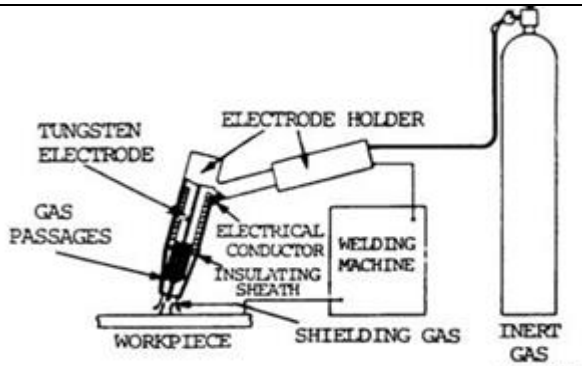
**Important Instructions to examiners:**

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills)
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

| Q. NO. | SUB Q. NO | MODEL ANSWER | MARKS |
|---|---|---|---|
| **Q.1** | | **Attempt any FIVE** | **5x4=20** |
| | **a** |  <br>Gas tungsten arc welding<br><br>Gas tungsten arc welding (GTAW), also known as tungsten inert gas (TIG) welding, is an arc welding process that uses a non-consumable tungsten electrode to produce the weld. The weld area is protected from atmospheric contamination by an inert shielding gas (argon or helium), and a filler metal is normally used, though some welds, known as autogenously welds, do not require it. A constant-current welding power supply produces electrical energy, which is conducted across the arc through a column of highly ionized gas and metal vapors known as plasma.<br>**Base metals welded:-**<br>i)Carbon and alloy steels<br>ii)Stainless steels,<br>iii)Heat resistance alloys<br>iv)Refractory metals<br>v)Copper alloys<br>vi)Ni alloys | 2m(dia.)<br><br>2m(Metals )any two |
| | **b** | Advantage of MIG<br>1. Because of continuously fed electrode MI welding is much faster as compared to TIG.<br>2. It can produce joint with deep penetration.<br>3. Thick and thin both type of joints can be welded effectively<br>4. Large metal deposition rates can be achieved<br>5. Process can be easily mechanized | 2m(any two) |

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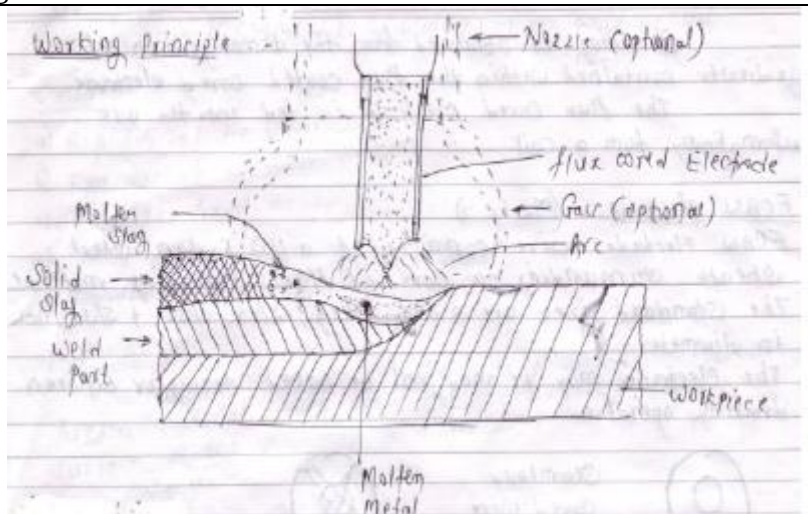
| | | 6. No flux is required<br>Limitation-<br>1) The process is slightly more complex, as compared to TIG because no of variable<br>2) Welding equipment is more complex more costly and less portable<br>3) Since air draft may disperse the shielding gas it will not be useful in open atmosphere condition<br>4) Weld metal cooling rate are higher than the process that deposit slag over the weld metal | 2m(any two) |
| | **c** |  <br>Working principal<br>FCAW is a process in which joint is produced by heating the work piece with an electric arc between a continuous tabular consumable electrode and work.<br>The electrode is flux cored i.e. the flux is contained within the electrode which is hollow. The flux inside the wire provided the necessary shielding of the weld pool FCAW utilizer the heat of an arc between a continuously fed<br>consumable flux cored electrode and the work piece which is to be joined.<br>The heat of the arc melts the surface of base metal and the end of the electrode. The metal melted off the electrode is transferred through the arc to the work piece. | 2m(dia.)<br>2m(expl.) |

