

WELCOME TO A LEVELS! ;)

Answer **all** questions.

Answers are either A, B, C or D. If you get something else, and think there's an option E - nope. There is **no** option E. Your answer **must** be wrong.

1 Which species contains the smallest number of electrons?

- A B^{3+} B Be^{2+} C H^{-} **D** He^{+}
- $5-3=2$ $4-2=2$ $1+1=2$ $2-1=1$

2 Which ion has both more electrons than protons and more protons than neutrons?

[$H = {}^1_1H$; $D = {}^2_1H$; $O = {}^{16}_8O$]

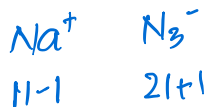
n
p
e

- A D^{-} B H_3O^{+} C OD^{-} **D** OH^{-}
- 1 $0+8=8$ $8+1=9$ $8+0=8$
 1 $3+8=11$ $8+1=9$ $8+1=9$
 2 $3+7=10$ $8+2=10$ $8+2=10$ ↓

3 Sodium azide, NaN_3 is an explosive used to inflate airbags in cars when they crash. It consists of positive sodium ions and negative azide ions.

What are the numbers of electrons in the sodium ion and the azide ion?

	sodium ion	azide ion
A	10	20
B	10	22
C	12	20
D	12	22



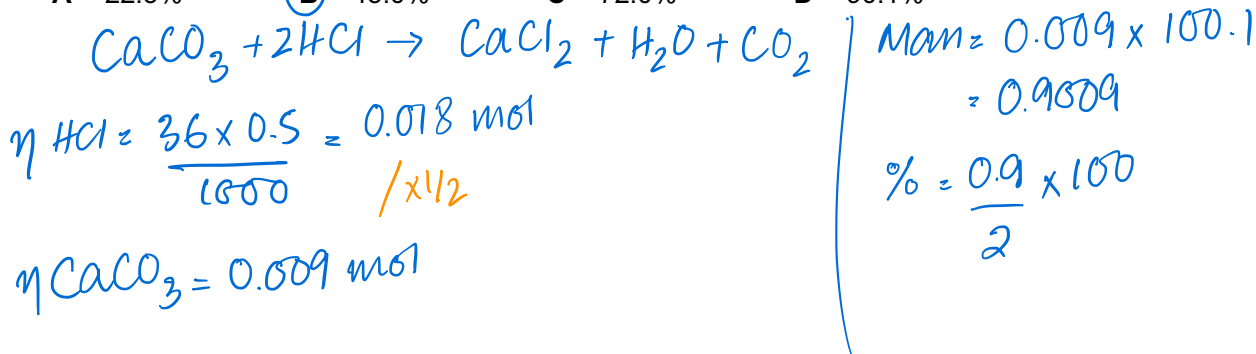
4 Which of these samples of gas contains the same number of atoms as 1g of hydrogen ($M_r : H_2, 2$)?

- A 22g of carbon dioxide ($M_r : CO_2, 44$) 0.5×3 $1g H_2 = 0.5 mol$ of H_2
 B 8g of methane ($M_r : CH_4, 16$) 0.5×5 but 1 mol H atoms.
C 20g of neon ($M_r : Ne, 20$) 1
 D 8g of ozone ($M_r : O_3, 48$) $\frac{8}{48} \times 3 = 0.5$

- 5 A piece of rock has a mass of 2.00g. It contains calcium carbonate, but no other basic substances. It neutralises exactly 36.0 cm³ of 0.500 mol dm⁻³ hydrochloric acid.

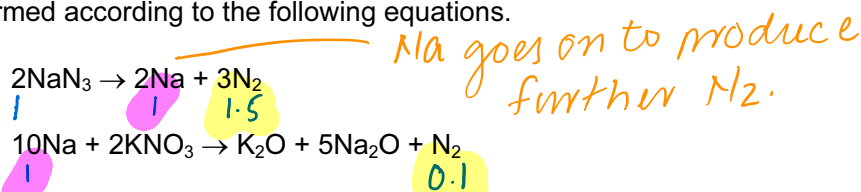
What is the percentage of calcium carbonate in the 2.00g piece of rock?

- A 22.5% **B** 45.0% C 72.0% D 90.1%



- 6 On collision, airbags in cars inflate rapidly due to the production of nitrogen.

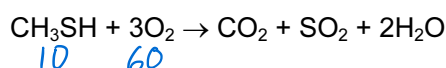
The nitrogen is formed according to the following equations.



How many moles of nitrogen gas are produced from 1 mol of sodium azide, NaN₃?

