Diploma Programme
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Programa del Diploma

Markscheme

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Chemistry

Higher level

Paper 3

34 pages

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Section A

Question			Answers	Notes	Total
1.	a		group 18/noble gases ✓ smallest difference between melting and boiling points ***OR*** weakest intermolecular forces «in that period» ✓	*Accept "group 17/halogens".*	**2**
1.	b	i	density increases «to a maximum in the transition elements» ***AND*** then decreases ✓		**1**
1.	b	ii	actinoids ***AND*** density increases down all groups «due to large increase in atomic mass for small increase in atomic volume» ***OR*** actinoids ***AND*** «much» greater atomic mass with similar type of bonding ***OR*** actinoids ***AND*** density «of actinoids» atomic number 90 to 95 is greater than corresponding lanthanoids ✓	*Accept "actinoids **AND** on graph actinoids have «much» greater density than lanthanoids".*	**1**

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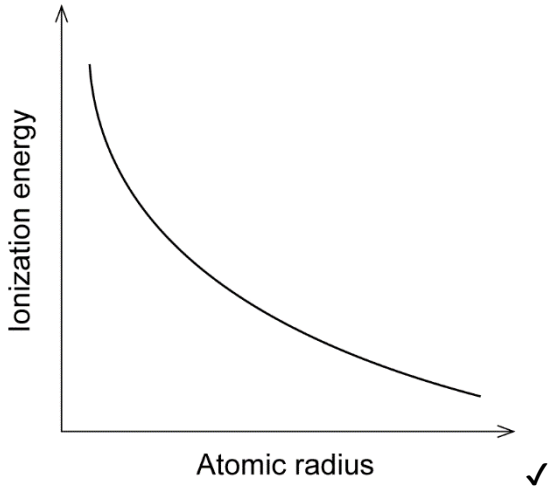
(Question 1b continued)

Question			Answers	Notes	Total
1.	b	iii	***Alternative 1:*** «metals with» low densities oxidize easier ✓ «metals with» low melting points oxidize easier ✓ ***Alternative 2:*** in s-block «metals with» high densities oxidize easier ***OR*** in s-block «metals with» low melting points oxidize easier ✓ in d-block «metals with» low densities oxidize easier ***OR*** in d-block «metals with» low melting points oxidize easier ✓	*Award **[1 max]** for "s-block metals more easily oxidized" **OR** "s-block metals have lower melting points" **OR** "s-block metals have lower densities".* *Accept "have greater activity" for "oxidize easier".*	**2**
1.	b	iv	 ✓	*Accept any negative sloping line.* *Do **not** award mark if line touches either axis.*	**1**

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Question			Answers	Notes	Total
2.	a	i	100 «s» ✓	*Accept 90 to 100 s.*	1
2.	a	ii	highest recorded temperature ***OR*** when rate of heat production equals rate of heat loss ✓	*Accept "maximum temperature".* *Accept "completion/end-point of reaction".*	1
2.	b	i	*Maximum temperature:* 73 «°C» ✓ *Assumption:* «temperature reached if» reaction instantaneous ***OR*** «temperature reached if reaction occurred» without heat loss ✓	*Accept "rate of heat loss is constant"* ***OR*** *"rate of temperature decrease is constant".*	2
2.	b	ii	*Any one of:* copper(II) sulfate ***AND*** mass/amount of zinc is independent variable/being changed ***OR*** copper(II) sulfate ***AND*** with zinc in excess there is no independent variable «as amount of copper(II) sulfate is fixed» ✓ copper(II) sulfate ***AND*** having excess zinc will not yield different results in each trial ✓ zinc ***AND*** results can be used to see if amount of zinc affects temperature rise «so this can be allowed for» ✓ zinc ***AND*** reduces variables/keeps the amount reacting constant ✓		1 max

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(Question 2b continued)

<table>
<tr><th colspan="3">Question</th><th>Answers</th><th>Notes</th><th>Total</th></tr>
<tr><td>2.</td><td>b</td><td>iii</td><td>
<table>
<tr><th>Value</th><th>Assumption</th></tr>
<tr><td>$m = 25.00\,g$</td><td>density of solution is $1.000\,g\,cm^{-3}$/same as water
OR
$25.00\,cm^3$ solution has a mass of 25.00 g
OR
mass of zinc/reactant is negligible
OR
mass of contents was 25.00 g ✓</td></tr>
<tr><td>$c = 4.18\,J\,g^{-1}\,K^{-1}$</td><td>specific heat of solution is $4.18\,J\,g^{-1}\,K^{-1}$ /same as water
OR
zinc/calorimeter/beaker/thermometer absorbs no heat ✓</td></tr>
</table>
</td><td>Accept “copper(II) sulfate/zinc sulfate” for “solution”.</td><td>2</td></tr>
<tr><td>2.</td><td>b</td><td>iv</td><td>lower/less exothermic/less negative AND heat loss/some heat not accounted for
OR
lower/less exothermic/less negative AND mass of reaction mixture greater than 25.00 g
OR
greater/more exothermic/more negative AND specific heat of solution less than water ✓</td><td>Accept “temperature is lower” instead of “heat loss”.
Accept “similar to theoretical value AND heat losses have been compensated for”.
Accept “greater/more exothermic/more negative AND linear extrapolation overestimates heat loss”.</td><td>1</td></tr>
</table>

