CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level

MARK SCHEME for the October/November 2013 series

8780 PHYSICAL SCIENCE

8780/03 Paper 3 (Structured Questions), maximum raw mark 80

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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International Examinations

1 **(a)** **A**: $Sr(OH)_2$
B: $SrSO_4$
C: $Sr(NO_3)_2$

any two correct for one mark
all three correct for two marks [2]

(b) **(i)** strong heating [1]

(ii) $SrCO_3 \rightarrow SrO + CO_2$ [1]

(c) **(i)** simplest whole-number ratio of atoms of each element present in the compound [1]

(ii) percentage Sr = (100 – 26.76) = 73.24%

Sr	O		
$\frac{73.24}{87.6}$	$\frac{26.76}{16.0}$		[1]
0.836	1.673		
1	2	SrO_2	[1]

(iii) H_2O_2 [1]

[Total: 8]

2 **(a)** the velocity/motion is in the opposite direction to original velocity/velocity v_{A1} before collision [1]

(b) $m_A v_{A1}$ $(+m_B v_{B1}) = m_A v_{A2} + m_B v_{B2}$ in symbols, words or numbers [1]
0.123 ($m\,s^{-1}$) [1]

(c) use of conservation of kinetic energy and use of KE = ½ mv^2 [1]
E_k before = 5.40×10^{-3} J and E_k after = 4.94×10^{-3} J (e.c.f from **(b)**) [1]
collision is inelastic as E_k before > E_k after (e.c.f) [1]
OR
considers speed of approach = speed of separation and evidence of calculation (1)
speed of approach = 0.3 ($m\,s^{-1}$), speed of separation = 0.16 + 0.123 = 0.283 ($m\,s^{-1}$) (1)
collision is inelastic as speed of approach > speed of separation (1)

[Total: 6]

3 recognition that **both** K_2O and P_4O_{10} **react** with water, (so cannot be present in solution) [1]
idea that the KOH and H_3PO_4 formed by reaction with water will then neutralise each other [1]

$K_2O + H_2O \rightarrow 2KOH$ [1]
$P_4O_{10} + 6H_2O \rightarrow 4H_3PO_4$ [1]
$H_3PO_4 + 3KOH \rightarrow K_3PO_4 + 3H_2$ [1]

[Total: 5]

4 **(a)** the resultant force (in any direction) on the beam is zero [1]
the resultant moment on the beam/about any point is zero [1]
(accept the sum of the clockwise moments = the sum of the anticlockwise moments)

(b) **(i)** **(ii)** vector diagram drawn with one side 3.9 cm in correct direction [1]
triangle completed correctly and correct arrows [1]
force $H = 77.5 \pm 2.5$ (N) [1]

[Total: 5]

5 **(a)** when two (or more waves meet at a point) the resultant displacement is the sum of the two individual displacements [1]

(b) **(i)** the amplitude of the trace (on the c.r.o.) would go from maximum to minimum (several times) (o.w.t.t.e) [1]

(ii) **1.** maxima and minima would be closer together (accept wavelengths on the screen are shorter) [1]

2. amplitude of the trace increases [1]

(c) to prevent (destructive) interference (o.w.t.t.e) [1]
the transmissions are not coherent **or** which would cause some places to have (very) poor reception (signal) [1]

[Total: 6]

6 **(a)** **(i)** anode = impure copper [1]
cathode = pure copper [1]
electrolyte = $CuSO_4$ / $Cu(NO_3)_2$ **not** $CuCl_2$ or just Cu^{2+}(aq) [1]

(ii) anode = $Cu \rightarrow Cu^{2+} + 2e^-$ and cathode = $Cu^{2+} + 2e^- \rightarrow Cu$ [1]

(iii) anode sludge/lime [1]

(b) when NaCl is added the [Cl^-] increases [1]
when water is added the [Cl^-] decreases [1]
as [Cl^-] increases equilibrium moves right / as [Cl^-] decreases equilibrium moves left [1]
to restore equilibrium / to reduce or increase [Cl^-] (as appropriate) [1]

responses should be given credit if they include the identification of changes to chloride ion concentration due to the additions of salt and water, the effects this has on the equilibrium position and a realistic Le Chatelier-based explanation

