OCR
RECOGNISING ACHIEVEMENT

GCE

Chemistry B (Salters)

Mark Scheme

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td><table><tr><td>stopped by paper</td><td></td></tr><tr><td>charged particles</td><td></td></tr><tr><td>highly penetrating</td><td>✓</td></tr><tr><td>deflected by magnetic fields</td><td></td></tr><tr><td>electromagnetic radiation</td><td>✓</td></tr><tr><td>unaffected by electric fields</td><td>✓</td></tr></table></td><td>3</td><td>If 4 responses, maximum mark 1
More than 4 responses, no marks</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Time taken for half the radioactive nuclei to decay OR mass to decrease by half OR radioactivity to reduce by a half ✓

Longer than – could cause long term effects/harm/damage/ionise to cells/named body part/tissue
OR too faint/not enough to detect ✓

Shorter than – not long enough to be able to detect/travel round body AW
OR could cause damage (same rules as above) ✓</td><td>3</td><td>Please make annotations where marks are scored

Must mention time/how long for something to reduce by half: nuclei, atoms, substance, isotope(s), radioactivity, mass
NOT nucleus, atom (ie in singular)
DO NOT ALLOW ‘decompose’ for ‘decay’

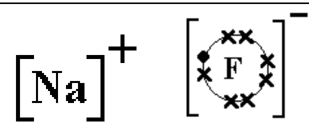
For first alternative could suggest specific damage (eg mutation)
must be ‘to cells/named body part/tissue’ not just ‘to patient/ people/humans/body’
‘Cancer’ on its own is too vague

For first alternative, answer must link time for detection/ travelling round body/ tracing/ producing image/ ‘use’ to short half life (and not just ‘difficult to detect’)
ALLOW ‘too much decay before use’ AW</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>Calculation to show (181 is) the molecular mass of FDG ✓

FDG ionised OR this is the molecular ion/cation ✓</td><td>2</td><td>Any total not 181 is CON of first mark

Mark separately

ALLOW any reference to charge of +1or ionisation mentioned (but not to anion/- ion)</td></tr>
</table>

Question			Answer	Marks	Guidance
1	(b)	(ii)	(molecule) has broken (up/down)/fragmented **OR** two or more electrons knocked off ✓	1	Must imply 'molecule broken' **ALLOW** 'fragmentation' **IGNORE** 'lower Mr' **NOT** decay/decompose **IGNORE** references to ^{18}F decaying
	(c)	(i)	 Correct charges on both ions ✓ Correct structures ✓	2	**IGNORE** inner shell electrons Square brackets not essential **ALLOW** with 8 electrons around Na Circles not needed Must be two different symbols for electrons **ALLOW** '1+' and '1–' (or +1 and -1) <u>No charges</u> scores zero; wrong number of ions scores zero
		(ii)	Bond angle = 90 (can be labelled on diagram) ✓ Six pairs/regions/groups/areas of electrons/areas of electron density around S/central atom ✓ Repel (to get) as far (away) as possible **OR** position (AW) themselves to minimise electron repulsion ✓ Octahedral/octahedron /'<u>square</u> (based) bipyramid' ✓	4	**Please make annotations where marks are scored** **ALLOW** right angle symbol on diagram All three ideas need to be present If central atom named it must be S(ulfur) **NOT** scored from diagram alone unless labelled **NOT** 'around central point' **NOT** 'repel as *much* as possible' **NOT** 'push' **NOT** 'atoms repel' **NOT** 'bonds repel' unless qualified earlier by mention of electrons being 'in' bonds **ALLOW** diagram that shows 3D structure unless **CON** in text
			TOTAL	**15**	

Question			Answer	Marks	Guidance
2	**(a)**	**(i)**	alcohol ✓ alkene ✓	2	**ALLOW** 'hydroxy(l)' **IGNORE** ‘OH’ **NOT** secondary, tertiary **ALLOW** <u>carbon - carbon</u> double bond or C=C
		(ii)	$C_9H_{10}O$ ✓	1	Atoms in any order **DO NOT ALLOW** ‘split answers’ eg $C_9H_{10}O$/C_9H_9OH
	(b)	**(i)**	<u>Fractional</u> distillation ✓	1	**ALLOW** fractionation
		(ii)	Division by appropriate A_r value ie C 38.7/12 (3.225) O 51.6/16 (3.225) H 9.7/1 (9.7) ✓ evaluation to give empirical formula (CH_3O) ✓	2	CH_3O scores both marks on its own **ALLOW** atoms in any order $C_2H_3O_2$ scores one mark (‘Z’ used) - no other ecf’s
		(iii)	Empirical formula is the <u>simplest/lowest/smallest</u> ratio of <u>atoms</u> **OR** different molecular formulae can have the same <u>simplest/lowest/smallest</u> ratio of <u>atoms</u> **OR** molecular formula can be multiple of empirical formula ✓	1	‘It’ cannot be accepted (unless qualified later in the answer) as it could refer to empirical or molecular in this context
		(iv)	Measure of ‘number of ways’ particles can be arranged **OR** degree/level/amount of disorder/chaos (in a system) ✓	1	‘Number of ways’ or ‘disorder’ can score on own but if elaborated on, must be particle<u>**s**</u> or molecule<u>**s**</u> (must be plural) and not <u>in</u> an element or compound **NOT** ‘atoms’ or ‘electrons’ (for particles)