- A 1.5 **B** 1.6 C 3.2 D 4.0

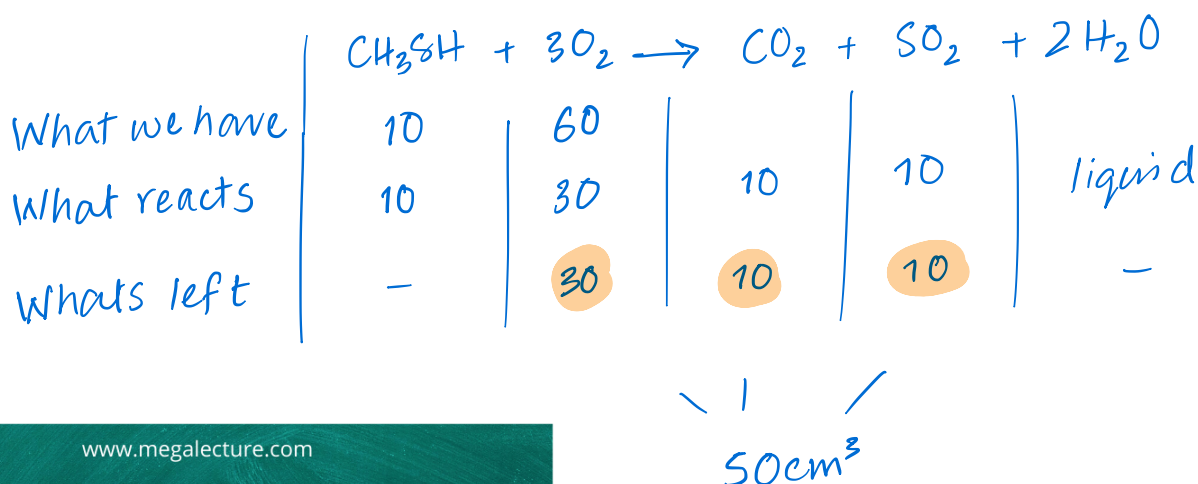
- 7 The foul smell that skunks spray is due to a number of thiols, one of which is methanethiol, CH₃SH, which burns as follows.



A sample of 10 cm³ of methanethiol was exploded with 60 cm³ of oxygen.

What would be the final volume of the resultant mixture of gases when cooled to room temperature?

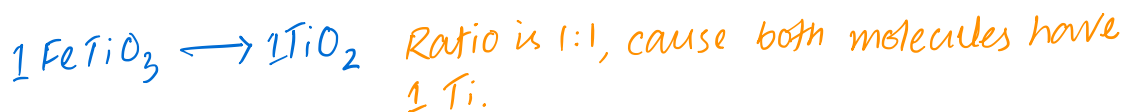
- A 20 cm³ B 30 cm³ **C** 50 cm³ D 70 cm³



- 8 Titanium(IV) oxide, TiO_2 , is brilliantly white and much of the oxide produced is used in the manufacture of paint.

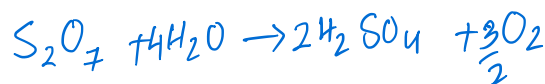
What is the maximum amount of TiO_2 obtainable from 19.0 tonnes of the ore ilmenite, FeTiO_3 ?

- (A) 10.0 tonnes B 12.7 tonnes C 14.0 tonnes D 17.7 tonnes



$$151.7 \text{ g} : 79.9 \text{ g}$$

$$19 \text{ tonnes} : 10 \text{ tonnes}$$



- 9 The compound S_2O_7 is hydrolysed by water to produce sulfuric acid and oxygen only.

Which volume of oxygen, measured at room temperature and pressure, is evolved when 0.352g of S_2O_7 is hydrolysed?

- A 12 cm^3 B 24 cm^3 C 48 cm^3 D 96 cm^3



$$V = 0.003 \times 24000 = 72 \text{ cm}^3$$

$$n_{\text{S}_2\text{O}_7} = \frac{0.352}{176.2} = 0.00199 \text{ mol.}$$

$$n_{\text{O}_2} = 0.001 \text{ mol.}$$

- 10 The reaction between aluminium powder and anhydrous barium nitrate is used as the propellant in some fireworks. The metal oxides and nitrogen are the only products.

Which volume of nitrogen, measured under room conditions, is produced when 0.783g of anhydrous barium nitrate reacts with an excess of aluminium?

- A 46.8 cm^3 (B) 72.0 cm^3 C 93.6 cm^3 D 144 cm^3



$$n_{\text{Ba}(\text{NO}_3)_2} = \frac{0.783}{137 + 2(14 + 48)} = 0.003 \text{ mol.}$$

$$n_{\text{N}_2} = 0.003 \text{ mol.}$$

$$V_{\text{N}_2} = \frac{3}{10} \times 24000 = 7200 \text{ cm}^3$$