CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level

MARK SCHEME for the October/November 2012 series

8780 PHYSICAL SCIENCE

8780/03 Paper 3 (AS 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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CAMBRIDGE
International Examinations

1 **(a)** Molecules/particles of gas collide with the walls of the cylinder (1)

leads to change in momentum (of particle) rate of change of momentum = force (1)
Many collisions leads to force over the whole wall / the collisions cause a force (hence pressure) on the walls. (1) [3]

(b) (Distance between collisions is reduced therefore) more collision per unit time/ more frequent collisions (Any mention of increased speed of molecules 0/1) (1) [1]

2 **(a)** **(i)** *y*-axis = number/proportion/percentage of molecules (with a given energy)
x-axis = energy/*KE* (NOT speed) (1)

(ii) proportion/percentage/number of molecules with $E \geqslant E_A$ /enough energy to react (1)

(iii) Line starts at origin; mode lower **and** shifted to the right; does not touch/is asymptotic to the *x*-axis (1)

(b) (large) increase in shaded area/number of molecules with $E \geqslant E_a$ (for a small increase in temperature) (1) [1]

3 **(a)** take many readings and average (1)
readings either at right angles or along the length of the wire/ignore anomalous (1) [2]

(b) percentage uncertainty in d = (0.01/0.14) × 100 = 7.1 % (accept fractional uncertainty throughout) (1)
(percentage uncertainty in A =7.1 × 2 =14.2)
absolute uncertainty in A = (0.015 × 14.2)/100 = 2(.1) mm (1) [2]
(accept 7% etc.)

4 **(a)** $21.7 \times 10^{-3} \times 0.150 = 3.255 \times 10^{-3}$ (mol) (1)

(b) **(i)** Moles of H_2X in 25.0 cm^3 = $(3.255 \times 10^{-3})/2 = 1.63 \times 10^{-3}$ (mol) (1)
Moles of H_2X in 250 cm^3 = 1.63×10^{-2} (mol) (1)

(c) M_r of H_2X = 1.92 / 1.63×10^{-2} = 117.9 = 118 (1) [4]

5 **(a)** **(i)** V = 1.3 × 2.5 = 3.25 V (accept 3.1 to 3.5) (1)
($T = 2 \times 10^{-3}$ /3) → f = 1500 Hz (accept 1400 – 1600 Hz) (1) [2]

(b) (i) Amplitude doubled, frequency unchanged (1)

(ii) zero amplitude (1)
mention of addition or subtraction (accept cancel for **(ii)**) or correct mention of constructive/destructive interference of signals in **(i)** or **(ii)** [to score this mark at least one of the marks in **(i)** or **(ii)** must be scored or it is clear the amplitude increased in **(i)** / decreased in **(ii)**] (1) [3]

6 (a) (i) $Q = (mc\Delta T) = 100 \times \underline{4.18} \times \underline{12.5}$ (1)
= 5225 J *allow 5.225 kJ if units changed by candidate* (1) [2]

(ii) $n CH_3CH_2CH_2OH = 0.341/60 = 5.68 \times 10^{-3}$ (mol) (1) [1]

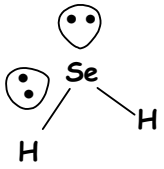
(iii) enthalpy change of combustion = –919 kJ mol^{-1} *penalise '+' or missing '–'* (1) [1]

(b) (i) source of error = heat loss to surroundings/loss of propan-1-ol by evaporation
allow incomplete combustion/non-use of heat capacity of apparatus (1)

(ii) Convincingly explains why ΔH **or** heat energy value/**q** would be (much) too low (1) [2]

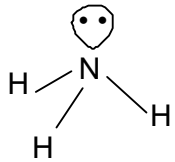
7 (a) $Al_2Se_3 + \mathbf{6}H_2O \rightarrow \mathbf{2}Al(OH)_3 + \mathbf{3}H_2Se$ (1) [1]

(b) (i) H_2Se = 'bent' shape with 2 lone pairs – based on tetrahedral



(1)

(ii) NH_3 = pyramidal shape with 1 lone pair



(1)

NOT dot-and-cross diagrams but allow [1] if **both** diagrams show the correct numbers of lone pairs
If lone pairs are missing from both diagrams, allow [1] if **both** shapes are correct.