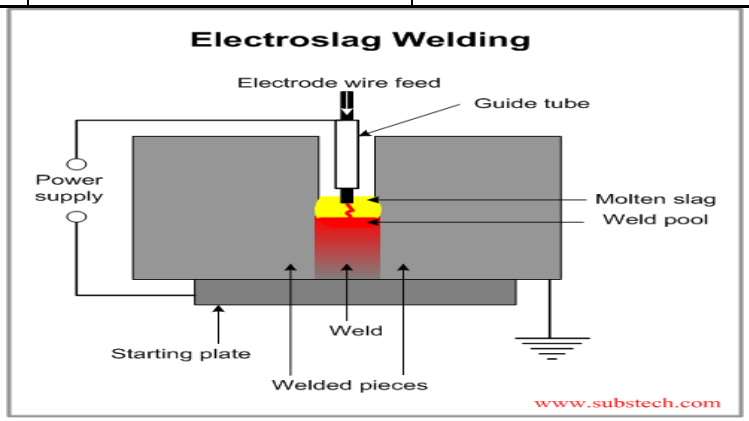
**d**

| Sr. No. | SAW | MIG |
|---|---|---|
| 1 | Submerged arc welding (SAW) is an arc welding process that fuses together the parts to be welded by heating them with one or more electric arcs between one or more bare electrodes and the work piece | It is an arc welding process in which joint is prepaed by heating the job with an electric arc established between a continuously fed metal electrode & the job. |
| 2 | SAW uses a flux. | No flux is used. |
| 3 | Separate shielding gas is not required | Separate shielding gas is used. |
| 4 | The arc is buried under the granular flux. | The arc is visible to the operator |
| 5 | Process is slow | Comparitively faster process |

4m

(any 4)

**e**




2m(dia.)

**Working:-**

**Electroslag Welding** is a welding process, in which the heat is generated by an electric current passing between the consumable electrode (filler metal) and the work piece through a molten slag covering the weld surface.

2m (expl.)

Prior to welding the gap between the two work pieces is filled with a

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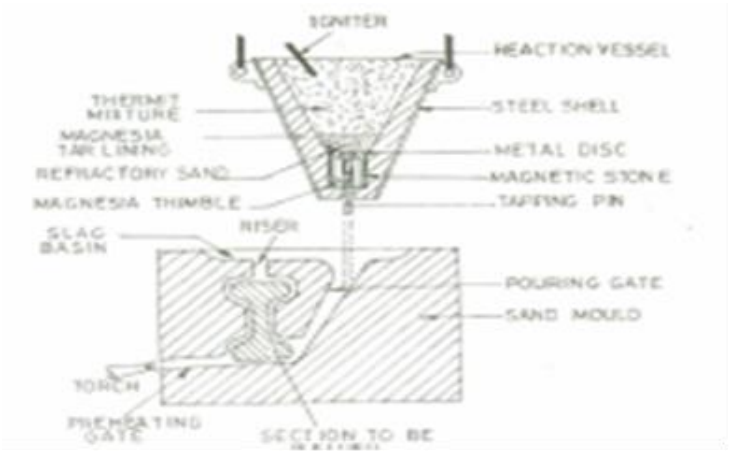
| | | welding flux. Electroslag Welding is initiated by an arc between the electrode and the work piece (or starting plate). Heat, generated by the arc, melts the fluxing powder and forms molten slag. The slag, having low electric conductivity, is maintained in liquid state due to heat produced by the electric current. | |
| | **f** |  | 4m(dia.) |
| | **g** | **ADVANTAGES OF RESISTANCE WELDING**<br>(i) Fast rate of production.<br>(ii) No filler rod is needed.<br>(iii) Semi-automatic equipment.<br>(iv) Less-skilled workers can do the job.<br>(v) Both similar and dissimilar metals can be welded.<br>(vi) High reliability and reproducibility are obtained.<br>(vii) More general elimination of warping or distortion of parts.<br><br>**DISADVANTAGES OF RESISTANCE WELDING**<br>(i) The initial cost of equipment is high.<br>(ii) Skilled persons are needed for the maintenance of equipment and its controls.<br>(iii) In some materials, special surface preparation is required.<br>(iv) Bigger job thicknesses cannot be welded. | 2m(any two)<br><br>2m(any two) |

