


| Question | Expected Answers | Marks |
|----------|---|-------|
| 1 a i | ${}^1_6\text{X}$ X 1 for each number | 2 |
| 1 a ii | carbon | 1 |
| 1 a iii | <i>two from:</i> higher temperature/heat/very hot/more energy available (1); higher pressure/more compressed (1); high gravity(1) not concn/density | 2 |
| 1 b i | p: 7 (1); n: 6(1); e: 7(1) mark separately but ecf on protons. | 3 |
| 1 b ii | electron (1) (or correct symbol) | 1 |
| 1 b iii | ${}^{13}_7\text{N} \rightarrow {}^0_{-1}\text{e} + {}^{13}_8\text{O}$ 3 for completely correct, otherwise: 1 for correct β particle; 1 for consistent symbol and atomic no (<u>except N</u>) | 3 |
| | short half-life/decays/doesn't last long enough.....(1) | 1 |
| 1 d i | Dative/co-ordinate (1) | 1 |
| 1 d ii |  6 electrons between atoms (1); <u>correct</u> electrons and <u>arrangement</u> between atoms (1); <u>one</u> lone pair/two electrons on each not between atoms (1) | 3 |
| 1 d iii | Theory: electron pairs/groups/regions <u>around central atom</u> /carbon (1); Electrons repel (1); get as far away possible/minimize repulsion/ energy (1); Application to OCS: two double bonds/regions of electron density (1); molecule/CO ₂ linear/bond angle 180° (1); (diagram can scores both) | 5 |
| | Total | 22 |

| Question | Expected Answers | Marks |
|----------|--|-------|
| 2 a | exothermic (1) | 1 |
| 2 b i | $\text{CaO(s)} + \text{H}_2\text{O(l)} \rightarrow \text{Ca(OH)}_2\text{(s)}$ (1) for correct state symbols | 1 |
| 2 b ii | Elements box correctly filled as $\text{Ca(s)} + \text{O}_2\text{(g)} + \text{H}_2\text{(g)}$ elements (1) state symbols (1) | 2 |
| 2b iii | $\Delta H_r = -\Delta H_f\text{CaO} - \Delta H_f\text{H}_2\text{O} + \Delta H_f\text{Ca(OH)}_2$ /correct figures used (+635 +286 -986) (1) ecf 2 nd mark on calculator Correct calculation leading to answer <u>on line</u> (with sign) -65 kJ mol^{-1} (1) | 2 |
| 2 c | 12/56 moles CaO (1) $\times 18 = 3.9 \text{ g water}$ (1) 2 sf (1)(mark independently); { 3.9 or 3.8 (from $12/56 = 0.21$) scores 3} | 3 |
| 2 d i | Stir(1); <u>Insulated</u> beaker/polystyrene cup/water jacket (1); Measure temperature rise/change /initial & final temperatures (1) ; Measure mass of solid/(known) amount/quantities (1) Measure volume/mass of water/(known) amount/quantities (1) | 5 |
| 2 d ii | hard to ensure all water reacts with CaO before any Ca(OH)_2 dissolves/ difficulty in maintaining a standard temp./25°C(1) | 1 |
| 2 e i | Alkali(ne) (1) | 1 |
| 2 e ii | test: named indicator/pH paper/pH meter (1); <u>Not</u> precipitates or react with acid. results: $\text{pH} > 7$ (pH meter)/ alkaline colour(dependent on indicator) (1) | 2 |
| 2 f i | Calcium(hydroxide) more soluble/more soluble down group (1); (ora) | 1 |
| 2 f ii | $\text{MgO} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2\text{O}$ correct formulae (1); balanced (for 'sensible equation') (1) | 2 |
| | | 21 |

| Question | Expected Answers | Marks |
|----------|--|-------|
| 3 a i | A, B, D <i>other letters contradict correct answers(allow F)</i> | 1 |
| 3 a ii | B and D | 1 |
| 3 a iii | C | 1 |
| 3 a iv | E | 1 |
| 3 a v | F | 1 |
| 3 b | 2-methyl (1); pentane (1); ignore dashes, commas, spelling etc | 2 |
| 3 c | entropy (1) | 1 |
| 3 d i | (more)complete combustion/less incomplete combustion/O ₂ combines/converts more C to CO ₂ (1) | 1 |
| 3 d ii | lower engine temperature/less energy to break bonds in reactants(1); less N ₂ -O ₂ reaction (1); OR more O ₂ and NO → NO ₂ (max 1) | 2 |
| 3 e i | Catalyst in different <u>phase/state</u> from reactants (1); Two from: speeds up reaction; catalyst unchanged/not used up AW; Alternative reaction pathway/lowers activation enthalpy; | 3 |
| 3 e ii | Two from: large surface area (1); reaction takes place on surface (1); Pt/it is expensive/the <u>thin layer</u> cuts down costs (1); allows Pt to heat up more quickly(1); | 2 |
| 3 f i | <i>M_r</i> of heptane = 100 (1) <i>subsumed by correct final answer</i> 3/100 = 0.03 (mol) (1) ecf on <i>M_r</i> | 2 |
| 3 f ii | 15 mol (per mol of heptane) (1) <i>subsumed by correct answer</i> 0.03 x 15 (or 7 and 8 separately) = 0.45 mol s ⁻¹ (1) ecf on (i) | 2 |
| 3 f iii | 0.45 x 60 = 27 dm ³ s ⁻¹ (1) ecf on (ii) | 1 |
| | Total | 21 |

| Question | Expected Answers | Marks |
|----------|--|-------|
| 4 a | Charged atom/group of atoms/molecule or atom/group of atoms/molecule that has lost or gained electron(s) NOT charged particle or specific ion(e.g. cation) | 1 |
| 4 b | arrow going up (1) from a definite lower level to higher one (1) | 2 |
| 4 c | arrow going down (1) (ignore positioning) | 1 |
| 4 d i | Diagram showing drop to <u>different energy</u> levels(or in words) (1); Each set caused by a drop to a <u>specific</u> level(1) | 2 |
| 4 d ii | Higher energy levels get closer/gaps becomes smaller (must state or label diagram) (1); Reference to frequency related to energy <u>gap</u> / $E = hf$ (1) | 2 |
| 4 e i | Different <u>isotopes</u> (1); with different masses/numbers of neutrons (1) | 2 |
| 4 e ii | Abundances/ratio/% of different isotopes/used to calculate A_r (1); | 1 |
| | Total | 11 |

(Paper total 75)