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Section B

Option A — Materials

Question			Answers	Notes	Total
3.	**a**		ionic ✓		**1**
3.	**b**	**i**	red ✓		**1**
3.	**b**	**ii**	emission spectra of both «^{6}Li and natural Li» give same colour/produce same «range of» wavelengths ***OR*** they have same electron transitions/same nuclear charge ✓	*Accept "the spectra are almost identical".*	**1**
3.	**b**	**iii**	ICP-MS ✓	*Accept "MS/mass spectrometry".*	**1**
3.	**c**		$n = \frac{m}{M_r} = \frac{0.694}{6.94} = 0.100\ \text{mol}$ $t = \frac{0.100\ \text{mol} \times 96\,500\ \text{C mol}^{-1}}{2.00\ \text{C s}^{-1}}$ 4830 «s» ✓	*Accept "4820" **OR "**4825 «s»".* *Award **[2]** for correct final answer.*	**2**

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(Question 3 continued)

Question			Answers	Notes	Total
3.	**d**	**i**	creation of mirror image/opposing magnetic field of external field «below critical temperature/T of superconductor» ***OR*** expulsion of magnetic field from superconductor «below critical temperature/T» ✓		**1**
3.	**d**	**ii**	*Any three of:* positive ions/cations in lattice are attracted to passing electron ✓ lattice is distorted «by this passing electron» ✓ creates «local» regions of increased positive charge ✓ second electron is attracted to deformation ***AND*** a coupling occurs ✓		**3 max**
3.	**e**		mass of Li in unit cell $= «2 \times \frac{6.94\ \text{g mol}^{-1}}{6.02 \times 10^{23}\ \text{mol}^{-1}} =» 2.31 \times 10^{-23}\ \text{g}$ ✓ volume of unit cell $= «(3.51 \times 10^{-8}\ \text{cm})^3 =» 4.32 \times 10^{-23}\ \text{cm}^3$ ✓ «density $= \frac{2.31 \times 10^{-23}\ \text{g}}{4.32 \times 10^{-23}\ \text{cm}^3} =» 0.535$ «g cm^{-3}» ✓	*Award **[3]** for correct final answer.*	**3**

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Question			Answers	Notes	Total
4.	a		*Any two of:* heterogeneous catalyst is in different phase than reactants ***AND*** homogeneous catalyst in same phase ✓ homogeneous catalysts chemically change/react and reformed at end of reaction ***OR*** reactants adsorb onto heterogenous catalyst and products desorb ✓ heterogeneous catalysts are more easily removed than homogenous catalysts ✓ heterogeneous catalysts can function at higher temperatures ✓ homogeneous catalysts are «generally» more selective ✓ homogeneous catalysts offer a broader range of reactions ✓	*Accept "state" for "phase".* *Accept "heterogeneous catalyst provides a surface to activate reaction".*	**2 max**
4.	b		elastomers bend under force «and return to original form when force is released» ***OR*** elastomers make tyre more flexible ✓ allows greater contact with road ✓		**2**
4.	c		does not contain heterocyclic ring with 2 oxygen atoms ***OR*** middle ring has only 1 oxygen atom ✓ produces similar toxic effects to dioxins ✓	*Accept "does not contain dioxin ring" for M1.*	**2**

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(Question 4 continued)

Question			Answers	Notes	Total
4.	**d**		addition ***AND*** not two different functional groups reacting ***OR*** addition ***AND*** formed by breaking one bond of the carbon–carbon double bonds ***OR*** addition ***AND*** empirical formula of monomer equals empirical formula of polymer ***OR*** addition ***AND*** no atoms removed/all atoms accounted for/no loss of water/ammonia/inorganic by-product/small molecules ***OR*** addition ***AND*** atom economy/efficiency is 100 % ***OR*** addition ***AND*** there is only one «reaction» product ✓		**1**
4.	**e**		*Any one of:* high content of raw materials in product/high atom economy ✓ use of low toxic chemicals/catalysts/materials/solvents ✓ renewable feedstock/raw materials ✓ use of renewable/clean/low carbon energy source ✓ high safety standards ✓ increase energy efficiency ✓ waste recycling ✓	*Accept other reasonable answers*.	**1 max**

