
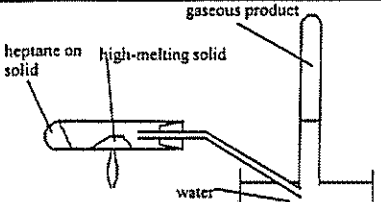
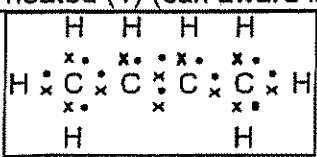
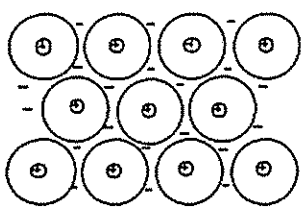
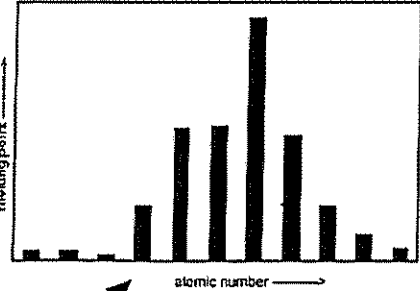


1 a i	<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 20%;"></th> <th style="width: 20%;">C-12</th> <th style="width: 20%;">C-13</th> <th style="width: 40%;"></th> </tr> </thead> <tbody> <tr> <td>protons</td> <td>6</td> <td>6</td> <td>(1) (both correct)</td> </tr> <tr> <td>neutrons</td> <td>6</td> <td>7</td> <td>(2) (1 each) <i>ecf from protons</i></td> </tr> <tr> <td>electrons</td> <td>6</td> <td>6</td> <td>(1) (both correct) <i>ecf from protons</i></td> </tr> </tbody> </table>		C-12	C-13		protons	6	6	(1) (both correct)	neutrons	6	7	(2) (1 each) <i>ecf from protons</i>	electrons	6	6	(1) (both correct) <i>ecf from protons</i>	4
	C-12	C-13																
protons	6	6	(1) (both correct)															
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1 a ii	atomic number 6 (<i>ecf from protons above</i>); mass number 12. (ALLOW 12.0)	2																
1 b	isotope(s)	1																
1 c	<p>3 from 4:</p> <p>(electro)magnet(ic field);</p> <p>deflects/attracts/repels/bends/anything implying change of direction particles</p> <p>NOT separates (IGNORE type of particle);</p> <p>according to their mass/weight(/charge ratio)/heavy light; (wrong way is CON);</p> <p>NOT large/small</p> <p>varying the magnetic <u>field</u> brings the particles on to D.</p> <p>(marks can be scored for labels on diagram)</p>	3																
1 d	$(98.89 \times 12) + (1.11 \times 13) (= 1201.11) (1)$ $\div 100 = 12.01(1)(1)$ <i>ecf</i> No units. ALLOW amu/g mol^{-1} ONLY; 3 decimal places (<i>mark separately provided answer starts with 12</i>)(1)	3																
1 e i	$C \rightarrow e/\beta (1) + (1)N$ ((1) for consistent symbol and Z, <i>except carbon</i>) extra info added to otherwise correct equation (IGNORE γ) scores max (2) – e/β on left OK. Otherwise electron on left can only score consistent symbol- Z mark. IGNORE minus charge on e.	3																
1 e ii	<p><i>Any four from:</i></p> <p>β-particles/γ-rays are ionising/ oxidising (1)</p> <p>destroy DNA/cause mutations/cancer/ damage cells/skin/tissue (AW)</p> <p>NOT people/us etc NOT harmful (1);</p> <p>β can penetrate skin/stopped by (any) metal (foil)/stone/concrete(1)</p> <p>γ great penetration/ (only) stopped/absorbed by lead (1)</p> <p><u>lead</u> container needed to protect (1)</p>	4																

2 a i	alkanes(s)	1
2 a ii	CH ₃ -CH ₂ -CH ₂ -CH ₂ -CH ₂ -CH ₂ -CH ₃ etc (or full structural or combination - ALLOW skeletal)	1
2 a iii	 Five carbon backbone (1) Correct branches NOT CH ₃ (1) Max (1) for "blobs", allow dots.	2
2 b	structure (as a ii) (1); name (<i>must match structure of carbon backbone</i>) (<i>ignore commas, dashes, gaps</i>) (1)	2
2 c	97% 2,2,4-trimethylpentane and 3% heptane	1
2 d i	alkene(s) (1); <u>cycloalkane(s)</u> (1)	2
2 d ii	C only (1); has a <u>benzene ring/delocalised electrons/is benzene/arene</u> (1) <i>depends on first being scored</i>	2
2 e	 heating tube or boiler and tube with solid, connected without leaks to... (1) CON if sealed; collection tube (or gas syringe) (1) <i>mark separately</i> labels, minimum heptane, catalyst (ignore qualification)/ alumina/pot, catalyst heated (1) (can award label mark if catalyst in heptane) IGNORE condensers	3
2 f i	 double bond (any combination of two dots and two crosses or other symbols)(1); single bonds (1)	2
2 f ii	P = 109 (±2) (1) Q = 120 (±3) (1) (degree sign not needed)	2