| Q.2 | | Attempt any TWO | 8X2=16 |
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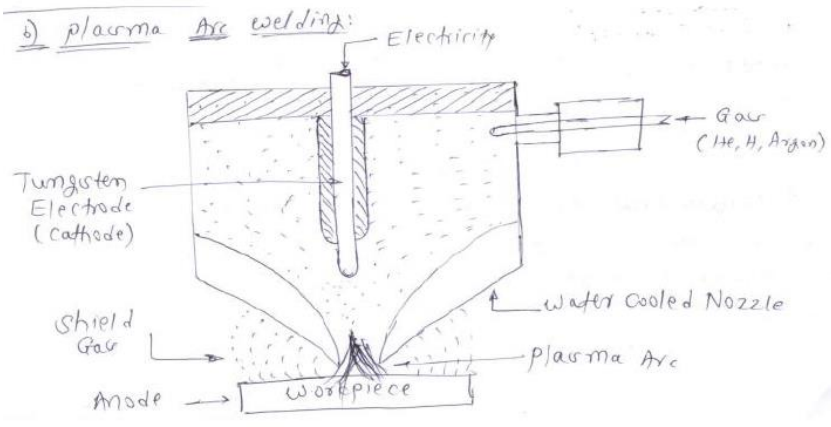
| | **a** | (1)Argon:<br>It is the extensively used shielding gas because of its availability as far as fusion welding is concerned.<br>0.94%is the % argon by volume prevent in the atmosphere.<br>It is used as a shield gas because of its low ionization potential, it forms stable and suite arc so there is less chance of spatter loss.<br>It has one disadvantage because of its lower ionization potential the voltage is reduced and less power in the arc is obtained.<br>Because of that it does not give deeper penetration<br>(2)Helium:<br>It is the second most abundant available natural gas in the atmosphere.<br>It has higher ionization potential than argon.so it gives deeper penetration<br>It has high electrical resistance so the voltage required to produce more and because of that high heat is generated in the arc<br>It again increases the penetration properties<br>(3)CO2:<br>It is a combination of carbon and oxygen<br>The experiment showed that using straight CO2gives border and deeper penetration as well as there is a less chance of under cutting. | 3m<br><br><br><br><br><br><br>3m<br><br><br><br><br><br>2m |
| | **b** |  <br>Working:-<br>• Plasma is gas of positive ions and negative electron equal number of positive ions and negative electron.<br>• In PAW joint is produced by striking an arc in between tungsten electrode and water cooled nozzle.<br>• When the laser are passed through arc and nozzle they get ionize and becomes plasma | 4m(dia.)<br><br><br><br><br><br><br><br><br><br><br><br>4m (expl.) |

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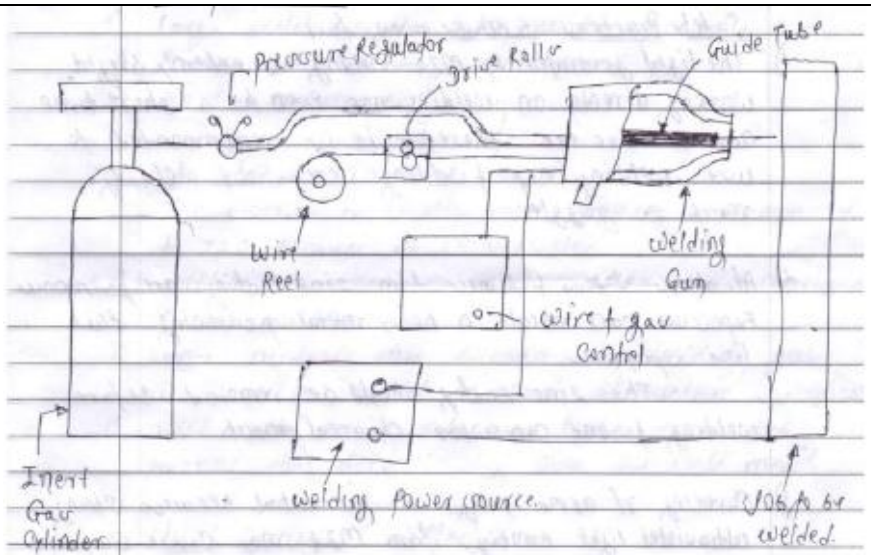
| | | • The laser generally used are argon, helium and hydrogen<br>• Non consumable tungsten within a water cooled nozzle is enveloped by a gas.the gas is forced to an electric arc through a constraint opening at the end of water cooled nozzle.<br><br>Temperature have been reported to 10000 to 300000C as comparison oxyacetylene welding is limited to 36000C | |
| | **c** |  <br>• Switch ON the electrical current, insert gas supply and water<br>• The arc is strucked by the any one method.<br>• By scratching the electrode by scrap metal workpiece as usual practice<br>• In the second method electrode is touched to thejob. It is refracted and then move forward to carry out welding<br>• About 15mm length of the electrode is projected from the torch before striking the arc. During welding torch remain about 10 to 12mm away from the job and arc length is kept between 1.5mm to 4mm<br>• Normally forehand technique is used, the angle made by torch with the horizontal is $70^0$<br>• The welding Gun is moved in forward manner steadily to achieve good welding | 4m(dia.)<br><br>4m (expl.) |

