Website: contoureducation.com.au | **Phone:** 1800 888 300
Email: hello@contoureducation.com.au

VCE Chemistry ¾

Gas Calculations & Stoichiometry [1.3]

Test Solutions

20 Marks. 2 Minutes Reading. 18 Minutes Writing.

Results:

Test	_____ / 15
Extension	_____ / 5

Section A: Test (15 Marks)

INSTRUCTION: 15 Marks. 1 Minute Reading. 12 Minutes Writing.

Question 1 (4 marks)

Tick whether the following statements are **true** or **false**.

Statement	True	False
a. In complete combustion, the oxygen is assumed to be the limiting reagent.		✓
b. If the efficiency of a spirit burner experiment is 30%, then 70% of the energy released by the fuel was lost to the environment.	✓	
c. Experimental ΔH values are typically greater than theoretical ones.		✓
d. The energy released by a fuel in a spirit burner is never less than the energy absorbed by the water being heated.	✓	
e. Volume-volume stoichiometry may only be used if the temperature and pressure are constant at SLC.		✓
f. At Standard Laboratory Conditions (SLC), one mole of every ideal gas occupies 24.8 L of volume.	✓	
g. In a chemical reaction, the limiting reagent determines the maximum amount of product that can be formed.	✓	
h. If 5 moles of hydrogen gas reacts with 2 moles of oxygen gas, the reaction will produce 4 moles of water.	✓	

Space for Personal Notes

Question 2 (4 marks)

Ethyne, C_2H_2, is a chemical compound that can be used as a fuel. Upon combustion of one mole of ethyne at SLC, 1300 kJ of energy is released.

a. Write the balanced thermochemical equation for the complete combustion of C_2H_2. (2 marks)

$C_2H_2(g) + \frac{5}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O(l) * \Delta H = -1300\ kJ\ mol^{-1}$

or

$2C_2H_2(g) + 5O_2(g) \rightarrow 4CO_2(g) + 2H_2O(l)\ \Delta H = -2600\ kJ$

b. Calculate the volume of CO_2 produced when 200.0 L of C_2H_2 is completely combusted at standard laboratory conditions (SLC). Justify your working with appropriate steps or reasoning. (2 marks)

Using volume-volume stoich (as T and P are constant) (1)

$V(C_2H_2) = 2 \times n(C_2H_2) = 400.0\ L\ (4\ s.f.)$ (2)

If molar volume approach was used, V(ethyne) = 400 L (3 $s.f.$)

Question 3 (1 mark)

How many kilojoules of energy would be released from the production of 49.6 L of carbon dioxide at 25°C and 100 kPa based on the following thermochemical equation?

$$2CH_3OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 4H_2O(l) \quad \Delta H = -1452\ kJ$$

$n(CO_2) = V/V_m = 49.6/24.8 = 2.0\ mol$ (1)

1452 kJ of energy would be released when 2 mol of CO_2 is evolved, directly observed from the equation provided.

Space for Personal Notes

Question 4 (6 marks)

A sample of butan-1-ol (C_4H_9OH) on a spirit burner which initially weighs 78.70 g undergoes complete combustion. After the combustion is complete, it is found that the spirit burner weighs 74.92 g. The heat energy released is used to heat 350 mL of water at SLC. The temperature of the water rises to 53.20°C.

a. Calculate the molar heat of combustion of butan-1-ol. (4 marks)

$\Delta m = 78.70 - 79.92 = 3.78\ g$

$n(C_4H_9OH) = \frac{m}{M} = \frac{3.78}{48+10+16} = 5.11\times10^{-2}\ mol$

$q_{absorbed} = mc\Delta T = 350 \times 4.18 \times (53.25 - 25.00)$

$= 4.13\times10^{4}\ J$

$= 41.32\ J$

$\Delta H = \frac{q}{n} = \frac{41.3\ kJ}{5.11\times10^{-2}\ mol} = -809\ kJ/mol\ (3\ s.f)$

b. Given that the process carried out is known to be 65.0% efficient, find the new calculated heat of combustion. (1 mark)

$\Delta H_{new} = \frac{809}{0.650} = -1.24\times10^{3}\ kJ/mol\ (3\ s.f)$

c. Propose a major reason as to why the experiment was not 100% efficient. (1 mark)

Heat loss to the surroundings → not all energy released by butan-1-ol was absorbed by the water.

Space for Personal Notes

Section B: Extension (5 Marks)

INSTRUCTION: 5 Marks. 1 Minute Reading. 6 Minutes Writing.

Question 5 (5 marks)

A reaction between nitrogen gas and hydrogen gas produces ammonia (NH_3) according to the balanced equation:

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

If 5.00 moles of nitrogen and 12.0 moles of hydrogen are reacted:

a. Calculate the volume of NH_3 produced. (3 marks)

H_2 is limiting as only 4 mol of N_2 would be needed to react with it. (1)

$n(NH_3) = \frac{2}{3} \times n(H_2) = \frac{2}{3} \times 12 = 8\ mol$ (2)

$V(NH_3) = n \times V_m = 8 \times 24.8 = 198.4\ L = 198\ L\ (3\ s.f.)$ (3)

b. Determine the amount, in g, of the excess reagent left over. (2 marks)

$n(N_2)_{used} = 4\ mol \rightarrow n(N_2)_{excess} = 5 - 4 = 1\ mol$ (1)

$m(N_2)_{excess} = n \times M = 1 \times (14 \times 2) = 28.0\ g$ (2)

Space for Personal Notes

CONTOUREDUCATION

Website: contoureducation.com.au | **Phone:** 1800 888 300 | **Email:** hello@contoureducation.com.au

VCE Chemistry ¾

Free 1-on-1 Support

Be Sure to Make The Most of These (Free) Services!

- Experienced Contour tutors (45+ raw scores, 99+ ATARs).
- For fully enrolled Contour students with up-to-date fees.
- After school weekdays and all-day weekends.

1-on-1 Video Consults	Text-Based Support
➢ Book via bit.ly/contour-chemistry-consult-2025 (or QR code below). ➢ One active booking at a time (must attend before booking the next).	➢ Message +61 440 137 304 with questions. ➢ Save the contact as "Contour Chemistry".

Booking Link for Consults
bit.ly/contour-chemistry-consult-2025

Number for Text-Based Support
+61 440 137 304