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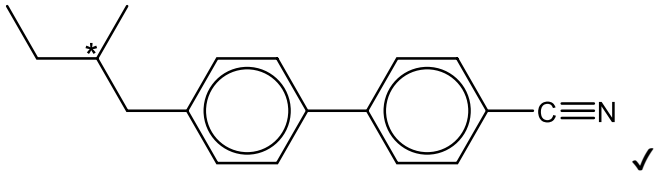
Question			Answers	Notes	Total
5.	a		 ✓		1
5.	b		*Low temperature:* intermolecular forces prevent molecules moving ***AND*** solid/«normal» crystal formation ✓ *High temperature:* «above a critical temperature» disrupts alignment of molecules ***AND*** behaves as fluid/liquid ✓	*Accept "weak intermolecular forces break **AND** behaves as fluid/liquid".*	2

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Question			Answers	Notes	Total
6.	a		*Structure:* giant covalent/network covalent ✓ *Bonding:* each carbon covalently bonded to 3 other carbons ***OR*** each bond has order of 1.5 ✓	*Accept "cylindrical/tube shaped".* *Accept "has delocalized electrons" **OR** "has sp^2 hybridization".*	**2**
6.	b		*Any one of:* 3D electrodes ✓ catalysts ✓ biosensors ✓ molecular stents ✓ body armour ✓ synthetic muscles ✓ micro transistors/circuitry/capacitors/electrodes ✓ reinforcing phase in a matrix/composite material «such as concrete» ✓ micro antenna ✓ stealth technology ✓ water/air filtration ✓ solar cells ✓ tennis racquets ✓ microelectronic circuits ✓	*Do **not** accept just general answers such as "medicine" or "defence".*	**1 max**

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Question			Answers	Notes	Total
7.	a		entropy increases «and the reaction proceeds to the right» ✓ more species / free molecules are formed ***OR*** more ways of distributing energy ✓		**2**
7.	b		six ✓		**1**

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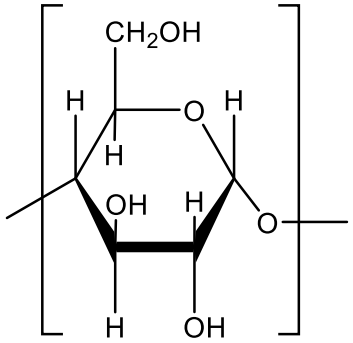
Option B — Biochemistry

Question			Answers	Notes	Total
8.	a		 continuation bonds ***AND*** **−**O attached to just one end ***AND*** both H atoms on end carbons must be on the same side ✓ *Type of linkage:* glycosidic ✓	*Square brackets not required.* *Ignore "n" if given.* *Mark may be awarded if a polymer is shown but with the repeating unit clearly identified.* *Accept "ether".*	**2**
8.	b		$(C_6H_{10}O_5)_n(s) + nH_2O(l) \rightarrow nC_6H_{12}O_6(aq)$ ✓	*Accept "(n-1)H_2O".* *Do **not** award mark if "n" not included.*	**1**
8.	c		$q = «mc\Delta T = 975\,g \times 4.18\,J\,g^{-1}\,K^{-1} \times 15.0\,K =» 61\,100\,«J»$ / 61.1 «kJ» ✓ «heat per gram $= \frac{61.1\,kJ}{3.49\,g} =» 17.5\,«kJ\,g^{-1}»$ ✓	*Award **[2]** for correct final answer.*	**2**

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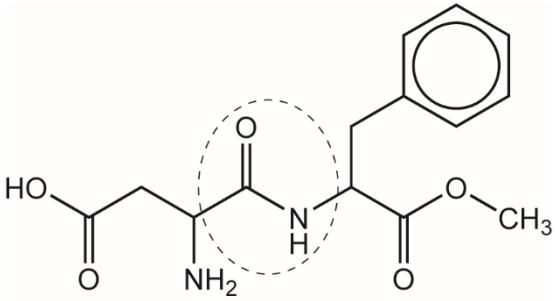
(Question 8 continued)

Question			Answers	Notes	Total
8.	**d**		*Any two of:* carbohydrate grains swell/break plastic into smaller pieces ✓ inclusion of carbohydrate makes the plastic more hydrophilic/water soluble ✓ carbohydrates are broken down/hydrolysed/digested by bacteria/micro-organisms ✓ plastic becomes more accessible to bacteria as holes/channels are created in it ✓ «presence of» carbohydrate weakens intermolecular/London/dispersion forces between polymer chains in the plastic ✓	*Accept "starch" for "carbohydrate" throughout.* *Do **not** accept "carbohydrates are broken down/hydrolyzed".*	**2 max**

Question			Answers	Notes	Total
9.	**a**		 *Name:* amide/amido/carboxamide ✓	*Accept "peptide bond/linkage".*	**2**

