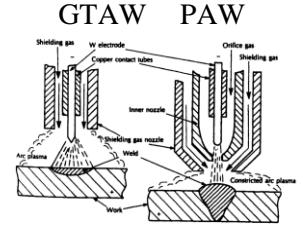


1. *Considering the working principles of gas tungsten arc welding (GTAW) and plasma arc welding (PAW), write three main differences (in point form only) between GTAW and PAW processes.*

- Constricted arc plasma in PAW. So, higher energy density, improved arc stability, deeper penetration capability, higher welding speeds as compared to GTAW.
- Arc initiation are different. In PAW a high-frequency pilot arc established between electrode and inner nozzle, ionizes the orifice gas and ignites the primary arc to the workpiece.
- PAW can operate in two modes, transferd arc and nontransferred arc mode. Two distinctly different welding modes also possible with the PAW process: the melt-in or conduction mode and the keyhole mode.



2. *It is very important to keep a higher ratio of “depth of penetration / width” of the molten weld pool during fusion welding that involves melting of materials. WHY? Explain with three points.*

- It reduces the likelihood of defects: When the width of the molten weld pool is wider than the depth of penetration, it can lead to higher heat affected zone and defects such as lack of fusion, porosity, and cracks.
- Structural Integrity: A higher aspect ratio ensures that the weld penetrates deeply into the base metal, creating a strong bond between the two materials.
- It maximizes efficiency and productivity: A higher depth of penetration allows for more efficient use of welding filler material and reduces the need for additional passes. This results in faster welding times and increased productivity.

3. *Considering the forces acting on the molten droplets at the tip of the filler wire during gas metal arc welding (GMAW), state three key differences between “short-circuiting mode of metal transfer” and “spray mode of metal transfer”.*

- In short-circuit transfer, decreased surface tension and increased electromotive and hydrodynamic forces result in the transfer of molten metal from the electrode to the weld pool. With high pinch forces, droplets are pinched off before they attain the size permitted by the surface tension, results in spray mode of metal transfer.
- Short-circuiting mode has low heat input, low deposition rate, and small droplet size. Spray mode has high heat input, high deposition rate, and fine droplet size.
- Short-circuiting mode associated with low current and short arc length whereas spray mode associated with high current and long arc length.

4. *For creating a leak proof joint between two overlapped metallic sheets, resistance welding is considered to be an efficient process. Why? Explain in three points.*

- Interaction of the welding metals with atmospheric gases, flux and filler wire do not happen in resistance seam welding compared to other welding methods. This reduces chances of defects and makes the joint leak proof.
- Continuous rolling of the seam in resistance seam welding makes it continuous air tight weld with no gaps in between.
- Less loss of heat compared to arc processes and application of pressure makes the process energy efficient.

5. *Explain with three points why a laser beam and an electron beam are considered as better-quality heat sources than an electric arc for fusion welding of metallic materials.*
 - Laser and electron beam heat source has a better resolution than electric arc.
 - We have a better control over the laser and electron beam heat source than electric arc heat source
 - Laser and electron beam can be used to weld thicker places due to higher heat intensity it can attain.
6. *Gas tungsten arc welding of aluminum alloys is preferred in AC polarity of tungsten electrode and workpiece. Why? Explain in three points.*
 - AC polarity provides cleansing action on the workpiece.
 - AC polarity gives a better control over the penetration depth in welding of Aluminum.
 - AC polarity gives alternate heating to the tungsten electrode and prevents the electrode from melting.
7. *During resistance spot welding of overlapped sheets, the weld joint (also referred to as weld nugget) is formed along the interface between the sheets and extended inside each sheet. It is important to ensure that the size of the weld nugget is same in both the sheets. How would you ensure that if the overlapped sheets are of unequal thicknesses? Explain with reasons in point form the possible options.*
 - Use electrodes of different area on different sheets.
 - Using different alloys of same material so that difference in material properties creates equal nugget sizes in material with different thickness.
8. *Explain with three points. In what way, submerged arc welding (SAW) is considered to be more efficient for joining of thicker plates? Explain with three points.*
 - In SAW, both alloying elements and metal powders can be added to the granular flux to control the weld metal composition and increase the deposition rate, respectively. Due to its high deposition rate, SAW is more efficient for joining of thicker plates.
 - Presence of granular flux aids in shielding the arc, and thus helps in holding the heat input and concentrating the heat into the weld area to promote deep penetration and hence is efficient for joining thicker plates.
 - The efficiency of transfer of energy from the electrode source to the workpiece is very high (usually over 90%), since losses from radiation, convection, and spatter are minimal. This high efficiency helps in joining thicker sections.
9. *In shielded metal arc welding (SMAW), flux cored arc welding (FCAW), submerged arc welding (SAW), fluxes are used to cover the molten pool to protect it from reacting with the atmospheric gases. What should be therefore be the three most important properties of the flux materials?*
 - The flux coating should decompose and generate shielding gas to protect the molten metal from the surrounding air.
 - Basicity of the flux should be high to avoid inclusion level of oxygen in the weld, to prevent oxidation and thus increases the toughness.
 - Arc stabilizers: Flux materials should be able to readily decompose into ions in the arc and increase the electric conductivity of arc and help the arc conduct the electric current more smoothly.
 - Density of the flux material should be lower than the weld material.
 - Melting point of the flux material should be lower than the weld material.
10. *What can be the three main reasons for which fusion welding, which will involve melting of materials, may be considered inadmissible for joining of two parts in an assembly?*

- When the difference between melting point of the two materials to be joined is too high.
- When the difference between thermal expansion coefficient of two materials is too high.
- When the heat affected zone due to excessive heating in fusion welding deteriorates the mechanical properties of the assembly.