



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 / 6³) [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/M²⁺ radius/size increases down the group/M²⁺ charge density decreases [1]
 anion/carbonate ion/CO₃²⁻ 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 Cu₂O₅CH₂ [1]
- (ii) Cu²⁺(aq) or [Cu(H₂O)₆]²⁺ NOT [Cu(H₂O)₄]²⁺ [1]
- (iii) D is CuO / copper(II) oxide [1]
 Cu₂O₅CH₂ → 2CuO + CO₂ + H₂O [1]
 221 → 159 (both M_rs) [1]
 ∴ 10 → 10 × 159 / 221 = 7.2 g (7.19) [1]
- (iv) E is copper; F is Fe²⁺ / Fe SO₄ [1]
 Fe + Cu²⁺ → Fe²⁺ + 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 $\frac{1}{2}\lambda$ or $(n + \frac{1}{2})\lambda$

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 $\lambda = (56 \text{ cm,}) 18.7 \text{ cm, } 11.2 \text{ cm, } (8.0 \text{ cm})$ [1]
so two minima [1]

[Total: 6]

- 5 (a) (i) $\text{CH}_2=\text{CH}-\text{CH}_2\text{CH}_2\text{CH}_3$ / pent-1-ene accept C_3H_7 on RHS [1]

(ii) 8 [1]

- (b) (i) e.g. $\text{C}_{40}\text{H}_{82} \rightarrow \text{C}_{16}\text{H}_{34} + 2 \text{C}_{12}\text{H}_{24}$ OR $\text{C}_{40}\text{H}_{82} \rightarrow \text{C}_{16}\text{H}_{34} + \text{C}_{24}\text{H}_{48}$ etc [1]

(ii) heat + catalysts/ SiO_2 / Al_2O_3 / Pt /ceramic/pumice/zeolite etc. If temp given $>500^\circ\text{C}$ [1]

(iii) bonds broken: $4(\text{C}-\text{C}) = 4 \times 350 = 1400 \text{ kJ mol}^{-1}$
bond formed: $2(\text{C}=\text{C}) = 2 \times 610 = 1220 \text{ kJ mol}^{-1}$
 $\Delta H = +180 \text{ kJ mol}^{-1}$ [1]

from eqn in (a)(i) : $+90 \text{ kJ mol}^{-1}$ for each $\text{C}=\text{C}$ formed (could be multiples of 90)

(iv) endothermic reactions $\Delta H > 0$ [1]

[Total: 6]

- 6 (a) $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$
exothermic [1]

(b) pressure. 50 atm / $50000 \text{ Pa/N m}^{-3}$ upwards; [2]
temp $400-600^\circ\text{C}$;
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 eutrophication (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]
 $= 5.0 \times 10^4 \times 1.6 \times 10^{-19}$
 $= 8.0 \times 10^{-15} \text{ N}$ [1]
- (ii) $a = F/m$ [1]
 $= (8.0 \times 10^{-15}) / (9.1 \times 10^{-31})$
 $= 8.8 \times 10^{15} \text{ m s}^{-2}$ [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) $\text{CH}_3\text{CH}_2\text{COCH}_3$ or butanone [1]
- (b) (i) NaBH_4 allow NaAlH_4 (Li Al H₄) (1) H_2 / Ni or Pt [1]
(ii) secondary alcohol [1]
(iii) $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$ [1]
- [Total: 6]**

- 10 (a) (i) energy/enthalpy change when 1 mol of a compound is formed from its elements at 298 K / 25°C and 100 kP / 1 atm [1]
[1]
- (ii) $\text{H}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$ [1]
- (b) (i) $\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{H}_2$ [1]
- (ii) heat released = $mc\Delta T$
= $200 \times 4.2 \times 12.2 = 10.25 \text{ kJ}$ [1]
- (iii) $\Delta H = (-10.25) \div 1.00 / 40.1 = -411 \text{ kJ mol}^{-1}$ sign necessary
for ecf, $\Delta H_{\text{reacn}} = 40.1 \times [\text{answer to (b)(ii)}]$ [1]
- (iv) $V = nRT/P$ [1]
= $\frac{(1/40.1) \times 8.31 \times 300}{1 \times 10^5} \quad 6.22 \times 10^{-4} \text{ m}^3$ [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]