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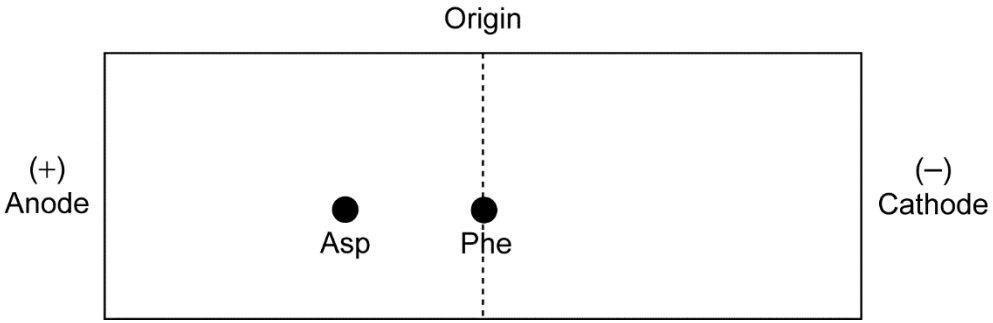
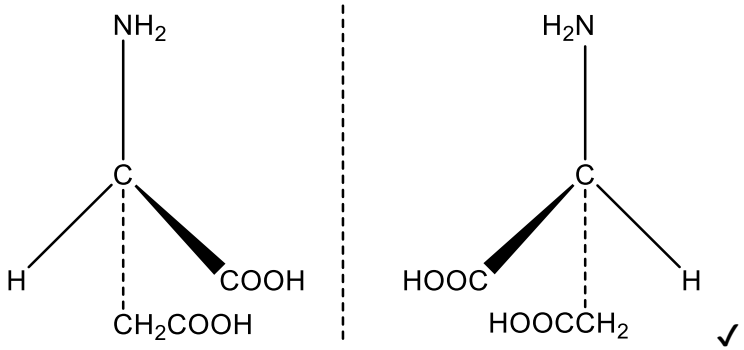
Question			Answers	Notes	Total
9.	b		 *Phe:* must be on the origin ✓ *Asp:* any position on the left/anode/+ side ✓		2
9.	c		 ✓		1

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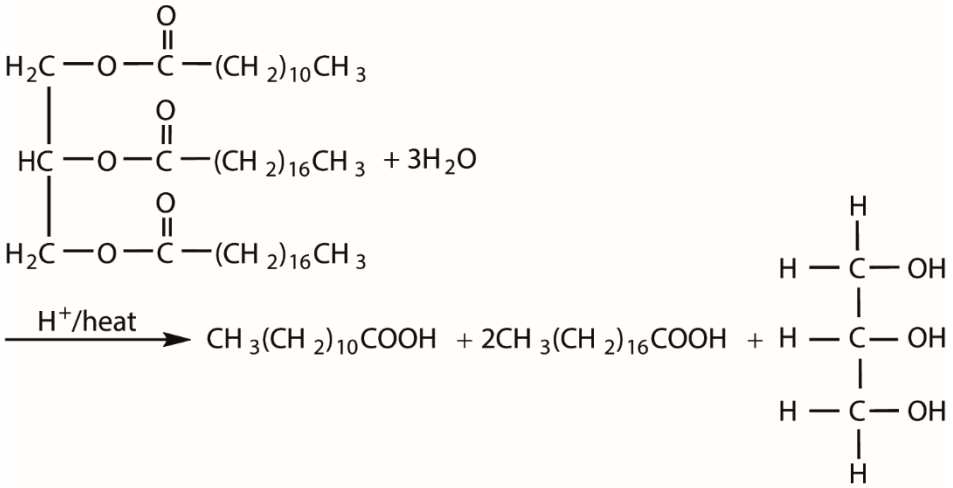
Question			Answers	Notes	Total
10.	a		coconut oil has higher content of lauric/short-chain «saturated» fatty acids ***OR*** cocoa butter has higher content of stearic/palmitic/longer chain «saturated» fatty acids ✓ longer chain fatty acids have greater surface area/larger electron cloud ✓ stronger London/dispersion/instantaneous dipole-induced dipole forces «between triglycerides of longer chain saturated fatty acids» ✓	*Do **not** accept arguments that relate to melting points of saturated and unsaturated fats.*	**3**
10.	b		 correct products ✓ correctly balanced ✓		**2**

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(Question 10 continued)

Question			Answers	Notes	Total
10.	**c**		*Any one of:* «increased risk of» coronary/heart disease ✓ «increased risk of» stroke ✓ «increased risk of» atherosclerosis ✓ «increased risk of type-2» diabetes ✓ increase in LDL cholesterol ✓ decrease in HDL cholesterol ✓ «increased risk of» obesity ✓		**1 max**

