Cambridge International AS Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary Level

PHYSICAL SCIENCE **8780/03**

Paper 3 Structured Questions **October/November 2016**

MARK SCHEME

Maximum Mark: 80

Published

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1 **(a)** speed has magnitude only **and** velocity has both magnitude and direction OR speed is a scalar **and** velocity a vector OR velocity is speed in a specific direction / speed = distance / time **and** velocity = displacement / time [1]

(b) 0 (N) [1]

(c) **(i)** attempt to find acceleration from the gradient e.g. evidence of using $\Delta v / \Delta t$ with data drawn from the graph [1]

$F = 72 \times (5 - 0) / 17.5 - 25) = -48$ (N) [1]

(ii) force is in the opposite direction to the velocity [1]

[Total: 5]

2 **(a)** proton number = 82
nucleon number = 206
element correctly identified as Pb [2]

All 3 correct for 2 marks; any 2 correct for 1 mark

(b) same number of protons, different number of neutrons [1]
same number of protons same number of electrons [1]
protons or electrons linked to the chemical properties [1]
different number of neutrons leads to different masses / densities / nuclear stability [1]

[Total: 6]

3 **(a)** **(i)** giant covalent / macromolecular / giant molecular [1]
many / strong (covalent) bonds must be broken [1]

(ii) simple molecular / covalent [1]

induced dipole-dipole forces of attraction (between molecules) [1]

S or S_8 has most electrons (in its molecule) [1]

(b) **(i)** heat is given out (during the reaction) / the temperature (of the reaction mixture) increases / the enthalpy of the reactants is greater than that of the products / ΔH is negative [1]

(ii) reactions have a high activation energies or E_a [1]

(iii) $(1s^2)\,2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$ [1]
$(1s^2)\,2s^2 2p^6 3s^2 3p^6$ [1]

(iv) electrons are transferred from zinc to sulfur [1]
(transfer of) two electrons [1]

[Total: 11]

4 **(a)** the gas molecules collide with the walls [1]
(rebound) leading to a change in momentum [1]
rate of change of momentum = force [1]
many collisions lead to force / pressure over the whole wall OWTTE [1]

(b) shorter distance between collision / smaller surface area [1]
more collisions per unit time / more molecules per unit volume [1]

[Total: 6]

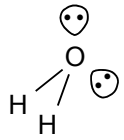
5 **(a)** **(i)** $2H_2S + SO_2 \rightarrow 3S + 2H_2O$ [1]

(ii) (initial oxidation number) –2 [1]
(final oxidation number) 0 **and** +4 [1]

(iii) $\frac{4.78(\times 106 \times 34.4)}{32.1(\times 1 \times 106)}$ [1]
5.08 (tonnes) [1]

(iv) temperature unit conversion / 380+273 / 653 (K) [1]
pV = nRT / correctly rearranged / numerical equivalent [1]
(V= $\frac{(1.54 \times 10^5) \times 8.31 \times (380 + 273)}{5.00 \times 10^5}$ =) 1671 (m^3) [1]

(b) **(i)** shape is bent / v-shaped [1]
i.e. diagram shows a tetrahedral shape **and** two lone pairs **and** two O–H bonds



(ii) 104.5 [1]

[Total: 10]

6 **(a)** amplitude correctly marked [1]

(b) calculation of time period (e.g. 5 divs = 2 waves 5 divs = 5 × 800 μs T= 2 ms [1]
$f = 1/T = 1/2 \times 10^{-3}$ = 500 (Hz) [1]

(c) use of $v = f\lambda$ leading to $f = 320 / 500$ [1]
$= 0.64$ (m) [1]

[Total: 5]

7 (a) the (algebraic) sum of the displacements of two or more waves at a point [1]

(b) recognition that the waves travel directly to point **P** and reflect from the metal plate to **P** [1]
waves reflected from the plate travel an whole number of wavelengths further than the waves which travel directly to **P** [1]

the two sets of waves are (exactly) in phase [1]

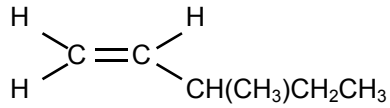
(c) maxima and minima closer together [1]
shorter wavelength so less path difference needed for complete wavelength difference [1]

[Total: 6]

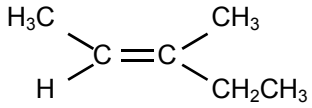
8 (a) (i) 2-bromo-3-methylpentane [1]

(ii) elimination [1]

(b) unambiguous structure for 3-methylpent-1-ene [1]



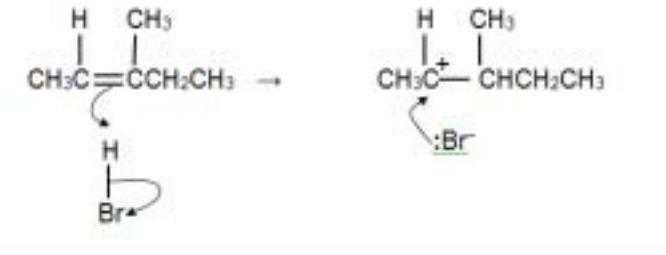
unambiguous structure for trans-3-methylpent-2-ene [1]



(c)(i),(ii) structural isomerism and correct pair of isomers [1]
geometric / cis-trans isomerism and correct pair of isomers [1]

(d) (i) a reaction in which two molecules react to produce a single molecule / conversion of double bond or unsaturated molecule into single bond or saturated molecule OWTTE [1]

(ii) 2 curly arrows on left-hand side [1]
intermediate and +ve charge [1]
curly arrow from lone pair on bromine [1]



[Total: 10]

9 (a) (i) I = 500 / 2000 = 0.25 (A) [1]

(ii) maximum current is small / too small to cause harm or damage / pd across the terminals is very small / the wire would not overheat [1]

(b) (i) resistance of parallel combination = $(1/3000 + 1/500)^{-1}$ = 500 Ω [1]
total resistance = 5500 Ω or I = 0.091 A [1]
p.d. across the supply = 500 – (0.091 × 2000) = 320 (V) [1]

(ii) resistance of thermistor decreases [1]
and so current increases and there is a larger p.d. across the safety resistor so reading decreases [1]

[Total: 7]

10 (a) (i) rate forwards = rate backwards / $R_f = R_b$ [1]
all concentrations remain constant [1]

(ii) concentration / amount of $Cr_2O_7^{2-}$ is (too) low (to change the colour) / equilibrium position is to the left / ORA [1]

(b) (i) any <u>three</u> from: [3]
(acid is added) the $[H^+]$ increases
rate of the forward reaction increases
the equilibrium position moves to the right
description of Le Chatelier's argument concerning $[H^+]$ increase

(ii) colour changes to yellow (when excess NaOH) [1]
equilibrium to be driven to the left [1]
the OH^- ions remove or react with or neutralise the (excess) H^+ (ions) / $[H^+]$ falls [1]

[Total: 9]

11 (a) (i) correct units (base) units for all quantities: $kg\,m^{-3}$, $m\,s^{-2}$, m, $m\,s^{-1}$ [1]

(ii) $kg\,m^{-1}s^{-1}$ [1]

(b) (i) 0.71(%) [1]

(ii) multiplication of **(b)(i)** by 3 (for r^3) [1]
calculation of uncertainty in mass leading to uncertainty in density of 3.5(%) [1]

[Total: 5]