CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary Level

MARK SCHEME for the October/November 2014 series

8780 PHYSICAL SCIENCE

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

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1 **(a)** sodium metal: + charges in all circles
sodium chloride: alternate + and – charges in circles

(b) **(i)** attraction between positive ions / lattice and delocalised electrons [1]

(ii) electrostatic attractions between ions **or** attractions between oppositely charged ions [1]

(c) **(i)** delocalised electrons flow though the metal in both phases [1]

(ii) ions can move in molten phase [1]
ions cannot move in solid phase [1]

[Total: 7]

2 **(a)** **(i)** $\frac{1}{2}mv^2 = 0.5 \times 3 \times 10^5 \times 200^2$ ($= 6 \times 10^9$) [1]
$mgh = 3 \times 10^5 \times 10 \times 8000$ ($= 2.4 \times 10^{10}$) [1]
total energy loss = sum of E_k and $E_p = 3 \times 10^{10}$ (J) [1]
one or two significant figures only (awarded if one clear answer to KE / PE) [1]

(ii) use of total energy / time [1]
$= 3 \times 10^{10} / (30 \times 60) = 1.7 \times 10^7$ (W) [1]

(b) **(i)** use of force × distance = E_k lost **or** other valid approach [1]
distance $= \frac{1}{2} \times 3 \times 10^5 \times (250 / 3.6)^2 / 4 \times 10^5$ [1]
1800 (m) [1]

(ii) safety margin **or** wet runway **or** different loading **or** other valid reason why runway needs to be significantly longer than calculated in **(b)(i)** [1]

[Total: 10]

3 **(a)** Avogadro's number of molecules [1]

(b) **(i)** moles of $O_2 = \dfrac{0.350}{32}$ = (1.09×10^{-2} mol) [1]
total moles of gas $= 29 \times 1.09 \times 10^{-2} = 0.317$ (mol)
accept 0.316 [1]

(ii) (number of moles of nitroglycerine) $= 4 \times 1.09 \times 10^{-2} = 0.0436$ (mol) [1]
(mass nitroglycerine) $= 227 \times 0.0436 = 9.9$ (g) [1]

(c) (i) pV = nRT

(ii) $p = \dfrac{nRT}{V} = \dfrac{0.873 \times 8.31 \times 1100}{1.00 \times 10^{-3}}$

7.98×10^{6} **or** 7980 **or** 7.98 [1]

units = Pa **or** kPa **or** MPa (as appropriate) [1]

[Total: 9]

4 (a) (i) air molecules collide with (and rebound from mercury) surface causing change in momentum (of molecules) [1]

change of momentum requires a force **or** rate of change of momentum equals force [1]

sum of forces over surface leads to pressure [1]

(ii) more molecules <u>per unit volume</u> / molecules closer together [1]

thus more collisions <u>per unit time</u> [1]

(b) <u>use of</u> $p = h\rho g$ (= $(395 - 280) \times 10^{-3} \times 13.6 \times 1000 \times 9.81$) [1]

1.53×10^{4} (Pa) [1]

[Total: 7]

5 (a) for (significant) diffraction to occur / similar slit width to wavelength [1]

so light spreads and goes through both double slits **or** spreads so that wavefronts through both double slits overlap [1]

(b) (i) fringes would be further apart [1]

(ii) fringes would be dimmer

accept no change of separation **or** sharper

do not accept different separation [1]

(c) (i) single wavelength **or** frequency

one colour is **insufficient** [1]

(ii) coloured fringes **/** no interference pattern / central white fringe [1]

many wavelengths, therefore maxima all at different places [1]

[Total: 7]

6 **(a)** rate of the forward reaction = rate of the backward reaction ($R_f = R_b$)
(all) concentrations remain constant

(b) **(i)** <u>appearance</u>: **A** goes darker <u>and</u> **B** goes lighter [1]
<u>explanation</u>: (is exothermic) so as temperature increases, equilibrium moves to left
or as temperature decreases, equilibrium moves to right [1]
in order to oppose the increase / decrease in temperature [1]

