Candidate evidence

Question 2(a)

Candidate A

determines the rate of the reaction.

Candidate B

The order in which molecules react.

Candidate C

The number of steps required for the reaction to take place.

Candidate D

The order of a reaction shows how many reactants are used in the rate determining step

Candidate E

The number of species reacting in the rate determining step.

Candidate F

The effect changing the concentration of a reactant or reactants has on the rate of reaction.

Question 5(a)

Candidate A

Splitting of degenerate d orbitals

Candidate B

To take in energy and to be promoted to a higher energy level.

Candidate C

The absorption of light (photons)

Candidate D

The fireworks cause electrons to become heated
They then become excited and jump to a higher energy level. When they jump they absorb a wavelength between 435nm and 490nm.
When they fall back to a lower energy level the colour they emit is complementary to that absorbed hence why it is orange/yellow.

Candidate E

The electrons become excited due to being exposed to high temperatures.

Question 7(b)(i)

Candidate A

a sigma bond forms when a 1s orbital and 3P orbitals hybridise to form 4 degenerate sp^3 orbitals.

Candidate B

Sigma bonds are formed by atomic overlap

Candidate C

Orbitals overlap side on

Candidate D

when orbitals overlap along the axis of the bond.

Candidate E

end on overlap of sp^3 hybridised orbitals

Question 7(b)(ii)

Candidate A

One s orbital and ~~[illegible]~~ two p orbitals combine to form and sp2 hybrid orbital.

Candidate B

when one 's' block orbital combines with ~~[illegible]~~ two 'p' block orbital forming a hybrid.

Candidate C

The combination of ~~ones~~ one s electron and ~~2~~ two p electrons.

Candidate D

This is when one S Subshell and 2 P Subshells merge together forming the double bond

Candidate E

The combination of 2 "P" orbitals with the "S" orbitals to create four new hybrid orbitals.

Candidate F

sp^2 hybridisation is when an s orbital mixes with two p orbitals forming 3 sp^2 orbitals and one unhybridised p orbital.

Question 7(d)(ii)(A)

Candidate A

Infrared radiation breaks the bonds between molecules. Different * ~~wavelengths~~ are needed to break the bonds meaning different functional groups can be identified.

* wavenumbers

Candidate B

Infrared ~~er~~ radiation causes the bonds to vibrate, so this vibration allows the functional groups to be identified as they will vibrate differently.

Candidate C

It vibrates the bonds of molecules and each type of bond vibrates a different certain amount.

Candidate D

Infrared radiation vibrate bonds within molecules. Different bonds vibrate different amounts meaning we can detect functional groups as they contain different bonds.

Candidate E

Infrared ~~eadiation~~ radiation causes the bonds to vibrate, but does not have enough energy to break the bonds in the molecules. Therefore the vibrating bonds can be identified. Bonds move and stretch in various ways depending on the length and type of functional group attached. Therefore, graphs can be taken, and functional groups identified.

Candidate F

The infrared radiation caused the bonds to vibrate and bend, ~~[illegible]~~ reflecting the light. The different functional groups are ~~are bend different amounts and reflect~~ but by different frequencies of light that can be seen by the transmittance of the different light freqs

Candidate G

Each bond absorbed a unique range of wavenumber.
different functional groups can be identified as each peak on the infrared spectrum responds to a unique stretch which corresponds to different functional groups,

Question 9(a)(ii)

Candidate A

two molecules with the same molecular formula and structural formula which can't be superimposed are optical isomers

Candidate B

Molecules with the same molecular formula ~~but different~~ and structural formula but no matter how they are rotated they can't be superemposed on each other. (Like a left and right hand).

Candidate C

an optical isomer is an isomer that can bend light.

Candidate D

Rotate plane polarised in different directions.

Candidate E

Optical isomers are isomers that are mirror images of eachother.

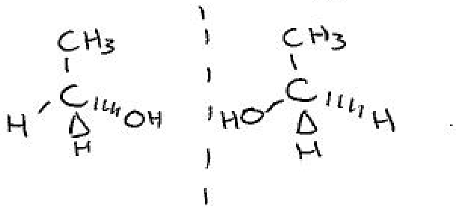
They are identical in structure but not in their 3D shape.

Candidate F

Two isomers which are supercmposible I.e mirror images of on another.

Candidate G

optical isomers are isomes that have the same atoms but are bonded differently.