Question			Answers	Notes	Total
11.	**a**		400–424 «nm» absorption band/violet ***AND*** 424–490 «nm» absorption band/blue ✓ complementary/opposite colour observed **OR** yellow/orange observed ✓	*Accept "400–500 «nm» absorption band" for M1.*	**2**
11.	**b**		extends energy absorption spectrum «for photosynthesis» ✓		**1**

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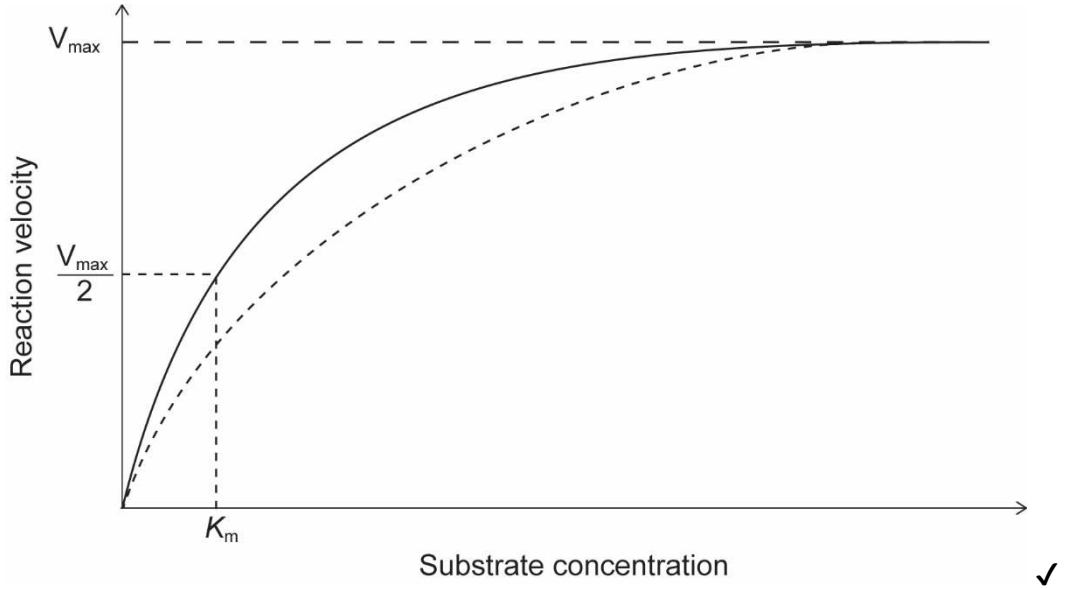
12.	**a**	**i**	 ✓	*Line must start at origin, to the right of original line and bending toward the same V_{max}.*	**1**

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(Question 12 continued)

Question			Answers	Notes	Total
12.	a	ii	K_m is higher /same V_{max} reached at higher [substrate] ✓ slower reaction rate ***OR*** gives time to excrete/eliminate methanol ✓		2
12.	b		«$pH = pK_a + \log\frac{[HPO_4^{2-}]}{[H_2PO_4^-]}$ / $6.10 = 7.20 + \log\frac{[HPO_4^{2-}]}{[H_2PO_4^-]}$» $\log\frac{[HPO_4^{2-}]}{[H_2PO_4^-]}$ = «6.10 – 7.20 =» –1.10 ***OR*** $\frac{[HPO_4^{2-}]}{[H_2PO_4^-]}$ = «$10^{-1.10}$ =» 0.079 ✓ $NaH_2PO_4 : Na_2HPO_4 = 12.6 : 1$ ✓	*Award **[2]** for correct final answer.*	2

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Question			Answers	Notes	Total
13.			*ascorbic acid:* many hydroxyl/OH groups ***AND*** *retinol:* few/one hydroxyl/OH group ***OR*** *ascorbic acid:* many hydroxyl/OH groups ***AND*** *retinol:* long hydrocarbon chain ✓ *ascorbic acid:* «many» H-bond with water ***OR*** *retinol:* cannot «sufficiently» H-bond with water ✓	*Do **not** accept "OH^-/hydroxide".*	**2**

Question			Answers	Notes	Total
14.	**a**		organism whose genetic material/DNA has been altered by genetic engineering techniques «involving transferring DNA between species» ✓	*Accept "any living organism that possesses a novel combination of genetic material obtained through the use of modern biotechnology".*	**1**
14.	**b**		*Any one of:* increased resistance to pests/micro-organisms ✓ increased shelf-life of food ✓ increased nutritional value ✓ greater crop yield ✓ greater tolerance of crops to adverse climatic/soil/growing condition ✓		**1 max**

