutrons / different nucleon number / different mass number;  
(b) (i) 2, 8, 5  
(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  
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 lone pair on each nitrogen atom;  
(ii) solid gas  
pattern: regular / lattice random / irregular / no pattern;  
distance: close far apart / spread out;  
movement: vibrate / fixed position moving;  
note: comparison must be made  
(b) particles have more energy / move faster;  
collide harder / collide more frequently / more collisions / collide with more force;  
allow: molecules instead of particles  
(c) (i) nitrogen has smaller $M_r$;  
nitrogen (molecules) move faster (than chlorine molecules) / ora;  
note: comparison must be made  
(ii) (at higher temperature) molecules move faster / have more energy
4 (a) (i) Any two from:
chromium
is harder;
has higher density;
has higher melting point / boiling point;
stronger;
or;
note: comparison must be made [2]

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

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

(ii) \( \text{Cr}_2(\text{SO}_4)_3 \) [1]
ignore: correct charges on ions

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

(iv) oxygen / \( \text{O}_2 \) [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:
\( \text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2 \) [1]
\( 2\text{Fe}_2\text{O}_3 + 3\text{C} \rightarrow 4\text{Fe} + 3\text{CO}_2 \)
\( \text{Fe}_2\text{O}_3 + 3\text{C} \rightarrow 2\text{Fe} + 3\text{CO} \)
\( \text{C} + \text{O}_2 \rightarrow \text{CO}_2 \)
\( \text{CO}_2 + \text{C} \rightarrow 2\text{CO} \)

one acid/base equation:
\( \text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3 \) [1]
\( \text{CaCO}_3 + \text{SiO}_2 \rightarrow \text{CaSiO}_3 + \text{CO}_2 \)

Any three additional equations or comments from:
carbon burns or reacts to form carbon dioxide;
this reaction is exothermic or produces heat;
carbon dioxide is reduced to carbon monoxide;
carbon monoxide reduces hematite to iron;
carbon reduces hematite to iron;
limestone removes silica to form slag;
limestone decomposes; [3]
6 (a) filter / centrifuge / decant; (partially) evaporate / heat / boil; allow to crystallise / cool / let crystals form; dry crystals / dry between filter paper / leave in a warm place to dry; [1]

(b) (i) number of moles of HCl used = 0.04 \times 2 = 0.08;
number of moles CoCl$_2$ formed = 0.04;
number of moles CoCl$_2$.$6$H$_2$O formed = 0.04;
maximum yield of CoCl$_2$.$6$H$_2$O = 9.52;
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 5.95g 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;
concentrations do not change / macroscopic properties remain constant; [1]

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

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

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

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

(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 CH₂;
- 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 same molecular formula; [1]
    not: general formula
    different structures / structural formulae; [1]

(ii) CH₃-CH₂-CH(OH)-CH₃ / (CH₃)₃C-OH
    allow: butan-2-ol and 2-methylpropan-2-ol [1]

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

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

(iii) CH₃-CH₂-CH₂-COOH / C₃H₇COOH / C₄H₈O₂
    allow: C₄H₇OOH
    allow: ecf on (c)(ii) [1]

(d) (i) measure volume of gas;
    measure time; [1]

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

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

9 (a) addition: polymer is the only product / only one product;
    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) CH₂=CHOCHOCH₃
    note: double bond does not need to be shown [1]

(d) -OC(CH₂)₄CONH(CH₂)₆NH-
    amide linkage correct; [1]
    correct repeat units;
    continuation bonds shown; [1]