2 g i	$C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$ products(1); reactants (1) <i>any balanced equation</i>	2
2 g ii	Broken 2 x C–C 694 Made 8 x C=O 6440 8 x C–H 3304 8 x O–H 3712 1 x C=C 612 6 x O=O 2988 Total 7598 (1) 10152 (1) <i>ecf from equation above</i> Broken – made (1) = 7598 – 10152 = $-2554 \text{ kJ mol}^{-1}$ (1) <i>including sign and unit, ecf</i> NOT mol^{-1} ALLOW $-2550 \text{ kJ mol}^{-1}$	4
2 g iii	Average/approx bond enthalpies used/vary between molecules (1); Standard states not used/ reference to $H_2O(l)$ (1)	2
2 g iv	(C–C has a) smaller bond enthalpy/weaker bond/less energy to break OR IGNORE any extra qualification. Must be a <i>comparison</i> .	1

3 a i	nitrogen and oxygen react/ combine/bond (together)/ nitrogen is oxidised/ burns /combusts (or correct equation)(1); in the <u>heat/spark / high temperature</u> of the engine (1) IGNORE pressure	2
3 a ii	<i>two sets from:</i> acid rain (1); which damages life/ corrodes buildings/causes eutrophication (1) smogs/ozone-production/ irritates respiratory tract(1); harmful to life/ toxic*(1) greenhouse gases (1); which cause global warming *(1) dissolves in watercourses (etc) (1); causes algal bloom /eutrophication (1) destroys <u>stratospheric ozone/ozone layer</u> (1); which removes protection from/ increases u.v./causes sunburn/skin cancer (1) <i>ALLOW</i> second mark on its own if <i>stratospheric</i> omitted. <i>ALLOW</i> second mark without first only where shown or where "**".	4
3 b	Incomplete combustion/ burning/oxidation (of fuel) or carbon released/ produced from fuel/hydrocarbon during combustion/reaction/decomposition of fuel	1
3 c i	different state/phase (from reactants)	1
3 c ii	$C + 2NO_2 \rightarrow CO_2 + 2NO$ correct formulae(1) ; balanced (1) <i>second mark depends on first being scored</i> <i>ALLOW</i> doubled or halved	2
3 c iii	A: C/CO ₂ , NO ₂ ; B: CO ₂ , NO	2

4 a	$M_r \text{ Pb}(\text{C}_2\text{H}_5)_4 = 323$ (1) <i>stated or implied</i> $\% = 207 \times 100/323 = 64(\%)$ <i>ecf</i> <i>IGNORE significant figures</i>	2
4 b i	 <p>lattice of metal particles (minimum two rows and three particles in all) labelled (or indicated) as positive (up to 4+) (1) <i>IGNORE any description of particles</i> electrons labelled between (1) (e or e⁻) <i>can be labelled "pool of electrons"</i></p>	2
4 b ii	held together by attraction between electrons and ions/ nuclei/positive residue/particles NOT just "electrostatic attraction". Other bonding descriptions are CON	1
4 c i	atomic/proton number(s)	1
4 c ii	(relative) <u>atomic mass/weight</u> NOT mass number	1
4 d i	falls/ gets weaker (AW) rises and falls (but rises to any element except Al is CON)	1
4 d ii	 <p>Na correctly identified (1); reason (follows low value for noble gas/ worked back from silicon) (1)</p>	2
4 d iii	$\text{Na}(\text{g}) \rightarrow \text{Na}^+(\text{g}) + \text{e}^-$ (1) for some ionisation of sodium (to positive ion) (not necessarily balanced or including electrons) (1) for correct equation <i>ALLOW</i> nuclear symbols (1) for state symbols for Na and ions	3
4 d iv	Chlorine (1) <i>ALLOW</i> Cl/ Cl ₂ It has the most protons/ highest atomic number/ highest Z (1); more attraction for electrons/ held more tightly/ harder to remove (1) <i>only if second mark correct or if "smallest atom" mentioned.</i> " I.E. increases across period" scores (1)	3