These are optical isomers, they are ~~non-superimpostable~~ non-superimposible images.
Each one is an enantiomere ~~[illegible]~~ A racemic mixture is a mixture with equal volumes of each enantioner.
Opticall isomers have different effects on plane polarised light.

Question 5(b)(ii)

Candidate A

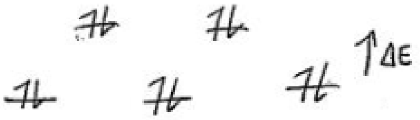
~~[illegible]~~ Transition metals ions with high oxidation states ~~[illegible]~~ ~~[illegible]~~ have a ~~[illegible]~~ larger gap between their highest occupied molecular orbital and lowest unoccupied molecular orbital so they absorb ~~energy of a smaller~~ radiation of a smaller wavelength ~~[illegible]~~ (higher frequency and energy). This means that they absorb radiation from the ultraviolet region of the electromagnetic spectrum rather than from the region of visible light, so they are colourless.

Candidate B

energy promotes electrons to higher energy levels, as they fall back to their original levels energy is released as photons. The colour absorbed by complex is in UV region of the electromagnetic spectrum, therefore the complex is colourless.

Candidate C

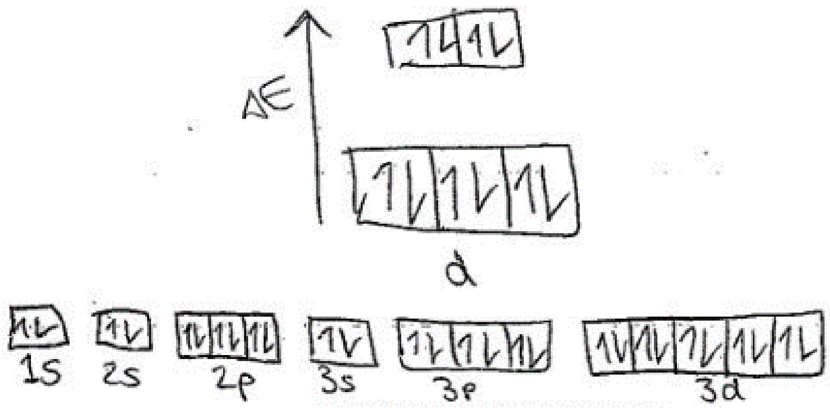
The ligand causes the d subshell to split



The energy difference of the splitting must be High enough so that the wavelength of light is small as seen in : $E = \frac{Lhc}{\lambda}$.
This would mean that the wavelength emitted must be ultra violet and therefore colourless

Candidate D

It is colourless as all the d-subshells are full and electrons cannot move and jump shells.



Candidate E

because the wavelength absorbed lies within the ultraviolet part of the electromagnetic spectrum which corresponds to colourless.

Question 7(c)

Candidate A

The conjugated system of alternating bonds decreases the gap between the HOMO and LUMO so the energy gap has an energy which corresponds to a wavelength in the visible part of the EM spectrum so a visible photon is emitted

Candidate B

The conjugated system absorbs energy which excites electrons, causing them to jump from the Lowest occupied molecular orbital to the Highest occupied molecular orbital. As the electrons fall back from the HOMO to the LOMO energy is emitted corresponding to the distance between the two orbitals.

Candidate C

a Condugated System is a serious of alternative double bonds, the smaller the Condugated system the Smaller the gap between homo and lumo and when an electron is exited and is Promoted from lumo to homo energy is Released which photon Coresponds to a colour in which the complementary colour on the Colour wheel is shown

Candidate D

carmine.
the energy gap between HOMO and LUMO allow excited ellectrons to be promoted from LUMO to HOMO when the drop back down to LUMO the energy ~~kn~~ absorbed is ~~corr~~ ~~corresponds~~ ~~[illegible]~~ is complementary to the ~~colour~~ energy transmitted)

Candidate E

The conjugated system allows electrons to absorb wavelengths of light in the visible spectrum to promote from the Homo to the Lomo. The distance from the Homo to the Lomo makes the electrons absorb blue-green light wavelengths to promote. They then release red wavelengths of light.

Candidate F

The conjugated system absorbs light ~~[illegible]~~ ~~[illegible]~~ that is blue-green in colour (490nm - 500nm), this absorbed energy promotes electrons in the ion to higher energy levels and absorb the energy leaving only the energy ~~[illegible]~~ for red light.