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Option C — Energy

Question			Answers	Notes	Total
15.	**a**		« $\frac{891\,\text{kJ mol}^{-1}}{16.05\,\text{g mol}^{-1}} = 55.5\,\text{kJ g}^{-1}$ =» 55.5 «MJ kg^{-1}» ✓		**1**
15.	**b**	**i**	«55.5 MJ × 58 % =» 32.2 «MJ» ✓		**1**
15.	**b**	**ii**	*Reason for higher efficiency:* no heat/energy loss in producing steam ***OR*** no need to convert chemical energy of the fuel into heat and then heat into mechanical energy ***OR*** direct conversion of «gravitational» potential energy to mechanical energy ✓ *Reason for decreased use:* limited supply of available hydroelectric sites ***OR*** rapid growth of electrical supply in countries with little hydroelectric potential ***OR*** not building «new hydroelectric» dams because of environmental concerns ✓	*Accept "less energy lost as heat" but do **not** accept "no energy lost".* *Accept "new/alternative/solar/wind power sources «have taken over some of the demand»".* *Accept "lower output from existing stations due to limited water supplies".*	**2**

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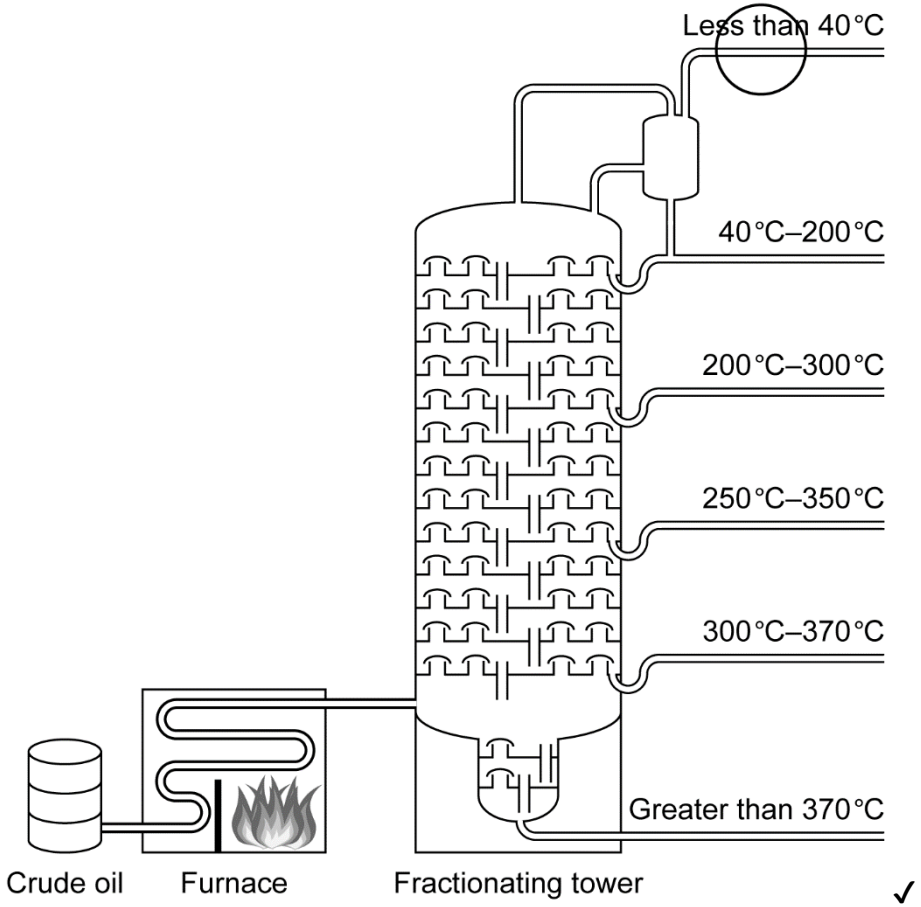
Question			Answers	Notes	Total
15.	c	i	 ✓ [Source: Image used with kind permission of science-resources.co.uk]		1
15.	c	ii	gasoline > diesel > lubricating motor oil > asphalt ✓	*Accept products written in this order whether separated by >, comma, or nothing.*	1

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(Question 15 continued)

Question			Answers	Notes	Total
15.	**d**	**i**	methane is tetrahedral ***OR*** methane has zero dipole moment/is non-polar/bond polarities cancel ✓ *Any two of:* IR absorption can result in increased vibrations/bending/stretching ✓ only modes that cause change in dipole absorb IR ✓ for methane this is asymmetric bending/stretching ✓		**3 max**
15.	**d**	**ii**	methane is less abundant ***AND*** has a greater effect «per mol» ✓		**1**