<table>
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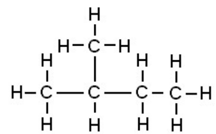
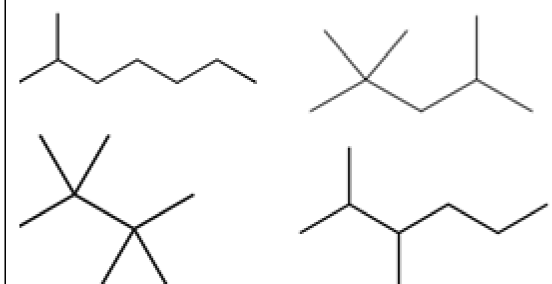
<tr><td>2</td><td>(c)</td><td></td><td>
<table>
<tr><th>substance</th><th>type of bonding</th><th>structure type</th><th>characteristic physical property</th></tr>
<tr><td>ethylene glycol</td><td>covalent</td><td>simple molecular</td><td>low melting point</td></tr>
<tr><td>sodium chloride</td><td>ionic</td><td>giant OR lattice</td><td>soluble in <u>water</u> OR high m/b point
OR
conduct when molten or in solution</td></tr>
<tr><td>paraffin wax</td><td>covalent</td><td>simple molecular</td><td>insoluble in water</td></tr>
</table>
✓✓✓</td><td>3</td><td>One mark for each row correctly completed

‘Giant covalent’ is a CON under ‘type of bonding’ column</td></tr>
<tr><td></td><td></td><td></td><td>TOTAL</td><td>11</td><td></td></tr>
</table>

Question			Answer	Marks	Guidance
3	**(a)**		Low/reduced/less tendency to auto-ignite/pre-ignite/knocking/pinking ✓	1	**DO NOT ALLOW** '**no** knocking'/'does **not** knock'
	(b)	**(i)**	 ✓	1	All bonds to be shown **DO NOT ALLOW** CH_3/CH_2 groups
		(ii)	Same molecular formula. Different structural formula/structure ✓ Any two skeletal isomers of C_8H_{18} (some possible structures shown opposite) ✓✓	3	**NOT** 'chemical (formula)' **ALLOW** 'same number <u>and</u> types of atoms' **ALLOW** different arrangement (of atoms) **ALLOW** a description of different structures (eg 'branches in different places') e.g.  **NOT** straight chain **IGNORE** any name given **ALLOW one** mark for two correct non-skeletal formulae **IGNORE** dots
	(c)	**(i)**	$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$ ✓	1	**ALLOW** multiples **All** must be correct to score. **IGNORE** state symbols except **CON** if C_5H_{12} is given as 'aq'

Question			Answer	Marks	Guidance
3	**(c)**	**(ii)**	Breaking bonds is a positive/endothermic (enthalpy change) or absorbs/requires/takes in energy **AND** forming bonds is negative/exothermic or releases/gives out energy ✓ Value/magnitude of negative (exothermic) value bigger than positive (endothermic) ✓ **Award of 2nd mark depends on first being scored**	2	e.g. 'more energy given out than taken in' *AW* references to different *number* of bonds **CONs** this mark 'More energy is released in making bonds than in breaking them' scores 1 'More energy is released in making bonds than is used (*AW*) in breaking them' scores 2 'Enthalpy changes of making the bonds are higher than those of breaking the bonds' scores 2nd marking point, if first point already scored
		(iii)	Produces only/nearly all carbon dioxide (and water) ora ✓	1	**ALLOW** 'produces little/no/less CO or C/particulates/soot' **ALLOW** 'complete combustion' ora **IGNORE** 'does not release pollutants', references to unburnt hydrocarbons

