M08/4/CHEMI/SP3/ENG/TZ1/XX/M+

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MARKSCHEME

May 2008

CHEMISTRY

Standard Level

Paper 3

15 pages

Subject Details: Chemistry SL Paper 3 Markscheme

Mark Allocation

Candidates are required to answer questions from **TWO** of the options **[2 × 20 marks]**. Maximum total = **[40 marks]**

1. A markscheme often has more marking points than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

2. Each marking point has a separate line and the end is signified by means of a semicolon (;).

3. An alternative answer or wording is indicated in the markscheme by a slash (/) - either wording can be accepted.

4. Words in brackets ( ) in the markscheme are not necessary to gain the mark.

5. Words that are underlined are essential for the mark.

6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.

7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by writing ***OWTTE*** (or words to that effect).

8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

9. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. Indicate this with **ECF** (error carried forward).

10. Only consider units at the end of a calculation. Unless directed otherwise in the mark scheme, unit errors should only be penalized once in the paper. Indicate this by writing **–1(U)** at the first point it occurs and **U** on the cover page.

11. Significant digits should only be considered in the final answer. Deduct **1 mark in the paper** for an **error of 2 or more digits** unless directed otherwise in the markscheme.

e.g. if the answer is 1.63:

2	*reject*
1.6	accept
1.63	accept
1.631	accept
1.6314	*reject*

Indicate the mark deduction by writing **–1(SD)** at the first point it occurs and **SD** on the cover page.

12. If a question specifically asks for the name of a substance, do not award a mark for a correct formula, similarly, if the formula is specifically asked for, do not award a mark for a correct name.

13. If a question asks for an equation for a reaction, a balanced symbol equation is usually expected, do not award a mark for a word equation or an unbalanced equation unless directed otherwise in the markscheme.

14. Ignore missing or incorrect state symbols in an equation unless directed otherwise in the markscheme.

Option A – Higher physical organic chemistry

A1. (a) (i) secondary because C attached to Br has 2 alkyl groups/one H / *OWTTE*; ***[1]***

(ii) S = substitution;
N = nucleophilic;
1 = unimolecular/molecularity of 1; ***[2 max]***
*Award **[2]** for three correct*, ***[1]*** *for two correct and **[0]** for one/zero*.

(iii) II;
I;
I; ***[2 max]***
*Award **[2]** for three correct*, ***[1]*** *for two correct and **[0]** for one/zero*.

(iv) 3-methylbutan-2-ol; ***[1]***

(v) rate = k[RBr] / rate = $k[RBr]^1[OH^-]^0$; ***[1]***

(b) curly arrow from O of OH^- to C of C–Br;
transition state showing partial bonds and negative charge;
curly arrow from C–Br bond to Br;
correct products; ***[3 max]***
*Award **[1]** each for any three*.

(c) (i) 4; ***[1]***
Accept answer of 5 only if presence of TSM is stated.

(ii) 6:3:1:1 *(in any order)*; ***[1]***

(iii) 1000 – 1300 / 3230 – 3550 (cm^{-1}); ***[1]***

A2. (a) trichloroethanoic (acid) / CCl_3COOH ;
0.22; ***[2]***

(b) 4.01 and 2,4-dinitrophenol; ***[1]***

(c) $K_a = \frac{[CH_3CH_2COO^-][H^+]}{[CH_3CH_2COOH]}$; ***[1]***
Accept H_3O^+ *instead of* H^+

(d) $[H^+] = \sqrt{K_a \times [CH_3CH_2COOH]}$ / $\sqrt{1.35 \times 10^{-5} \times 0.25}$;
$[H^+] = 1.83$ to 1.84×10^{-3} ;
pH = 2.73 to 2.74; ***[3]***

Option B – Medicines and drugs

B1. (a) $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$;
$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$; ***[2]***
*Award **[1 max]** if H_2CO_3 given as the product.*

(b) twice as much HCl neutralized / *OWTTE*; ***[1]***

(c) to prevent stomach acid rising (into the esophagus) / to prevent heartburn / to prevent acid reflux; ***[1]***

(d) (i) carbon dioxide (gas) produced (in both reactions); ***[1]***

(ii) MgO / $Mg(OH)_2$ / $Al(OH)_3$; ***[1]***
Accept correct name in place of formula.

B2. (a) (i) induce sedation/calmness/soothing effect/relaxation / reduce anxiety; ***[1]***

(ii) induce loss of consciousness / sleep / coma / death; ***[1]***

(b) they relieve the symptoms of (mental) depression; ***[1]***

(c) (i) liver damage / liver disease / liver cancer / cirrhosis;
increased blood pressure / heart disease / stroke;
miscarriage / fetal abnormalities; ***[2 max]***
*Award **[1]** each for any two*.