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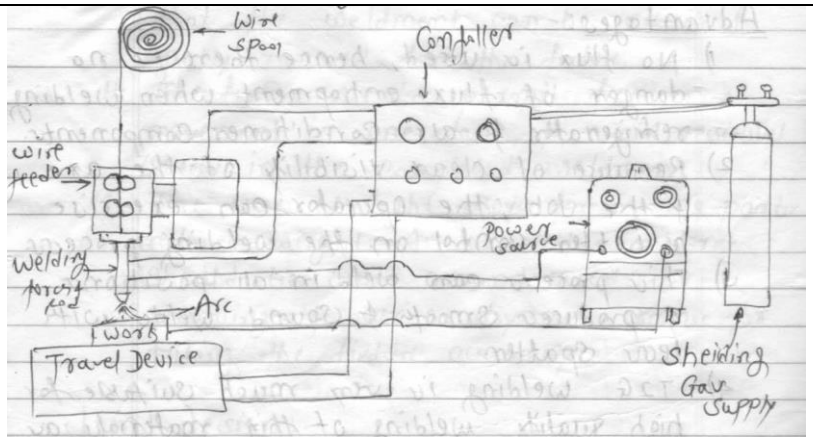
| **Q.3** | | **Attempt any four** | **4x4=16** |
| | **a** |  <br>**Working:-**<br>In automatic welding some of the activities are carried out without manual work.<br>In this type of welding the control of welding variable and relative movement between the welding head and work are automatic<br>Usually a single switch working through sequencing device operator the control for power and consumables like wire and gas<br>This may also bring crater filling device, if incorporated, into action automatically. fig. shows a block diagram for a typical automatic welding system.<br>As soon as welding is started first in manual way automatic welding controls the variables like arc voltage, welding current. Wire feed rate etc. to control the arc length in the case of arc welding processes and to control the depth of molten metal and slag pool in electro slag welding. | 2m<br>(dia)<br>2m (expl.) |
| | **b** | **Micro welding:-**<br>Micro Arc Welding is the short and long-run service provider delivering hand held micro TIG and micro laser welding repair work.<br>Micro welding is the name given to the process that has evolved from traditional TIG welding (or more recently termed GTAW), using the | 4m |