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Question			Answers	Notes	Total
16.	a	i	$^{235}U + {}^{1}n \rightarrow {}^{144}Ba + {}^{89}Kr + 3{}^{1}n$ ✓		1
16.	a	ii	greater binding energy per nucleon in products than reactants ✓	*Accept "mass of products less than mass of reactants"* ***OR*** *"mass converted to energy/$E = mc^2$".*	1
16.	a	iii	«Δm = mass of reactants-mass of products» Δm = «234.99346 – 143.89223 – 88.89788 – (2 × 1.00867) =» 0.18601 «amu» ✓ Δm = «0.18601 amu × 1.66×10^{-27} kg amu^{-1} =» 3.09×10^{-28} «kg» ✓ E = «$mc^2 = 3.09 \times 10^{-28}$ kg × $(3.00 \times 10^{8}$ m $s^{-1})^2$ =» 2.78×10^{-11} «J» ✓	*Award* ***[3]*** *for correct final answer.*	3
16.	b		mass/amount/quantity required so that «on average» each fission/reaction results in a further fission/reaction ✓ at least one of the «3» neutrons produced must cause another reaction ✓	*Accept "minimum mass of nuclear fuel needed for the reaction to be self-sustaining".*	2
16.	c		$\lambda \left(= \frac{\ln 2}{t_{\frac{1}{2}}} = \frac{\ln 2}{3.15} \right) = 0.220$ «min^{-1}» ✓ $t \left(= -\frac{1}{\lambda} \ln \frac{N}{N_0} = -\frac{\ln 0.1}{0.220} \right) = 10.5$ «min» ✓	*Award* ***[2]*** *for correct final answer.*	2

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Question			Answers	Notes	Total
17.	a		increased ***AND*** fuels can be compressed more «before ignition» ✓	*Accept "engines can be designed with higher compression ratio" **OR** "less chance of pre-ignition/auto-ignition/knocking occurring".*	1
17.	b	i	Electrode A: $C_2H_6O\,(aq) + 3H_2O\,(l) \rightarrow 12H^+\,(aq) + 12e^- + 2CO_2\,(g)$ ✓ Electrode B: $3O_2\,(g) + 12H^+\,(aq) + 12e^- \rightarrow 6H_2O\,(l)$ ✓	*Accept balanced equations with integer or fractional coefficients.* *Penalize equilibrium arrows once only.*	2
17.	b	ii	*Name:* PEM/proton-exchange membrane/polymer exchange membrane/polymer electrolyte membrane ✓ *Function:* allows the passage of protons/H^+ ions «from anode to cathode but not electrons or molecules» ✓		2
17.	b	iii	*Any one of:* water is a reactant/allows the cell to operate at a higher concentration of protons/H^+ ions ***OR*** water is a stronger electrolyte and thus produces higher electric current ✓ less dangerous/flammable ✓		1

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(Question 17 continued)

Question			Answers	Notes	Total
17.	**c**		use of «farm» land «for production» ***OR*** deforestation «for crop production for fuel» ***OR*** can release more NO_x «than normal fuel on combustion» ✓	*Ignore any reference to cost.*	**1**

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Question			Answers	Notes	Total
18.	a		metal conductivity decreases ***AND*** semi-conductor conductivity increases ✓ *metal:* collisions between «already free moving» electrons/vibrating lattice ions and electrons increase ✓ *semi-conductor:* provides sufficient energy for electrons to move to conduction band ***OR*** allows semiconductors to ionize forming freely moving electrons ✓		**3**
18.	b		*Any one of:* cheaper ✓ uses light of lower energy ✓ plentiful resources ✓ renewable resources ✓ use of nanoparticles provides large surface area exposure to sunlight ✓ can absorb better under cloudy conditions ✓ better conductivity ✓ more flexible ✓		**1 max**

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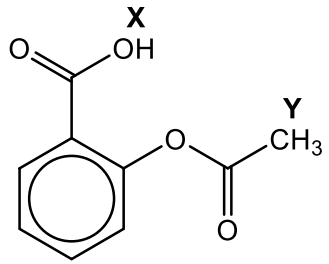
Option D — Medicinal chemistry

Question			Answers	Notes	Total
19.	**a**		*Name:* hydroxyl ✓ *Absorption band:* 3200–3600 «cm^{-1}» ✓	*Accept "phenol" **OR** "alcohol" but **not** "hydroxide".*	**2**
19.	**b**	**i**	 correct **X** ✓ correct **Y** ✓	*X and Y must be near the Hs.*	**2**
19.	**b**	**ii**	**X**: singlet ***AND*** **Y**: singlet ✓		**1**

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Question			Answers	Notes	Total
20.	**a**		«four-membered» beta-lactam ring ✓	*Accept a diagram showing a structural representation of the beta-lactam ring.*	**1**
20.	**b**	**i**	produce penicillinase/enzyme that deactivates penicillin ✓		**1**
20.	**b**	**ii**	side-chain changed «preserving beta-lactam ring» ✓	*Accept "R group changed".*	**1**

