UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level

PHYSICAL SCIENCE **8780/03**

Paper 3 **For Examination from 2011**

SPECIMEN MARK SCHEME

Duration

MAXIMUM MARK: 80

This document consists of **5** printed pages and **1** blank page.

1 **(a)** 1.7 % [1]

(b) use of density = mass / volume (= 580 / 6^3) [1]
= 2.685 g cm^{-3} … (allow 2.68, 2.69, 2.7) [1]

% uncertainty in volume = 3 × (0.1 / 6) × 100 = 5.0% [1]
(→ uncertainty in density = 0.18 g cm^{-3})

density = 2.7 ± 0.2 g cm^{-3} [1]
(e.c.f and answer 2.69 ± 0.18 g cm^{-3} scores 3/4 marks)

[Total: 5]

2 **(a)** ball moving in opposite direction (after collision) [1]

(b) **(i)** change in momentum = 1.2 (4.0 + 0.8) [2]
(correct values, 1 mark; correct sign {values added}, 1 mark)
= 5.76 N s … (allow 5.8) [1]

(ii) force = $\Delta p / \Delta t$ or $m\Delta v / \Delta t$ [1]
= 5.76 / 0.08 or 1.2 × 4.8 / 0.08 [1]
= 72 N [1]

(c) 5.76 = 3.6 × v [1]
v = 1.6 m s^{-1} [1]

(d) (total) kinetic energy not conserved [1]

[Total: 10]

3 **(a)** carbonates become more stable down the Group/higher decomposition temperature [1]
cation/M^{2+} radius/size increases down the group/M^{2+} charge density decreases [1]
anion/carbonate ion/CO_3^{2-} suffers less polarisation/distortion [1]

(b) **(i)**

Cu	=	57.7/63.5	=	0.91	correct ratios [1]
O	=	36.2/16	=	2.26	
C	=	5.4/12	=	0.45	
H	=	0.9/1	=	0.90	hence $Cu_2O_5CH_2$ [1]

(ii) $Cu^{2+}(aq)$ or $[Cu(H_2O)6]^{2+}$ NOT $[Cu(H_2O)_4]^{2+}$ [1]

(iii) **D** is CuO / copper(II) oxide [1]
$Cu_2O_5CH_2 \rightarrow 2CuO + CO_2 + H_2O$ [1] [1]
221 → 159 (both M_rs) [1]
∴ 10 → 10 × 159 / 221 = 7.2 g (7.19) [1]

(iv) **E** is copper; **F** is Fe^{2+} / Fe SO4 [1]
$Fe + Cu^{2+} \rightarrow Fe^{2+} + Cu$ (or full equation) [1]

(v) redox/displacement [1]

[Total: 13]

4 **(a)** either phase difference is π rad / 180° [1]
or path difference (between waves from S_1 and S_2) is ½ λ or (n + ½)λ

either same amplitude / intensity at M [1]
or ratio of amplitudes is 1.28 / ratio of intensities is 1.28

(b) path difference between waves from S_1 and S_2 = 28 cm [1]
wavelength changes from 33 cm to 8.25 cm [1]
minimum when λ = (56 cm,) 18.7 cm, 11.2 cm, (8.0 cm) [1]
so two minima [1]

[Total: 6]

5 **(a)** **(i)** CH_2=CH–$CH_2CH_2CH_3$ / pent-1-ene *accept C_3H_7 on RHS* [1]

(ii) 8 [1]

(b) **(i)** e.g. $C_{40}H_{82} \rightarrow C_{16}H_{34} + 2\ C_{12}H_{24}$ **OR** $C_{40}H_{82} \rightarrow C_{16}H_{34} + C_{24}H_{48}$ etc [1]

(ii) heat + catalysts/SiO_2/Al_2O_3/Pt/ceramic/pumice/zeolite etc. *If temp given >500 °C* [1]

(iii) bonds broken: 4(C–C) = 4 × 350 = 1400 kJ mol^{-1}
bond formed: 2(C=C) = 2 × 610 = 1220 kJ mol^{-1}
ΔH = +180 kJ mol^{-1} [1]
from eqn in **(a)(i)** : +90 kJ mol^{-1} for each C=C formed (could be multiples of 90)

(iv) endothermic reactions ΔH > 0 [1]

[Total: 6]

6 **(a)** $N_2 + 3H_2 \rightleftharpoons 2NH_3$
exothermic [1]

(b) pressure. 5O atm / 50000 Pa/N m^{-3} upwards; [2]
temp 400-600 °C;
catalyst of iron
(1 mark for 2 correct; 2 marks for all 3 conditions correctly stated)

(c) too high a temp and equilibrium favours LHS, less ammonia at equilibrium [1]
too low a temp, rate too slow/not enough molecules have E_a [1]

(d) excess (hence uncontrolled) nitrates leach out of fields into streams, seas (1)
bacteria or algae grow fast/use oxygen/clog up water (1)
balance destroyed/fish unable to live (1)
process called eutrification (1) **any 2** [2]

[Total: 7]

7 **(a)** **(i)** arrow in upward direction, foot near P [1]

(ii) curved path, consistent with **(i)** between plates [1]
then straight (with no kink at change-over) [1]

(b) **(i)** F = E q [1]
$= 5.0 \times 10^4 \times 1.6 \times 10^{-19}$
$= 8.0 \times 10^{-15}$ N [1]

(ii) a = F/m [1]
$= (8.0 \times 10^{-15})/(9.1 \times 10^{-31})$
$= 8.8 \times 10^{15}$ m s^{-2} [1]

[Total: 7]

8 **(a)** use of either $P = VI$ and $V = IR$ or $P = V^2 / R$ [1]
resistance = 38.4 Ω [1]

(b) zero [1]
1.5 kW [1]
3.0 kW [1]
0.75 kW [1]
2.25 kW [1]

[Total: 7]

9 **(a)** **(i)** orange ppt *allow red to yellow/crystals or solid* [1]

(ii) ketone [1]

(iii) $CH_3CH_2COCH_3$ or butanone [1]

(b) **(i)** $NaBH_4$ allow $NaAlH_4$ (Li Al H_4) (1) H_2 / Ni or Pt [1]

(ii) secondary alcohol [1]

(iii) $CH_3CH(OH)CH_2CH_3$ [1]

[Total: 6]

10 (a) (i) energy/enthalpy change when 1 mol of a compound is formed from its elements [1]
at 298 K / 25°C and100 kP / 1 atm [1]

(ii) $H_2(g) + ½\ O_2(g) \downarrow H_2O(l)$ [1]

(b) (i) $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$ [1]

(ii) heat released = $mc\Delta T$
$= 200 \times 4.2 \times 12.2 = 10.25$ kJ [1]

(iii) $\Delta H = (-10.25) \div 1.00 / 40.1 = -411$ kJ mol^{-1} sign necessary
for ecf, $\Delta H_{reacn} = 40.1 \times$ [answer to **(b)(ii)**] [1]

(iv) $V = nRT/P$ [1]
$= \frac{(1/40.1) \times 8.31 \times 300}{1 \times 10^5}$ 6.22×10^{-4} m^3 [1]

*allow ecf on error in moles of Ca in **(b)(iii)** and on error in equation in **(b)(i)***

[Total: 8]

11 (a) rate of decay/activity/decay (of nucleus) is not affected by external factors [2]
(If states specific factor(s), such as temperature/pressure/chemical bonding rather than giving general statement above, then give 2 marks for two stated factors, but 1 mark only if one factor stated)

(b) (i) gamma/γ [1]

(ii) alpha/α [1]

(iii) gamma/γ [1]

[Total: 5]

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