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| | | technology of electric current being applied to the work piece to generate heat at the point of the *arc gap.* At the point of the arc gap, a molten pool is established and the filler rod is introduced into the molten pool.<br>The difference between traditional TIG and micro welding is that micro welding is done at extremely low amperages (usually less than 10 amps) in combination with fine control of the amperage range, along with the aid of a high-powered (10-20X or more) microscope.<br>**Problems**:-<br>As Micro welding is a state of the art process that is used for welding small areas. Often the micro weld requires the surrounding area to be minimally effected by heat, requiring precise heating of the weld to only allow proper fusion of the joint. Micro welding requires the use of miniature TIG welding equipment (Gas Tungsten Arc) that is not much larger than a pen. Micro TIG welding is the latest in tool welding technology.<br>**Methods:-**<br>GMAW<br>GTAW<br>Micro laser welding | |
| | **c** | 1) Procedure Number<br>2) Process type<br>3) Consumable size, type and full condition<br>4) Consumable baking requirement, if applicable<br>5) Parent material grade and specification<br>6) Thickness range<br>7) Pate or pipe diameter range<br>8) Welding position and choice of welding technique<br>9) Joint Fit Up, Preparation, Cleaning, Dimensions etc.<br>10) Backing Strip, Back Gouging information.<br>11)Pre-Heat (Min Temp and Method)<br>12) Interpass if Required (Maximum Temperature recorded)<br>13) Post Weld Heat Treatment. If Required (Time and Temp)<br>14) Welding Technique (weaving, max run width etc.)<br>15) Arc Energy Limits should be stated if impact tests are required or if the material being welded is sensitive to heat input. | 4m (1m for each)any four |

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| | **d** | Definition<br><br>Distortion in welding can be defined as the expansion and contraction of weld metal and adjust base metal during the heating and cooling cycle of welding process. It is an unintentional destruction of weld metal. Doing welding in one side of the part will cause much more distortion than if the welds are alternated from one side to other<br><br>TYPES OF DISTORTION<br><br>Distortion in weldments takes place by three-dimensional changes that occur during welding: .<br>(a) Longitudinal shrinkage that occurs parallel to the weld line.<br>(b) Transverse shrinkage that occurs perpendicular to the weld line.<br>(c) Angular change that consists of rotation around the weld tine.<br>**(a)Longitudinal type [Fig.(a)]**<br>When a weld is deposited lengthwise on a light, narrow and perfectly flat strip of metal that is neither clamped nor held in any way the strip will tend to bow upward in the direction of bead.<br>This is due to the longitudinal contraction of the weld metal as it cool<br>Longitudinal contraction is maximum along the weld centre line and decrease towards the edges.<br>Longitudinal distortion depends upon the<br>(i) Contraction forces.<br>(ii) Stiffness of the section being welded.<br>(iii) Distance between the centroids of weld and section.<br>**b) Transverse type [Fig (b)].**<br><br>when two plates being butt-welded together neither too heavy nor<br><br>held together and are thus free to move they will be drawn closer together by the contraction of the weld metal is called transverse contraction<br>Transverse contrition exists all along the weld length. And it depend upon the permanent contraction of elements in the weld zone.<br>The transverse contraction can be prevented by<br>(i)Proper tack welding.<br>{ii)'Placing a wedge between the plates [Fig. (b-1].<br>(iii)/Separating the plates (before welding) to provide allowance (about 1 mm/100 mm of weld) for contraption[Fig. (b-2)}.) | 1m(def.)<br><br>1m<br><br>1m |

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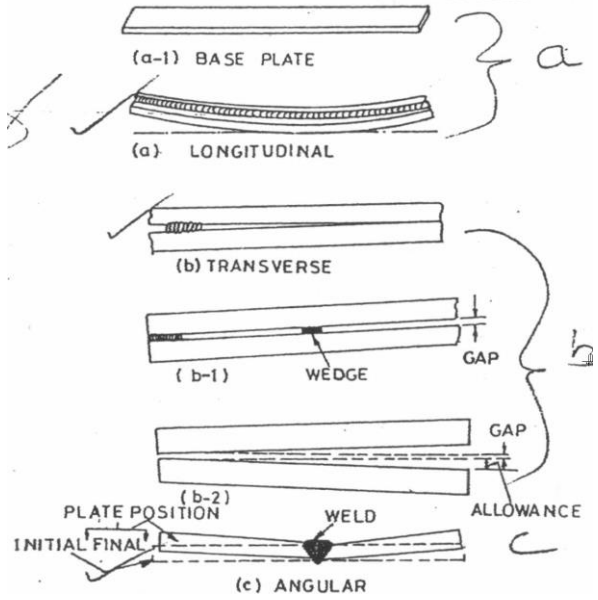
| | |  <br>**(c)Angular type:**<br>When two beveled plates are welded, it is found that the plates are pulled out of line with each other Since the opening at the top of the single Vee groove is greater than at the bottom, a greater portion of the weld metal is deposited there, and thus the drawing or pulling is greatest on that side of the joint.<br>Angular contraction is related to the shape and size of the cooling weld metal zone and the stiffness of the remaining unfused part.<br>Double groove joints tend to minimize -angular distortion because the contraction effects of the two sides, i.e., top and bottom of the plate, get cancelled with each other<br>cancelled with each other | 1m |
| | **e** | Advantages:<br><br>1. Joint preparation is often much simpler than for other welding processes.<br>2. Much thicker steels can be welded in single pass and more economically.<br>Thicknesses up to 450 mm in plain and alloy steels can be welded without difficulty.<br>3. Electroslag welding gives extremely high deposition rates.<br>4. Residual stresses and distortion produced are low.<br>5. Flux consumption as compared to that in submerged arc welding is very low.<br>6. During the electroslag process, since no arc exists, no spattering or intense arc flashing occurs | 2m (adva.) |