(ii) potassium dichromate / $K_2Cr_2O_7$ / $Cr_2O_7^{2-}$;
orange to green;
ethanal / CH_3CHO / ethanoic acid / CH_3COOH ; ***[3]***

B3. (a) 16; ***[1]***

(b) (i) penicillin G deactivated by penicillinase/enzyme; ***[1]***

(ii) side chain/R group modified/rearranged / *OWTTE*; ***[1]***

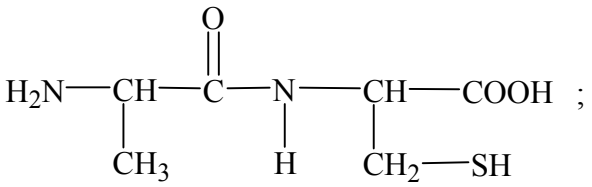
(c) cell wall formation prevented / cell wall destroyed; ***[1]***

(d) (i) takes/analyses sample (of blood, urine, *etc*.) / identifies bacterium; ***[1]***

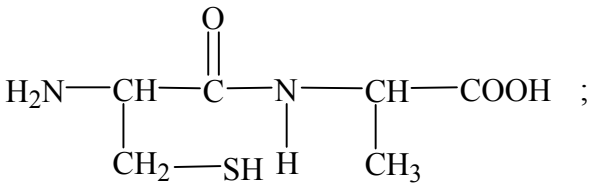
(ii) kills beneficial/useful bacteria; ***[1]***
Do not accept good or friendly bacteria.

Option C – Human biochemistry

C1. (a)



;



;

[2]

(b) condensation;
water / H_2O ; ***[2]***

(c) (i) hydrolyses polypeptide/protein / releases amino acids; ***[1]***

(ii) place amino acid mixture on gel/paper;
use buffer solution;
apply potential difference;
acids move different distances;
develop/spray with ninhydrin;
compare isoelectric points / compare distances travelled with standards; ***[4 max]***
*Award **[1]** each for any four.*

C2. (a) (i) $CH_3(CH_2)_{20}COOH$ / other correct more detailed formula; ***[1]***

(ii) 340 / 341; ***[1]***

(b) erucic acid has kinked chain / *OWTTE*;
molecules pack less closely / reduces area of contact;
van der Waals'/intermolecular/London/dispersion forces weaker; ***[3]***
Do not accept weaker hydrogen bonding.
Accept opposite arguments for behenic acid.
If answers refer to the relative strengths or the breaking of C–C or C=C bonds, then no marks can be awarded.

(c) number $= \frac{304 \times 334}{254 \times 100}$ / other correct working;
= 4; ***[2]***
*Award **[1]** for final answer of 8 based on use of A_r instead of M_r of iodine.*

C3. (a)

	Adrenaline	Thyroxine
Elements present, other than carbon, hydrogen, oxygen	nitrogen	iodine and nitrogen;
Where produced	adrenal gland **and**	thyroid gland;

[2]

(b) hypothalamus;
pituitary gland;

[2]

Option D – Environmental chemistry

D1. (a) $N_2 + O_2 \rightarrow 2NO$; ***[1]***

(b) $2H_2S + 3O_2 \rightarrow 2SO_2 + 2H_2O$; ***[1]***

(c) respiratory irritant / causes respiratory tract infections; ***[1]***

(d) $2NO + 2CO \rightarrow N_2 + 2CO_2$; ***[1]***

(e) (increased) NO;
(decreased) CO / hydrocarbons; ***[2]***

(f) (particulates) attracted to oppositely charged electrodes / electrostatic precipitation; ***[1]***

D2. (a) (i) (N_2O) more effective / better at trapping heat; ***[1]***

(ii) (CO_2) more abundant; ***[1]***

(b) radiation/energy from sun is short wavelength;
absorbed by (surface of) earth;
radiation emitted by earth is long(er) wavelength;
greenhouse gases absorb this radiation;
(which is) (re-)radiated back to earth;
*Award **[1]** each for any three up to **[3 max]**.*

climate change / stated example such as desertification;
global warming;
melting of glaciers/ice caps;
coastal flooding / rise in sea level; ***[4 max]***
*Award **[1 max]** for any of the above four.*