Candidate G

A conjugated system allows electrons to be delocalised across a number of C atoms This narrows the gap between the HOMO and LUMO, so electrons can ~~absorb~~ ~~energy to~~ move from HOMO to LUMO ~~in the~~ by absorbing energy* corresponding to the visible part of the electromagnetic spectrum. Carmine can absorb energy which corresponds to the colour red.

Candidate H

· A conjugut syster has delocalised electrons.
· The electrons from the HOMO (highest occupied molecular orbital) are promoted to the LUMO (lowest unoccupied molecular orbital)
· They electrons are promoted by absorbing photons. The difference in energy of the LUMO and HOMO is equal to the energy ~~absorbed~~ of the photon absorbed (490 – 500 nm)
· The complementary colour to the photon absorbed gives the red colour of the carmine.

Candidate I

conjugation lowers the energy difference between HOMO and LUMO so energy of a lower frequency (higher wavelength) ∴ absorbed to ~~[illegible]~~ promote an electron from HOMO to LUMO. Therefore the colour seen (complementary to the colour absorbed) has a higher wavelength, e.g. red.

Question 6(c)

Candidate A

The ~~ethanol~~ reactants had impurities

Candidate B

- Impurities or contamination in the vodka

Candidate C

- Perhaps the concentration of the potassium dichromate was wrong

Candidate D

The acidified potassium dichromate was a lower concentration than 0.010 mol l^{-1}

Candidate E

not all the ethanol was reacted with acidified potassium dichromate.

Candidate F

there was a different alcohol or aldehyde present, also reacting with $Cr_2O_7^{2-}$ (acidified), a different species was oxidised

Question 1(b)

Candidate A

$= 103.34 \text{ KJmol}^{-1}$

Candidate B

$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$

$= 127 - 298(0.0794)$

$= 127 - 23.6612$

$= 103.3388$

$= 103 \text{ kJmol}^{-1}$

Candidate C

$\Delta G^\circ = 127 - 298(79.4)$

$\Delta G^\circ =$
$127 - 298(0.0794)$

$= 103.3 \text{ KJ mol}^{-1}$

Candidate D

$\Delta G = \Delta H - T\Delta S$

$= 127 - \frac{298 \times 79.4}{1000}$

$= 103.34$

$= 103.3 \text{ kJ mol}^{-1}$

Question 2(b)(ii)

Candidate A

$rate = K[H_2O_2][I^-]$

Candidate B

$r = k[H_2O_2][I^-]$

Candidate C

$R = K[H_2O_2][I^-]$

Candidate D

$rate = k[H_2O_2][I^-]$

Question 1(b)

Candidate A

$\Delta G° = \Delta H° - T\Delta S°$

$= 127 - 298 \times 0.0794$

$= 127 - 23.6612$

$= 103.3388$ kJ mol^{-1}

79.4 J ⇒ 0.0794 kJ

Candidate B

$\Delta G° = \Delta H° - T\Delta S°$

$= 127 - 298(0.0794)$

$= 127 - 23.6612$

$= 103.3388$ K Jmol^{-1}

$\Delta H = 127$ kJ

Candidate C

$\Delta G° = \Delta H° - T\Delta S°$

$= 127 - (298 \times 0.0794)$

$= 103.339$ kJ mol^{-1}

79.4 ÷ 1000

= 0.0794 kJ K^{-1} mol^{-1}

Question 4(c)(ii)(B)

Candidate D

n
c v

$c = n/v$
$= 0{\cdot}02/0{\cdot}25$
$= 0{\cdot}08\,\text{mol}\,\ell^{-1}$

$CH_2ClCOOH$
H: 1
O: 32
Cl: 35·5
H_2: 2
C: 12
87g.

$n = m/g$
$= 1{\cdot}89/87$
$= 0{\cdot}02\,\text{mol}$

$pH = \frac{1}{2}pKa - \frac{1}{2}\log_{10} c.$
$pH = \frac{1}{2}(2{\cdot}796) - \frac{1}{2}\log_{10}(0{\cdot}08)$
$pH = 1{\cdot}398 - \frac{1}{2}(-1{\cdot}09..)$
$= 1{\cdot}398 + 0{\cdot}548$
$= 1{\cdot}946$

$pKa = -\log_{10} Ka.$
$= -\log_{10}(1{\cdot}6 \times 10^{-3})$
$= 2{\cdot}796.$