NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2011

PHYSICAL SCIENCES: PAPER II

MARKING GUIDELINES

Time: 3 hours 200 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

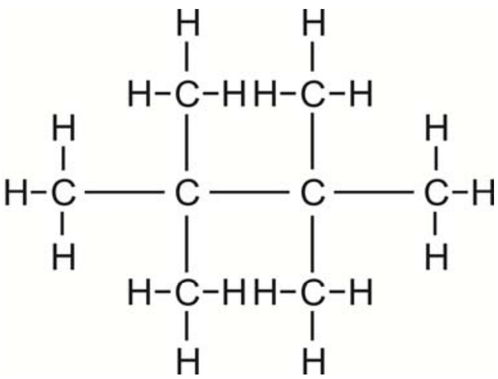
The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

QUESTION 1

1.1	D	(2)
1.2	B	(2)
1.3	B	(2)
1.4	A	(2)
1.5	C	(2)
1.6	A	(2)
1.7	D	(2)
1.8	A	(2)
1.9	C	(2)
1.10	B	(2)
		[20]

QUESTION 2

2.1



Semistructural max ½
Hydrogen/s left off ½

Max chain length 4.
All single single bonds. (2)

2.2 $2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$ (or multiples)
LHS (balancing) RHS (balancing)
CO_2 H_2O (4)

2.3 C_3H_6 or structural (1)

2.4 Fast (1)

2.5 Addition. (A is unsaturated) and bromine adds across the double bond. (3)

2.6 To make polymers/as a monomer for making polymers
(other possibilities to be discussed) (1)

2.7 2.7.1 (3-methyl) – but – (1-ene) → pentene (⅓ max) (3)

2.7.2 (H ↔ OH: OR)

```
   H   OH  CH3  H
   |   |   |    |
H — C — C — C — C — H
   |   |   |    |
   H   H   H    H
```

4 carbons
OH in right place
single bonds (3)

2.7.3 Alcohols/Alkanols (1)

2.8 2.8.1 Alcohols have hydrogen bonding rather than Van der Waals' forces. Hydrogen bonds are stronger than V.d. Waals'. (4)

2.8.2 Greater mass
The longer the chain, the more electrons.
Greater chance of temporary dipole./stronger v.d. Waals/London (3)

2.9 2.9.1 Same molecular formula.
Different structural formula. (2)

2.9.2 $CH_3CH_2CHCH_2$ } 1-butene
$CH_3CHCHCH_3$ } 2-butene
$CH_3C(CH_3)CH_2$ } methylpropene

$CH_3CH_2CH_2CH_3$
carbons
all HS (9)

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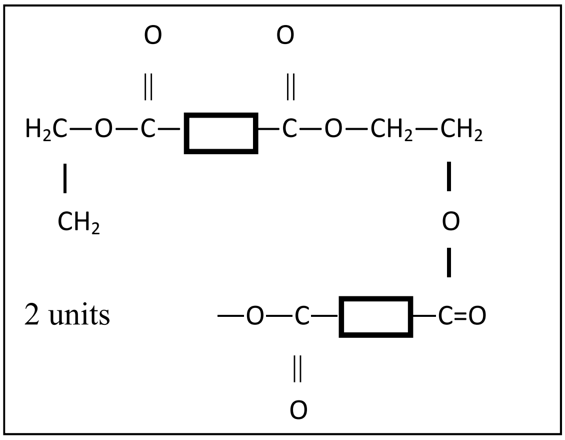
QUESTION 3

3.1

2 × ester link
2 × repeat units



CH_3
|
$CH_3 – CH – CH_3$ me-propane
carbons
all Hs
branch

If only one structure (branched)
4 C
10 H
name
condensed
branched/straight

Branched only 6
Straight only 3
Both 9 (4)

3.2 Condensation (esterification) (2)

3.3 No. Too large to be volatile as gas. (2)

3.4 The ester link is reversed back to acid and alcohol. Shorter chains acid reacts (2)

3.5 Cyclic structure/An acid/alcohol with only one functional group is added./run out of reactants (2)

3.6 3.6.1 Can be melted and reshaped (thermoplastic).
Decomposes (thermoset)/chars, burns, degrades (2)

3.6.2 Thermoplastic: easy to recycle.
Thermoset: cannot be recycled. (2)

3.6.3 Thermoplastic: low
Thermoset: high – rigid (2)

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QUESTION 4

4.1 $CuSO_4$ (1)

4.2 If different salts – they may react/The **solution** enables the metal ions to dissolve and **drift**, completing the circuit. Epectrolyte present (2)