Question			Answer	Marks	Guidance
3	(c)	(iv)	*Benefit:* water is the only product **OR** no CO_2 ✓ *Problem:* storage issues **OR** leakage **OR** hydrogen is explosive/highly flammable **OR** requires changes to engine *AW* ✓	2	**IGNORE** <u>no</u> pollution no harmful products Reference to 'less NO_x' is a **CON** **ALLOW** 'no CO/SO_x' **IGNORE**: 'no greenhouse gases'/'carbon neutral' *The context here is the **<u>use</u>** of hydrogen* **IGNORE** references to sustainability and source of hydrogen **IGNORE** 'renewable' **IGNORE** references to generation of hydrogen needing fossil fuel/availability **IGNORE** hydrogen fuel not readily available
	(d)		Vol. of oxygen = 12.5 x 60cm^3 (750) ✓ Vol. of air = 750 x 100/21 (3571) ecf ✓ ÷ 1000 (3.6 dm^3) ecf ✓ ***Answer 3.6 (allow 3.57…..) scores all three marks without reference to working***	3	**Please make annotations where marks are scored** (unless fully correct) If answer is not 3.57 dm^3 (to 2 or more sig figs) then award marks for **up to two of** the following: • Multiplying 12.5 by 60 • multiplying a number by 100/21 • dividing by 1000 **NB:** this may have been done in the first steps i.e. look for '0.06' **ALLOW** 2 or more sig figs
	(e)	(i)	(Catalyst) (it) speeds up a reaction <u>and</u> can be recovered chemically unchanged/unchanged at end **OR** (it) provides a path/alternative route of lower activation enthalpy/energy ✓	1	**ALLOW** '..... and not used <u>up</u> in the reaction'
		(ii)	B D A C ✓✓	2	one mark for two in the correct **places** eg B A D C scores one mark B A C D does not score any marks
			TOTAL	**17**	

Question			Answer	Marks	Guidance
4	(a)		Electrons drop to lower energy levels ✓ emit light/electromagnetic radiation/photons ✓ Energy proportional to frequency **OR** E = hv **OR** E = hf ✓ (Gaps between) levels unique/different for a particular/different elements ✓	4	**Please make annotations where marks are scored** **ALLOW** 'back to ground state' providing energy levels mentioned (see below) 'Shells' must be qualified by reference to energy levels somewhere in answer Reference to energy levels can come from any place in answer **ALLOW** freq/wavelength *related* to energy gap/energy lost **QWC** only award first mark if 'electron'/ 'electrons'/ 'electronic') is spelled correctly at least once
	(b)		left gaps/spaces/blanks (in the order) ✓	1	
	(c)	(i)	$Ga(s) + As(s) \rightarrow GaAs(s)$ equation ✓ state symbols ✓ Standard state is solid for both elements (and compound) because T_m is greater than 298 (K) ✓	3	**ALLOW** ½As_2 and ½Ga_2 and ¼As_4 Equation **MUST** be to form one mole of GaAs 298 must be mentioned (or indicated, eg in subtraction sums)
		(ii)	$\Delta H_1 = \Delta H_2 + \Delta H_3$ ✓ energy (change) /enthalpy (change)/ΔH (of a particular reaction) independent of route *AW* ✓ providing initial and final conditions the same/conditions remain the same ✓	3	**ALLOW** $\Delta H_1 = \Delta H_3 + \Delta H_2$ **OR** $\Delta H_2 = \Delta H_1 - \Delta H_3$ **OR** $\Delta H_3 = \Delta H_1 - \Delta H_2$ **NOT** arrow (→) instead of = **NOT** 'starting and finishing points same' **ALLOW** '(providing) all done under standard conditions'

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<tr><td>4</td><td>(d)</td><td></td><td>3 outer electrons ✓
In group 3 ✓</td><td>2</td><td>ACCEPT $4s^2 4p^1$ or $s^2 p^1$ for first point
ALLOW group13
No ecf</td></tr>
<tr><td></td><td>(e)</td><td>(i)</td><td>(60.1 x 69) + (39.9 x 71) ÷ 100 ✓

sf ✓

69.8 scores both marks automatically</td><td>2</td><td>ALLOW sig fig mark for any 3 sig fig answer derived correctly from a calculation</td></tr>
<tr><td></td><td></td><td>(ii)</td><td><table><tr><th>isotope</th><th>number of protons</th><th>number of electrons</th><th>number of neutrons</th></tr><tr><td>^{69}Ga</td><td>31</td><td>31</td><td>38</td></tr><tr><td>^{71}Ga</td><td>31</td><td>31</td><td>40</td></tr></table>
✓✓</td><td>2</td><td>One mark for each completely correct row
No ecf’s</td></tr>
<tr><td></td><td></td><td></td><td>TOTAL</td><td>17</td><td></td></tr>
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