(ii) <u>explanation</u>: both R_f and R_b increase when heated **or** decrease when cooled [1]
more molecules / less molecules will have $E \geq E_a$ [1]
so more / less collisions will be successful [1]

*although question refers to **A** taking less time than **B**, candidates may argue why **A** is faster or why **B** is slower – allow either approach*

(c) **(i)** (ΔH =) 9.16 – 2 × 33.18 = **–**57.2
minus sign required [1]

(ii) $\frac{1}{2}N_2(g) + O_2(g) \rightarrow NO_2(g)$
state symbols required [1]

(iii) $2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$
correct products [1]
correctly balanced
allow multiples and fractions [1]

[Total: 12]

7 **(a)** <u>use of</u> $R = V/I = 5000/2.4 \times 10^{-5}$ [1]
$2.1 \times 10^{8}\,\Omega$ [1]

(b) **(i)** $P = I^2 R = (2.4 \times 10^{-5})^2 \times 5 \times 10^6 = 2.9 \times 10^{-3}$ (W) [1]

(ii) $P = IV = 5000 \times 2.4 \times 10^{-5} = 0.12$ (W) [1]
$0.12 - 2.9 \times 10^{-3} = 0.117$ (W) [1]
accept answer ≈ 0.12 (W) as recognition that the power dissipated in the resistor is very small in comparison to that of the glass container

(c) **(i)** $Q = It = 2.4 \times 10^{-5}$ [1]
C **or** coulombs [1]

(ii) <u>use of</u> $n = Q/e = (2.4 \times 10^{-5}/1.6 \times 10^{-19}) = 1.5 \times 10^{14}$ **ecf from (c)(i)** [1]

(iii) $W = P/n = 0.117/1.5 \times 10^{14} = 7.8 \times 10^{-16}$ (J) **ecf from (c)(ii)** [1]

[Total: 9]

8 (a) P into Q: oxidation
P into T: dehydration **or** elimination

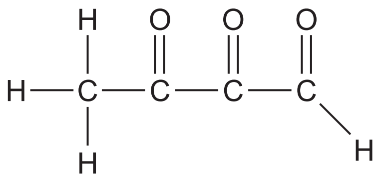
(b)

C	**H**	**O**		
$\frac{55.81}{12}$	$\frac{6.98}{1}$	$\frac{37.21}{16}$		[1]
4.65	6.98	2.33		
1.996	2.996	1		
2	3	1	shows working to get ratio	[1]

molecular formula can be obtained from the structural formula (C_2H_3O from $C_4H_6O_2$)
award one mark for dividing by the A_r and a second mark for correctly manipulating the numbers to get the proportion 2:3:1

(c) (i) R: $CH_3COCOCO_2H$ [1]
S: $CH_3CH(OH)CH(OH)CH_2OH$ [1]
T: $CH_2{=}CHCOCH_2OH$ [1]
allow any unambiguous formula

(ii) [1]



structure must show <u>all</u> bonds

(d) (i) Fehling's **or** Tollens' **accept** Na metal [1]
red precipitate **or** silver mirror with **Q** bubbles with **P** [1]
no response with **P**, no response with **Q** [1]

***not** acidified dichromate **or** 2,4-DNPH **or** iodoform test*

(ii) aldehyde, alcohol as appropriate [1]

[Total: 12]

9 **(a)** **(i)** sum of the emfs around any closed loop in a circuit is equal to the sum of pote… difference (owtte)

(ii) going round a complete loop there must be same amount of work done (per unit charg… as energy given (per unit charge) (owtte) [1]

(b) **(i)** $I_1 = I_3 - I_2$ [1]

(ii) $E_2 = 4 I_3 R$ [1]

(iii) $E_1 = 5 I_1 R + 4 I_3 R$ [1]

(iv) recognition that $I_1 = I_3$, and hence $E_1 = 9 I_1 R$ [1]
substitution to show $E_2 : E_1 = 4:9$ [1]

[Total: 7]