D3. (a) ozone more expensive because it must be generated on site / chlorine cheaper because it can be stored on site / *OWTTE*;
effect of chlorine lasts longer / effect of ozone lasts for shorter time;
both kill bacteria / only ozone effective against viruses;
chlorine leaves taste / ozone does not leave taste;
chlorine produces toxic/carcinogenic products / ozone does not; ***[4 max]***
*Award **[1]** each for any two of last three points.*

(b) use of partially permeable membrane;
sea water subjected to high pressure/pressure above 70 atm;
(only) water passes through membrane; ***[3]***

Option E – Chemical industries

E1. (a) (i) $2CH_4 + O_2 \rightarrow 2CO + 4H_2$ / $CH_4 + \frac{1}{2}O_2 \rightarrow CO + 2H_2$; ***[1]***

(ii) $Fe_3O_4 + H_2 \rightarrow 3FeO + H_2O$; ***[1]***

(iii) $FeO + CO \rightarrow Fe + CO_2$; ***[1]***

(b) (i) becomes less brittle/more malleable; ***[1]***

(ii) acid-base reaction / neutralization; ***[1]***

E2. (a) aluminium is too reactive/much more reactive than iron / high(er) up in the reactivity series; ***[1]***

(b) lowers operating temperature/melting point of alumina/mixture / acts as solvent; ***[1]***
Do not accept "lowers melting point of aluminium".

(c) *Positive electrode:*
$2O^{2-} \rightarrow O_2 + 4e^-$;

Negative electrode:
$Al^{3+} + 3e^- \rightarrow Al$; ***[2]***
Accept – $4e^-$ on LHS of first equation.
*Award **[1]** if both equations correct but at wrong electrodes.*

(d) carbon / graphite / C;
burn in oxygen / react with oxygen / form carbon dioxide; ***[2]***
Do not accept erode/corrode/wear away.

E3. (a) column hotter at the bottom/cooler at the top;
molecules/fractions with lower boiling points/smaller sizes rise higher;
fractions condense at different heights; ***[3]***

(b)

Type of cracking	**Catalyst used**	**Other substance present**	**Example of type of product formed**
Steam cracking	none	steam	alkenes;
Catalytic cracking	alumina / silica / aluminosilicate;	none	branched alkanes
Hydrocracking	platinum;	hydrogen;	aromatic compounds

[4]

(c) $C_7H_{16} \rightarrow 2C_2H_4 + C_3H_8$; ***[1]***

(d) $C_6H_{14} \rightarrow C_6H_{12} + H_2$; ***[1]***

Option F – Fuels and energy

F1. (a) (C) $(394 \div 12) = 32.8$ (kJ g^{-1});
(CH_4) $(890 \div 16) = 55.6$ (kJ g^{-1});
(C_8H_{18}) $(5512 \div 114) = 48.4$ (kJ g^{-1}); ***[3]***
No penalty for use of negative signs.
Accept use of A_r values as integers or to 2 dp.
If atomic number used instead of atomic mass, penalise once only.

(b) (i) sulfur dioxide/SO_2 / smoke / particulates; ***[1]***

(ii) $C + H_2O \rightarrow CO + H_2$; ***[1]***

F2. (a) new element(s)/atom(s) formed / change in nucleus;
loss in mass / large amount of energy formed / mass converted to energy; ***[2]***

(b) $^{235}_{92}U + ^{1}_{0}n \rightarrow ^{144}_{56}Ba + ^{90}_{36}Kr + 2^{1}_{0}n$ ***[2]***
*Award **[1]** for all three isotopes correct.*
*Award **[1]** for 2 neutrons formed.*

(c) (i) time for amount/mass of isotope/activity (of sample) to halve / *OWTTE*; ***[1]***

(ii) (2 hours is) 6 half-lives;
2 (mg) / 0.002 g; ***[2]***
No credit for 2 g
*Award **[2]** for correct final answer.*

(iii) Tl;
Po; ***[2]***

(iv) alpha deflected less / beta deflected more;
alpha moves towards negative / beta moves towards positive / alpha and beta deflected in opposite directions; ***[2]***

F3. (a) $PbO_2 + 4H^+ + SO_4^{2-} + 2e^- \rightarrow PbSO_4 + 2H_2O$;
Accept $H_2SO_4 + 2H^+$ on LHS

$Pb + SO_4^{2-} \rightarrow PbSO_4 + 2e^-$; ***[2]***
Accept use of $-2e^-$ on opposite sides.

(b) (i) voltage depends on nature of materials used / *OWTTE*; ***[1]***

(ii) six connected together (in series); ***[1]***