Question			Answers	Notes	Total
21.	**a**		$CaCO_3(s) + 2HCl(aq) \rightarrow CO_2(g) + CaCl_2(aq) + H_2O(l)$ ✓	*Accept balanced ionic equations involving "H^+" or "H_3O^+".* *Do **not** accept "H_2CO_3".*	**1**
21.	**b**		*Omeprazole:* inhibits enzyme/«gastric» proton pump «which secretes H^+ ions into gastric juice» ***OR*** inhibits the H^+/K^+-ATPase system ✓ *Ranitidine:* inhibits/blocks H2/histamine receptors «in cells of stomach lining» ***OR*** prevents histamine binding to H2/histamine receptors «and triggering acid secretion» ✓	*Accept "H2-receptor antagonist" for M2.*	**2**

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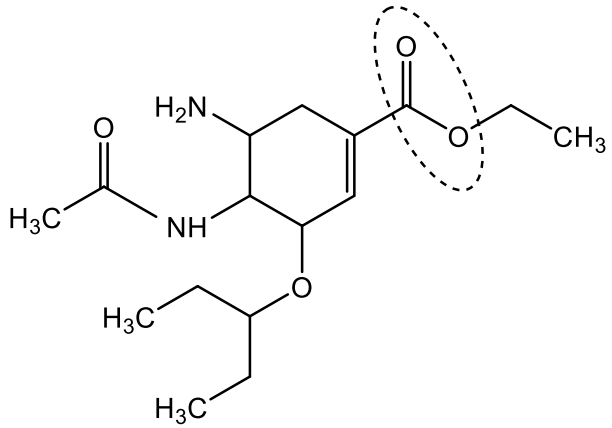
Question			Answers	Notes	Total
22.	a	i	 ✓	*Accept circles that include the alkyl side chain.*	1
22.	a	ii	283 ✓		1
22.	b		more soluble «in water» ✓		1
22.	c		viruses undergo «rapid» mutation ✓ mutation causes a change in viral protein ***OR*** drug no longer binds to virus ✓	*Accept "rapid reproduction «allows resistant viruses to multiply»".*	2

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Question			Answers	Notes	Total
23.	a		«temporarily» bond/bind to «opioid» receptors in the brain/CNS ✓ block the transmission of pain impulses ✓		2
23.	b		«codeine crosses blood–brain barrier more easily» morphine has more hydroxyl/OH «groups than codeine» ✓ codeine/ether group is less polar ***OR*** hydroxyl/OH «groups in morphine» H-bond to water ✓	*Award **[1 max]** if no statement or an incorrect statement about the blood–brain barrier.*	2

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Question			Answers	Notes	Total
24.	a	i	***Alternative 1*** half-lives = «$\frac{24.0}{6.0}$ =» 4.0 ✓ «N(t) (%) = 100(0.5)^4 =» 6.3 «%» ✓ ***Alternative 2*** $\lambda = «\frac{\ln 2}{t_{\frac{1}{2}}} = \frac{\ln 2}{6.0}$ » 0.116 hour^{-1} ***OR*** $\frac{N_t}{N_0} = e^{-0.116 \times 24}$ ✓ 6.3 «%» ✓	*Accept "6.25 «%»".* *Award **[2]** for correct final answer.*	**2**
24.	a	ii	$^{99}Tc \rightarrow {}^{99}Ru + \beta^-$ Ru ✓ mass number of Ru ***AND*** beta product ✓	*Accept "e/$e^-/{}^0_{-1}e$" for "β^-".*	**2**
24.	b	i	small/low amounts of radiation ***AND*** for a short time ✓	*Accept "weakly ionizing radiation" instead of "small amounts of radiation".* *Accept "short half-lives" instead of "for a short time".*	**1**
24.	b	ii	stored in shielded containers until radiation level drops «to a safe level» ✓		**1**
24.	c		lower frequency/longer wavelength/lower energy ***OR*** does not use ionizing radiation/radionuclides ✓	*Do **not** accept "does not cause cancer".*	**1**

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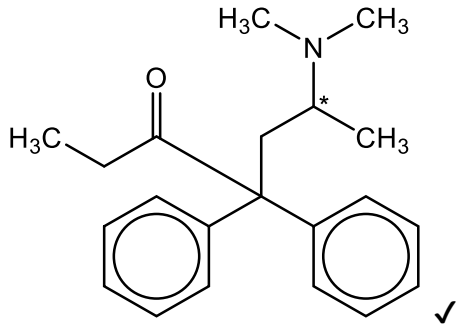
Question			Answers	Notes	Total
25.	a		 ✓		1
25.	b		«plane-»polarized light passed through sample ✓ analyser/second polarizer determines angle of rotation of plane of plane-polarized light ***OR*** each enantiomer rotates plane «of plane-polarized light» in opposite directions «by the same angle» ✓		2

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