[Total: 9]

7 **(a)** **(i)** use of $a = \Delta v / \Delta t$ **or** acceleration = gradient (= $16 \times 10^6 / 3.5 \times 10^{-9}$) [1]
4.6×10^{15} (m s^{-2}) [1]

(ii) use of $F = ma = 9.11 \times 10^{-31} \times 4.6 \times 10^{-15}$) (must use 9.11×10^{-31} kg) e.c.f from **(i)** [1]
4.2×10^{-15} (N) or 4.1×10^{-15} (N) [1]

(b) steeper slope with electron emerging earlier [1]
with higher final speed [1]

(c) use of $E = F/q = (5.0 \times 10^{-15} / 1.6 \times 10^{-19})$ [1]
3.1×10^4 (NC^{-1}) [1]

[Total: 8]

8 **(a)** **(i)** (2-) methylpropan-1-ol **or** appropriate structural formula [1]

(ii) elimination/dehydration [1]

(iii) hydrogen bromide/HBr [1]

(b) 1-bromo(-2-)methylpropane [1]
allow transposition of substituents but not 2-bromo-

(c) **(i)** (p-)amine [1]

(ii) curly arrow from lone pair of N to C joined to Br [1]
curly arrow from C–Br bond to Br atom [1]
correct intermediate showing positive charge on N atom [1]
curly arrow showing deprotonation [1]

[Total: 9]

9 **(a)** work done/energy transferred per unit charge [1]

(b) 150 (Ω) [1]

(c) **(i)** <u>use</u> of $V = IR$ to show $I = 6.0/400$ [1]

(ii) zero (V) <u>and</u> correct reasoning using $V = IR$ [1]

(iii) resistance of thermistor = 600 (Ω) [1]
pd across thermistor = ¾ × 6 V = 4.5 V or evaluation of total resistance [1]
use of $V = IR$ to find I (= 7.5×10^{-3} A compared with 1.5×10^{-2} A) or by Kirchhoff or other [1]

(iv) evidence of using Kirchhoff for loop CAD [1]
1.5 (V) [1]

[Total: 9]

10 **(a)** **(i)** $\Delta H = \Sigma$(bonds broken) – Σ(bonds formed) **or** [1]
cycle (4 × 390 + 160 × 2 × 150 + 4 × 460) – [994 + (8 × 460)]
–814 (kJ mol^{-1}) *minus sign required* [1]

(ii) O is reduced
oxidation number of O goes from –1 to –2
N is oxidised
oxidation of N goes from –2 to zero

award two marks for four points
award one mark for any two or three points [2]

(b) **(i)** equations added together
$3N_2H_4 \rightarrow 4NH_3 + N_2$
$4NH_3 + N_2H_4 \rightarrow 3N_2 + 8H_2$
$4N_2H_4$ (+ $4NH_3$) $\rightarrow$ $4N_2$ (+ $4NH_3$) + $8H_2$
cancelled NH_3
divided by 4 to give $N_2H_4 \rightarrow N_2 + 2H_2$ [1]

only allow this mark if the reasoning is clear and unambiguous

(ii) $nN_2H_4 = 400/32 = 12.5$ [1]
n(gas) = 3 × 12.5 = 37.5 [1]
$$P = \frac{37.5 \times 8.31 \times 950}{0.025}$$ [1]
P = 11842 (kPa) [1]

[Total: 9]

11 **(a)** any four from: [4]
α-particles at gold foil
thin (gold foil)
detector moved to different angles / vacuum / foil
most un-deviated / little deviation
a few scattered through large angles / $>$ 90°

(b) **(i)** like charges repel, so large deflections show nucleus must have same charge as alpha (o.w.t.t.e) [1]
or argument based on conservation of momentum for large deflections
or large angle deflection means mass/positive charge is not distributed throughout

(ii) most α-particles were un-deviated / very few scattered through large angles, (hence cross-section of nucleus is very small) [1]

[Total: 6]