4.3 Process where a species loses electrons during a reaction or just loss of electrons. (2)

4.4 4.4.1 $Cr \rightarrow Cr^{3+} + 3e^-$ (2)

–1 double arrows

4.4.2 $Cu^{2+} + 2e^- \rightarrow Cu$ (2)

4.5 Cr (consistent with oxidation half-reaction in 4.4) (2)

4.6 $2Cr + 3Cu^{2+} \rightarrow 2Cr^{3+} + 3Cu$
LHS RHS balancing (3)

4.7 $E^\theta_{cell} = E^\theta_{cat} - E^\theta_{an}$
$= 0,34 - (-0,74)$ No carryover
$= 1,08$ V (3)

4.8 Spontaneous (YES) → E^θ_{cell} value is positive or for –ve if consistent (2)

4.9 The cell is not operating under standard conditions.
conc ≠ 1 mol·dm^{-3}
pressure ≠ 1 atm (for a gas electrode)
temp ≠ 25 °C (4)

conc. 1 mol·dm^{-3}
temp. 25 °C
press for gases ✓ bonus

4.10 4.10.1 Salt bridge (1)

4.10.2 NaCℓ solution (any soluble salt solution) (2)

4.10.3 Maintain electrical neutrality.
Complete the circuit. (2)

4.11 4.11.1 Zn can lose (oxidised) or Zn^{2+} can gain 2 e^- (reduced) in a reaction or the reaction is reversible. (1)

4.11.2 When connected to the std hydrogen ½ cell zinc undergoes oxidation to produce an emf of 0,76V.
Zn is a stronger red. agent (3)

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QUESTION 5

5.1 Na dissolves in Hg to form an amalgam. NaOH produced is very pure.
OR It is liquid (and so convenient) and conducts electricity. (2)

5.2 $Na^{+} + e^{-} \rightarrow Na(s)$ (2)

5.3 5.3.1 Added to water. (1)

5.3.2 Na reacts with water./Redox reaction or equation (1)

5.3.3 $NaOH/H_2$ (2)

5.4 $2C\ell^{-} \rightarrow C\ell_2 + 2e^{-}$ (2)

5.5 Iron would react and contaminate product and need replacement. Titanium does not react with $C\ell_2$ gas. (Any 1) (2)

5.6 Product is pure.
No need to concentrate the product.
More energy efficient to run. (Any 2) More cost-efficient
No steam ½ (4)

5.7 No need to concentrate the product. (2)

5.8 Yes or No. (Must be with reason.)
Reason
More efficient/cost (3)

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QUESTION 6

6.1 rate fastest
Any relationship between temp and time taken.
0/2 if question (2)

6.2 6.2.1 Temperature (1)

6.2.2 Time (1)

6.2.3 Conc of solutions
Same observer
Any other suitable (2)

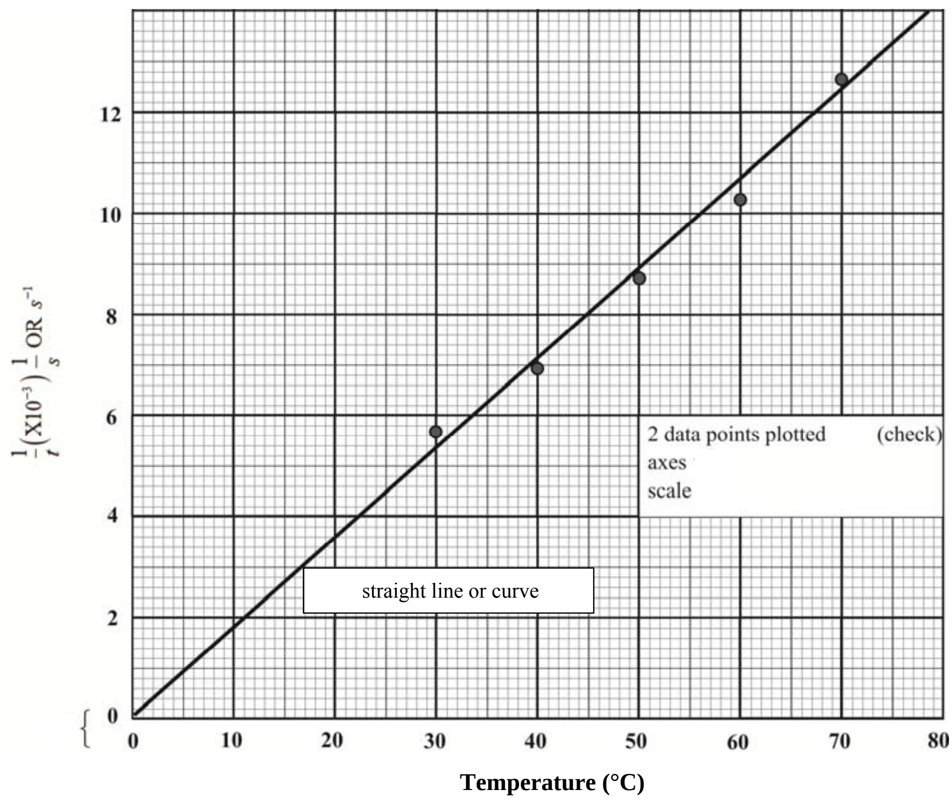
6.3 Yes. (The test is fair) + the controls have ensured that the data is reliable. (3)