(iii) Se has 2 lone pairs but N has only 1 lone pair /allow Se has more lone pairs than N (1)
Lone pairs repel more strongly than bonding pairs / etc. reference to repulsion of atoms negates (1) [4]

8 **(a)** Isotopes are different forms of the same element with the same number of protons but different numbers of neutrons (accept proton/atomic number, neutron number) (1)
$^{14}_{7}N + {}^{1}_{0}n \rightarrow {}^{14}_{6}C + {}^{1}_{1}p$ (1) [2]
all symbols correct (accept H)

(b) all numbers correct (1)
(special case: accept $^{15}_{7}N \rightarrow {}^{14}_{6}C + {}^{1}_{1}p$ for 1mark) (1) [2]

(c) correct position mother nuclide correctly labelled (1)
correct position daughter nuclide correctly labelled (1) [2]
(accept both correctly positioned and clear indication for 1 max)

9 **(a)** Cross (**X**) is positioned where **1** goes flat i.e. where **4** joins **1**
and student explains that after **X**, NH_3 formed/destroyed at same rate/$R_f = R_b$ **or** amount/concentration of NH_3 constant at equilibrium. (1) [1]
Do NOT allow line goes flat/ NH_3 not formed any more

(b) **(i)** increased pressure = **3** increased temperature = **2** (1)

(ii) explain that pressure favours side with fewer moles (dependent on **b(i)**) (1)
fewer moles on right / there is a 2:1 mole ratio L:R/equilibrium moves right/more NH_3 formed (1)

(iii) catalyst increases rate **and** does not change equilibrium position/rates increase equally (1) [4]

10 **(a)** **(i)** $p = 0.142 \times 53.0$ (1)
$= 7.53\ \text{kg m s}^{-1}$ (N s or kgms^{-1}) (1) [2]

(ii) $F = \Delta p/\Delta t = 7.53 / 0.451 = 167\,\text{N}$ (1) [1]

(b) $E_k = ½\ mv^2 = ½$ xo.142 $\times 53^2 = 199\,\text{J}$ (1) [1]

(c) **(i)** clear mention of friction /drag/resistance (1)
as work is done against frictional force (1) [2]

(ii) kinetic energy is converted to internal (heat/thermal) energy of the ball and/or surroundings (1) [1]

11 (a) (i) Parallel vertical lines arrows downwards (minimum 2) (1) [1]

(ii) $E = V/d = 400/5\ (\times 10^{-2})$ (1)
$= 8000\ \text{V m}^{-1}$ or N C^{-1} accept $80\ \text{V cm}^{-1}$ or N C^{-1} (1) [2]

(b) Clear parabolic shape towards the positive plate (1) [1]

(c) (i) Increases (uniformly) (1)

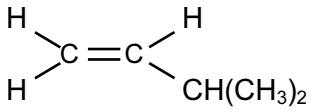
(ii) unchanged (1) [2]

12 (a) (i) 2-bromo-3-methylbutane *allow variants such as 3*-bromo-2-methylbutane (1)

(ii) elimination (1)

(iii) sodium/potassium hydroxide **and** dissolved in alcohol (1)

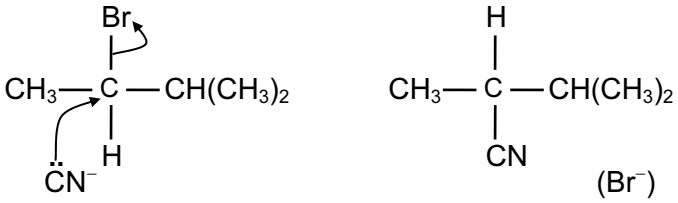
(iv)



(1)

(v) No, as the right hand C in the C=C bond has two CH_3/the same groups attached to it. (1) [5]

(b)



both arrows correctly positioned (1)
correct structure for nitrile (1) [2]

13 (a) Quantity with magnitude and direction (1) [1]

(b) (i) Arrow vertically down and arrow along the string, all 3 arrows go through a single point (by eye) (1) [1]

(ii) $0.510 \times 9.81 = 5.0(0)\ \text{N}$ (1) [1]

(iii) triangle with correct directions (45,90,45), with at least one force labelled (1)
arrows correct (1)
$T = 35 \pm 1\ \text{N}$ (1) [3]

(c) Evidence of acceleration = 4.7 m s^{-1} (1)
correct line on graph (1) [2]

14 (a) Any two from:
brown = NO_2
relights spill = O_2
residue is Group II/metal oxide
forms (soluble) Group II/metal hydroxide in water (1) [2]

(b) (i) Barium/Group I/Group II nitrate *accept strontium nitrate/lithium nitrate* (1)

(ii) $2Ba(NO_3)_2 \rightarrow 2BaO + 4NO_2 + O_2$ *allow ecf on error in nitrate* (1) [2]

15 (a) dissolved in molten cryolite/cryolite lowers melting point of mixture (1)
electrolysis using carbon/graphite electrodes (1)
$Al^{3+} + 3e^- \rightarrow Al$ (1)
it is expensive (to extract) due to the cost of the large amount of electricity/energy needed/high current used (1) [4]

(b) Any one advantage from:
conserves resources
save energy
reduces mining/landfill
reduces pollution – developed
reduces need for transport - developed (1) [1]