<table>
<tr>
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<td>APPLICATIONS OF ELECTRO SLUG WELDING<br><br>1. Heavy plates, forgings and castings can be butt welded.<br>2. Where plates or castings of uniform thickness are involved or if they taper at a uniform rate, electroslag welding has virtually replaced hermit welding, being much simpler.<br>3. Following alloys can be welded:<br>Low carbon and medium carbon steels.<br>High strength structural steels.<br>High strength alloy steels such as stainless steel and nickel alloys</td>
<td>2m(appl.)</td>
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<td>f</td>
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<table>
<tr><th>FCAW</th><th>TIG WELDING</th></tr>
<tr><td>1. This is known as flux cored arc welding<br>(FCAW)</td><td>1. This is known as tungsten inert gas welding.</td></tr>
<tr><td>2. The electrode used in this process is flux coated</td><td>2. Tungsten rod is used as electrode.</td></tr>
<tr><td>3. The flux contained in the hollow electrode acts as a shielding.</td><td>3. It is gas shielded tungsten arc welding.</td></tr>
<tr><td>4.Continuously feed flux filled electrode.</td><td>4. Welding rods are used which are slow feeding.</td></tr>
<tr><td>5. The electrode is hollow.</td><td>5. It used non consumable tungsten electrode</td></tr>
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<td>4m(any four)</td>
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| Q.4 | | Attempt any TWO | 8x2=16 |
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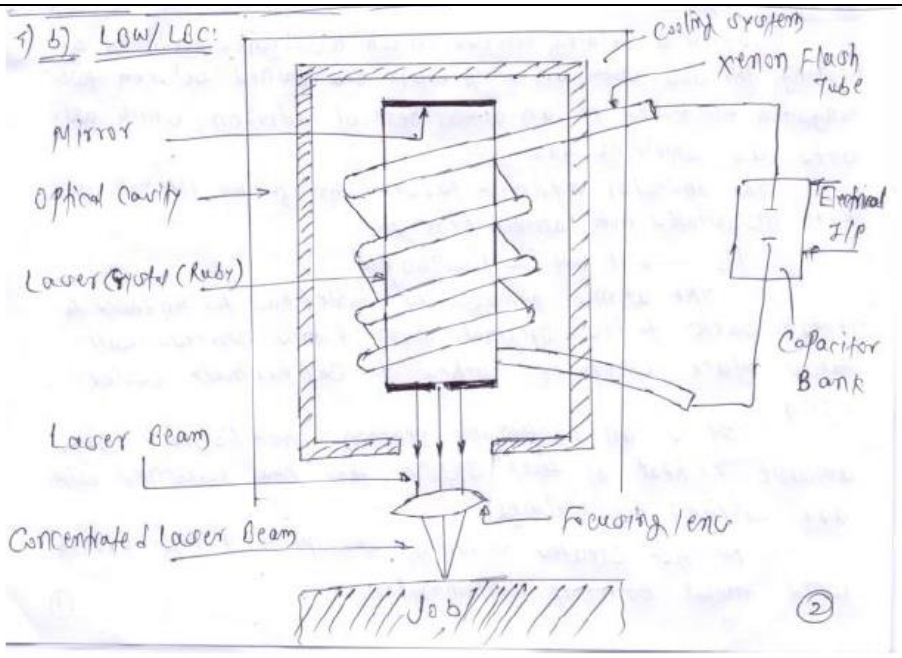
| | **a** |  <br>Working:-<br>• Laser beam welding/cutting is that joint is produced by heat obtain from the application of the concentrated coherent light beam impinging upon the surface to be joined/cut<br>• Laser is device which creates intense beam that can impart tremendous energy on a small area to produce fusion for welding/cutting purpose.<br>• It consists of ruby crystal which contains at chromium in dispersed condition. The ends of their rods are like mirror and one end has a tiny hole.<br>• At the outside of the crystal one flash tube is fixed containing insert gas. It is de----for producing thousands of flashes per second which further converts electrical energy into light energy.<br>• Capacitor bank which strikes electrical energy energizes flash tube by an triggering system because of that xenon transforms a high proportion of electrical energy into white light flashes<br>• As ruby is exposed to intense light flashes chromium atomic to excite and pumped to high energy level because of that they form radiation in the form of red Fluor cent light. When that red light escape through mirror through a small hole and by focusing on a narrow laser beam on optical lenses produces intense spot of laser on the job<br>• Optical energy as it impacts on the work piece converts into | 2m dia.<br><br>4m expl. |