6.4 Straight line through origin (2)

6.5 Values for points are:

30	$5{,}46 \times 10^{-3}$	see graph
40	$6{,}94 \times 10^{-3}$	
50	$8{,}70 \times 10^{-3}$	
60	$10{,}3 \times 10^{-3}$	
70	$12{,}7 \times 10^{-3}$	

Both temp vs $\frac{1}{t}$ and $\frac{1}{t}$ vs temp } acceptable (7)



6.6 As temp. increases rate increases. $\frac{1}{3}$
Inverse relationship as the temp. inc, time decreases.
Temp. is inv. prop. to time.
Math statement $\frac{1}{3}$
As time increases, temp decreases. $\frac{1}{3}$ (3)

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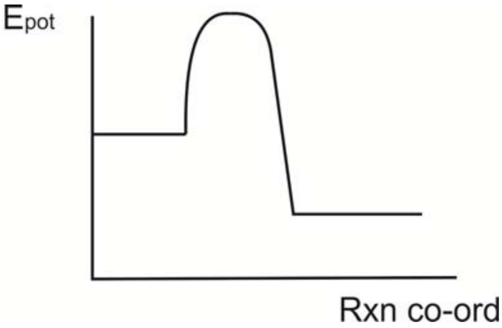
QUESTION 7

7.1 No. The conditions are such that the forward reaction is constantly favoured. Not a closed system. Products are removed. (3)

7.2 Removing ammonia prevents the reverse reaction./Produces more NH_3. (2)

7.3



Shape
Start higher than end height (3)

7.4 Increase pressure. or Increase concentration of reactants.
Add a catalyst.
Increase temperature. (3)

7.5 Yield Amount (2)

7.6 A lower temperature produces a better yield, but the rate drops too low. Higher pressures would give a better yield, but involves greater expense and risks to safety increase. (4)

7.1 7.7.1 $K_c = [NH_3]^2/[H_2]^3\ [N_2]$ max $\frac{1}{3}$ if ( ) (3)

7.7.2 $K_c = (0,4)^2\ /(0,3)^3\ (0,7) = 8,47$ (or 8,47) no carry over (2)

7.7.3 (i) Decrease (2)

(ii) No change (remains same) (2)

(iii) Remain same (2)

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QUESTION 8

8.1 8.1.1 A cell using a paste.
OR not liquid medium. (1)

8.1.2 Cannot be recharged. (2)

8.2 The casing of zinc corrodes (dissolves) as the cell runs.

$Zn \rightarrow Zn^{2+} + 2e^{-}$ (3)

8.3 The paste does not allow ions to drift easily (causing build-up of charge). (2)

8.4 8.4.1 Q = It = 2 × 60 × 60 = 7 200 C (3)

8.4.2 n_e = 7 200/96 500 = 0,075 mol (0,08)

OR no. of $e^{-} = \frac{7\ 200}{1{,}6 \times 10^{-19}} = 4{,}5 \times 10^{22}$

$\therefore\ n_{e^-} = \frac{4{,}5 \times 10^{22}}{6{,}02 \times 10^{23}} = 0{,}075$ mol Carry over (2)

8.4.3 n_{Cd} = 0,075/2 = 0,038 mol (0,04) (1)
Not carry over

8.4.4 m Cd = nM = 0,038 × 112 = 4,2 g (4,48) ½ if used 112 (2)

8.4.5 The disposal of the cells is problematic. Toxic (1)

8.4.6 Less expensive over time.
Less resource intensive (any sensible suggestion) (2)

8.4.7 No. The voltage is determined by the half-reactions. (2)

8.4.8 Yes. The distance between the anode and cathode will affect internal resistance. (2)

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Total: 200 marks