LIVE SESSION - 2

# Welding Processes

# INTRODUCTION

# PRACTICE QUESTIONS

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|---|---|
| Q1. Which one of the following gases has highest ionisation energy? | A. Argon<br>B. Iron vapour<br>C. Helium<br>D. Atomic hydrogen |
| Q2. While welding of metals and alloys, metal vapours control the ionisation process inside arc because | A. ionisation energy decreases as a function of temperature<br>B. ionisation energy increases as a function of temperature<br>C. metal vapours have low ionisation energy<br>D. metal vapours have high ionisation energy |
| Q3. By introducing diatomic gases in atomic arc shielding gases, | A. arc becomes hotter<br>B. weld bead penetration increases<br>C. arc extinguishes<br>D. temperature gradient inside the arc can be reduced. |
| Q4. When the ionisation energy of a gas is high | A. more electrons can be generated at low temperatures<br>B. more ions can be generated at low temperatures<br>C. arc temperature increases<br>D. arc extinguishes |
| Q5. According to Eggert-Saha equation, when the temperature of the gas increases | A. ion number density decreases<br>B. fraction of ionisation decreases<br>C. fraction of ionisation increases<br>D. electron number density decreases |

# PRACTICE QUESTIONS

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|---|---|
| Q6. Plasma jet formation in arc is due to | A. repulsion of charge carriers<br>B. generation of Lorentz force<br>C. accumulation of charge carriers at the electrode tips<br>D. all the above. |
| Q7. When CO2 dissociate it forms | A. CO2 and O2<br>B. C2 and O<br>C. CO and O<br>D. all the above |
| Q8. Dissociation energy of a diatomic gas | A. changes with gas velocity<br>B. decreases when the temperature is increased<br>C. increases when the temperature is increased<br>D. does not change with temperature |
| Q9 Average drift velocity of electron increases when the | A. gas velocity increases<br>B. time between two collisions decreases<br>C. electron number density increases<br>D. time between two collisions increases |
| Q10. Which one of the sequences are arranged in ascending order of ionisation energy? | A. He, N, CO, Ar<br>B. Ar, He, CO, N<br>C. He, CO, Ar, N<br>D. CO, N, Ar, He |

# PRACTICE QUESTIONS

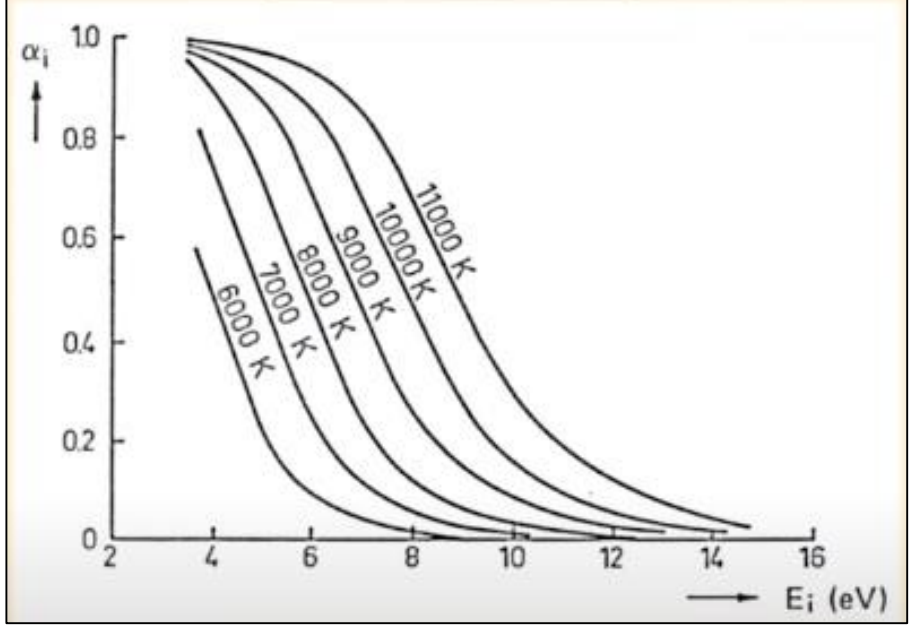
| | |
|---|---|
| Q11. Arc column becomes electrically neutral, when | A. number density of electron is more than ions<br>B. number density of electrons and ions is equal<br>C. number density of electron is lesser than ions<br>D. when temperature of electron and ions are nearly equal |
| Q12. When we stop shielding gas supply during welding | A. arc becomes hotter<br>B. arc extinguishes<br>C. weld bead penetration increases<br>D. none of the above |
| Q13. At same welding conditions for which of the shielding gas arc temperature is lower | A. Mixture of He and CO2<br>B. Mixture of Ar and CO2<br>C. Ar<br>D. CO2 |
| Q14. In arc column at low pressure, electron temperature is always greater than gas temperature, because | A. Electrons having longer free path<br>B. Electrons drift velocity is always greater than gas velocity<br>C. Higher time spent by electrons between two successive collisions<br>D. All of the above |
| Q15. Which one of the following arc welding process has high process efficiency than others? | A. Gas metal arc welding<br>B. Submerged arc welding<br>C. Gas tungsten arc welding<br>D. Flux cored arc welding |

