Level 2 Chemistry: practice paper 2026

AS 91164 Demonstrate understanding of bonding, structure, properties and energy changes · Vertex Academy practice paper, not an NZQA paper

Attempt ALL the questions. Show ALL working. Write your answers on lined paper, or in the space under each question.

QUESTION ONE

(a) The fertiliser plant at Kapuni in Taranaki makes ammonia, NH_3, from natural gas. The gas also contains methane, CH_4, and carbon dioxide, CO_2.
For each of CH_4, NH_3 and CO_2, name the shape of the molecule and give the bond angle around the central atom.

(b) Describe the Lewis structures of NH_3 and CO_2: the bonds between the atoms and the lone pairs on each atom.

(c) Electronegativities: H 2.2, C 2.6, N 3.0, O 3.4.
Explain why NH_3 molecules are polar but CO_2 molecules are non-polar.

(d) In the laboratory, ammonia, NH_3, and boron trifluoride, BF_3, both have a central atom bonded to three other atoms. Electronegativities: H 2.2, B 2.0, N 3.0, F 4.0.
Discuss the shapes and the polarities of NH_3 and BF_3.

QUESTION TWO

(a) A class tested four solids. Their results are in the table.
For each solid, name the type of solid, the particles it is made of, and the attractive forces between those particles.

Solid	Melting point (°C)	Conducts as a solid?	Conducts when molten?
copper	1085	yes	yes
sodium chloride	801	no	yes
silicon dioxide	1710	no	no
iodine	114	no	no

(b) Copper is used for electrical wiring because it conducts electricity and is ductile: it can be drawn out into a thin wire.
Describe the features of the structure of copper that make it conduct and make it ductile.

(c) Explain why sodium chloride does not conduct electricity when it is solid, but does conduct when it is molten or dissolved in water.

(d) Iodine melts at 114 °C. It dissolves in cyclohexane, a non-polar solvent, but only very slightly in water. Silicon dioxide melts at 1710 °C and does not dissolve in either solvent.
Discuss these properties of iodine and silicon dioxide in terms of their particles and the forces between them.

QUESTION THREE

(a) Camping stoves burn butane, C_4H_{10}. An instant cold pack works by dissolving ammonium nitrate, NH_4NO_3, in water.
For each process, state whether it is exothermic or endothermic, give the sign of ΔrH, and describe what happens to the temperature of the surroundings.

(b) $\Delta_cH(C_4H_{10}) = -2877$ kJ mol^{-1}. $M(C_4H_{10}) = 58.0$ g mol^{-1}.
Calculate the energy released when 25.0 g of butane burns completely.

(c) Kapuni makes ammonia from nitrogen and hydrogen:
$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
Bond enthalpies (kJ mol^{-1}): N≡N 945, H–H 436, N–H 391.
Calculate ΔrH for this reaction, and explain what the sign of your answer shows.

(d) Methane burns in oxygen:

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

Bond enthalpies (kJ mol^{-1}): C–H 414, O=O 498, C=O 804, O–H 463. $M(CH_4)$ = 16.0 g mol^{-1}.

Calculate ΔrH, then the energy released when 8.00 g of methane burns. A data book gives $\Delta cH(CH_4)$ = −890 kJ mol^{-1}, with liquid water as a product. Discuss why your value differs from the data book value.

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