

Q1.

2 The unsaturated hydrocarbon ethyne (acetylene), C_2H_2 , is widely used in 'oxy-acetylene torches' for cutting and welding metals. In the torch, ethyne is burned in oxygen to produce a flame with a temperature of 3400K.

(a) Ethyne is a linear molecule with a triple bond, $C\equiv C$, between the two carbon atoms.

Draw a 'dot-and-cross' diagram of an ethyne molecule.

[1]

(b) When used for cutting or welding, ethyne is transported in cylinders which contain the gas under pressure. A typical cylinder has a volume of 76 dm^3 and contains ethyne gas at 1515 kPa pressure at a temperature of 25°C .

Use the general gas equation, $pV = nRT$, to calculate the amount, in moles, of ethyne in this cylinder.

[2]

(c) In some countries, ethyne is manufactured from calcium carbide, CaC_2 , which is produced by heating quicklime and coke together at 2300K.



When water is added to the CaC_2 , calcium hydroxide, $Ca(OH)_2$, and ethyne, C_2H_2 , are produced.

(i) Construct a balanced equation for the formation of ethyne from calcium carbide.

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(ii) Use this equation and your answer to part (b) to calculate the mass of CaC_2 which will react with an excess of water to produce enough ethyne to fill 100 cylinders of the gas.

[3]

Q2 .

2 The kinetic theory of gases is used to explain the large scale (macroscopic) properties of gases by considering how individual molecules behave.

(a) State **two** basic assumptions of the kinetic theory as applied to an ideal gas.

(i)

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(ii)

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[2]

(b) State **two** conditions under which the behaviour of a real gas approaches that of an ideal gas.

(i)

(ii)

[2]

(c) Place the following gases in decreasing order of ideal behaviour.

ammonia, neon, nitrogen

most ideal **least ideal**

Explain your answer.

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[3]

(d) By using the kinetic-molecular model, explain why a liquid eventually becomes a gas as the temperature is increased.

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[2]

Q3.

Bicycles may be carried on commercial airliners. When carried on airliners, bicycles are placed in the luggage hold. This is a part of the aircraft which, in flight, will have different temperatures and air pressures from those at sea level.

This question concerns the change in pressure in an inflated bicycle tyre from when it is at sea level to when it is in the hold of an airliner in flight.

- (d)** At sea level and a temperature of 20°C an inflated bicycle tyre contains 710cm^3 of air at an internal pressure of $6 \times 10^5\text{Pa}$.

Use the general gas equation $PV = nRT$ to calculate the amount, in moles, of air in the tyre at sea level.

[2]

The same bicycle, with its tyres inflated at sea level as described in **(d)** above, is placed in the luggage hold of an airliner. At a height of $10\,000\text{m}$, the temperature in the luggage hold is 5°C and the air pressure is $2.8 \times 10^4\text{Pa}$.

- (e)** Assuming the volume of the tyre does not change, use your answer to **(d)** to calculate the pressure inside the tyre at a height of $10\,000\text{m}$.

[2]

Q4.

(c) (i) State the basic assumptions of the kinetic theory as applied to an ideal gas.

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(ii) Suggest **one** reason why CO₂ does not behave as an ideal gas.

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[5]