## Degree of ionisation

- The degree of ionisation $\alpha_i$ is fraction of gas in the ionised state.
- $\alpha_i$ is related to temperature $T$ by Eggert-Saha equation,

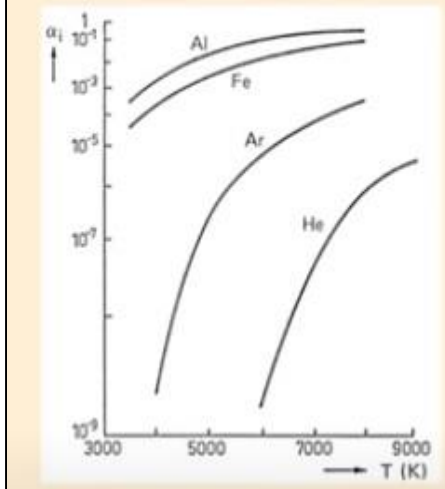
$$\frac{\alpha_i^2}{1-\alpha_i^2} = C_1 \frac{T^{\frac{5}{2}}}{p} \exp\left(-\frac{E_i}{kT}\right)$$

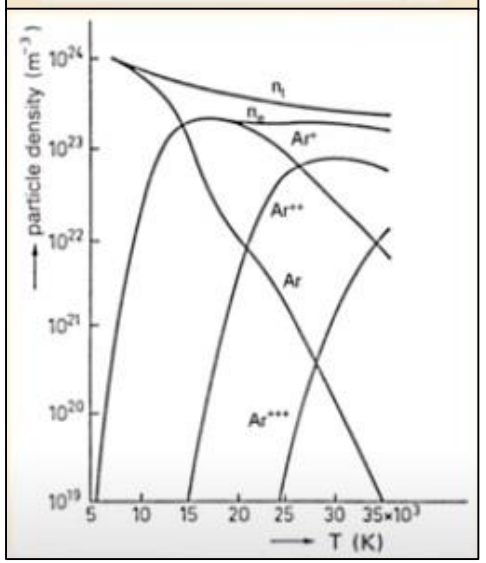
## Eggert-Saha equation



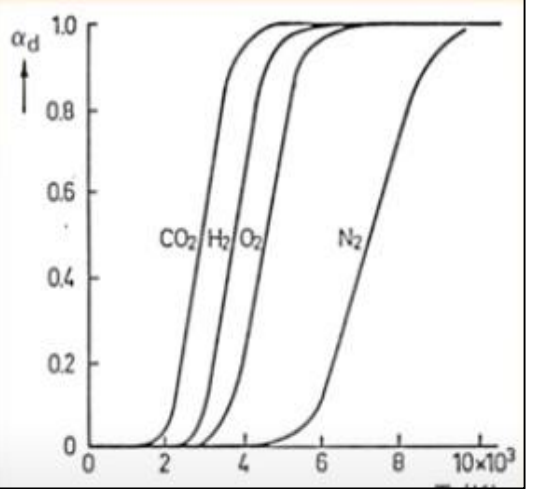

| Element | $E_i$ (eV) | Element | $E_i$ (eV) |
|---|---|---|---|
| H | 13.6 | P | 10.5 |
| $H_2$ | 15.6 | S | 10.4 |
| He | 24.6 | Ar | 15.8 |
| B | 8.3 | K | 4.3 |
| C | 11.3 | Ca | 6.1 |
| CO | 14.1 | Ti | 6.8 |
| $CO_2$ | 14.4 | Mn | 7.4 |
| N | 14.5 | Fe | 7.9 |
| $N_2$ | 15.5 | Ni | 7.6 |
| O | 13.6 | Cu | 7.7 |
| $O_2$ | 12.5 | Zn | 9.4 |
| F | 17.4 | Zr | 6.8 |
| Na | 5.1 | Mo | 7.1 |
| Mg | 7.6 | Sn | 7.3 |
| Al | 6.0 | W | 7.9 |
| Si | 8.1 | Pb | 7.4 |

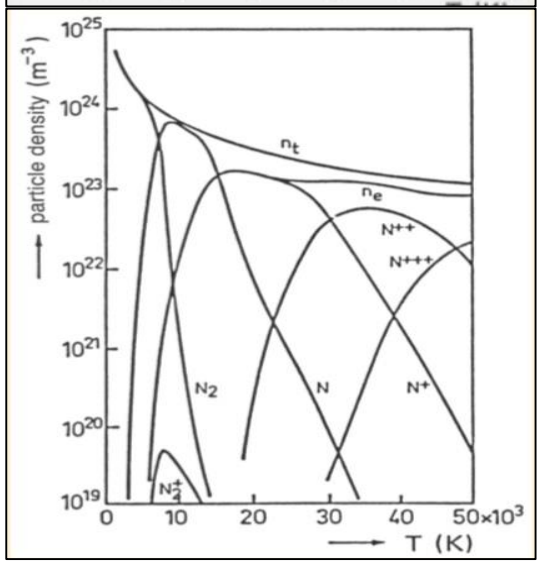
## Ionisation of Al, Fe, Ar and He



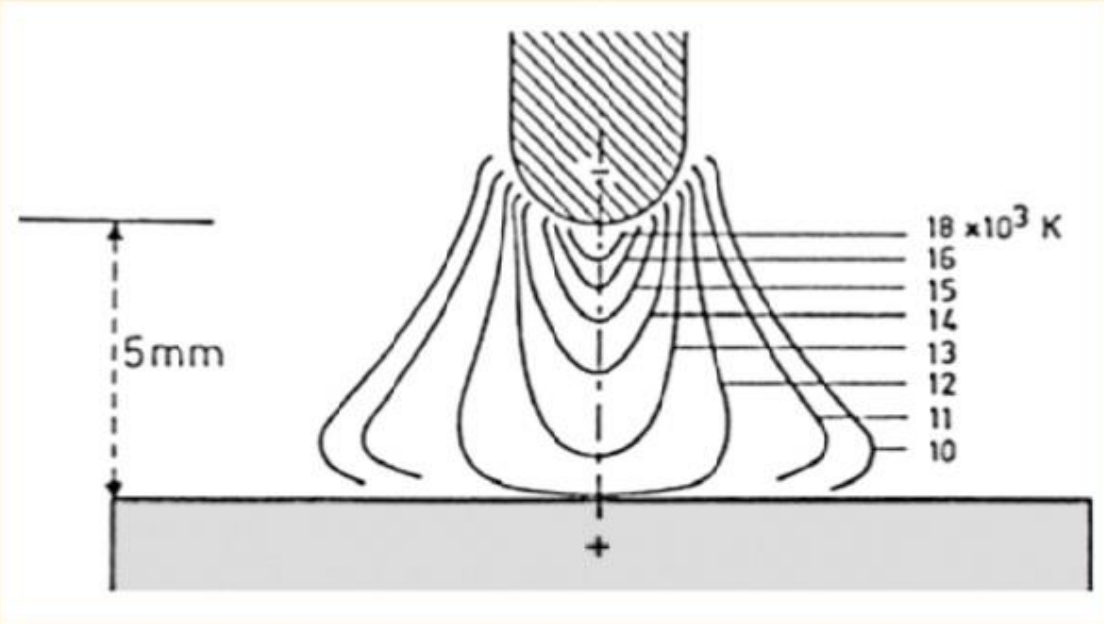




## Dissociation of molecular gases



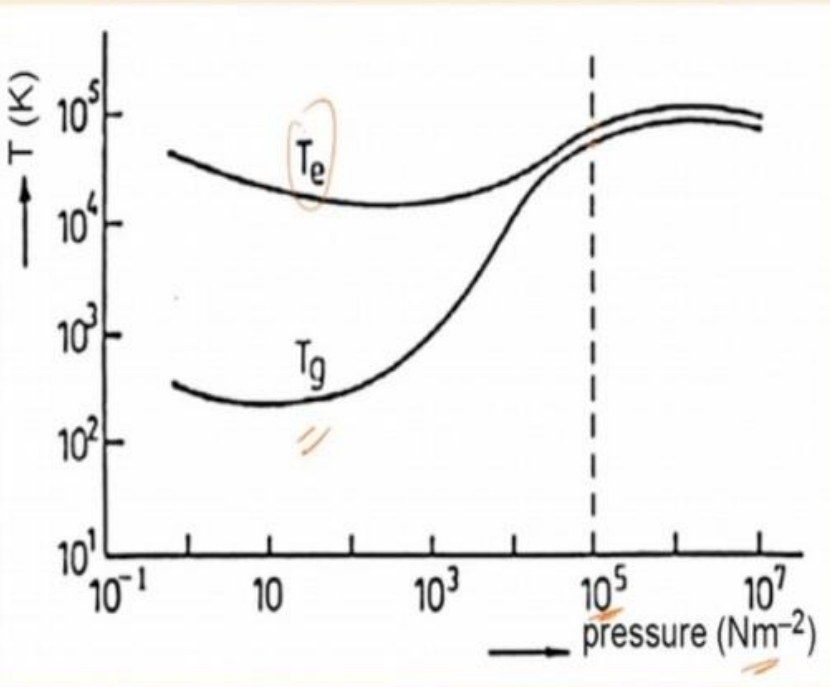
- At 1 atm. pressure, $T = T_e = T_g$,




The total electrical energy produced per unit time and unit volume,

$$U_{el} = U_{cond} + U_{rad} + U_{conv}$$

Deviation from thermal equilibrium




$$T_e \cong T_g$$

Thank you…..