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| | | heat energy. The temperature generated can be made sufficient to melt materials to be welded or cu<br>Applications of laser beam welding:-<br>(i) laser is a high energy light beam that can both weld and cut till metal<br>(ii)For connecting leads on small electronic components and in integrated circuitry in the electronic industry.<br>(iii) To weld lead wires having polyurethane insulation without removing the insulation. The laser evaporates the insulation and completes the weld.<br>iv) To join hard high melting point metal alloys.<br>(v) In space and aircraft industry for welding light gauge materials.<br>(vi) Laser process can join dissimilar metals and other difficult to weld metals such as copper, nickel, aluminium, stainless steel. tungsten, columbium, titanium, zirconium, tantalum, kovar etc.<br>(vii)Laser can weld wire-to-wire, sheet-to-sheet, wire-to-sheet, tube to sheet and small-diameter stud welds.<br>(viii) Laser beam is used for micro welding purposes. It is particularly suitable for the welding of miniaturized and microminiaturized components | 2m(appl.) |
| | **b** | Following are the equipments used in latest welding<br>**1) Welding cycle controller:-**<br><br>The basic function of this component is to control the weld time, squeeze time etc. for precise method.<br>**2) Work piece Positioning Sensor:-**<br><br>The basic function of this component is to position the work piece in the correct manner.<br>**3) Modern Jigs & Fixtures:-**<br><br>The welding fixtures are usually designed to hold one specific assembly.<br>**4) Electrode Feed Controller:**<br><br>It will control the electrode feed rate.<br>**5) Fume Extractors:**<br><br>The gases which are generated during the welding can be removed by using fume extracters. | 8m<br>(any 4) |
| | **c** | Definition<br>Distortion in welding can be defined as the expansion and contraction of weld metal and adjust base metal during the heating and cooling cycle of welding process. It is an unintentional destruction of weld | 2m |

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| | | metal. Doing welding in one side of the part will cause much more distortion than if the welds are alternated from one side to other.<br><br>**Causes Of Distortion:-**<br>If a metal is uniformly heated and cooled there would be almost no distortion. However, because the material is locally heated and restrained by the surrounding cold metal, stresses are generated higher than the material yield stress causing permanent distortion. The principal factors affecting the type and degree of distortion, are:<br>• Parent material properties<br>• Amount of restraint<br>• Joint design<br>• Part fit-up .<br>• Welding procedure<br>**Parent material properties:-**<br>Parent material properties which influence distortion are coefficient of thermal expansion and specific heat per unit volume. As distortion is determined by expansion and contraction of the material, the coefficient of thermal expansion of the material plays a significant role in determining the stresses generated during welding and, hence, the degree of distortion. For example, as stainless steel has a higher coefficient of expansion than plain carbon steel, it is more likely to suffer from distortion.<br>**Restraint:-**<br>If a component is welded without any external restraint, it distorts to relieve the welding stresses. So, methods of restraint, such as 'strong-backs' in butt welds, can prevent movement and reduce distortion. As restraint produces higher levels of residual stress in the material, there is a greater risk of cracking in weld metal and HAZ especially in crack-sensitive materials.<br>**Joint design:-**<br>Both butt and fillet joints are prone to distortion. It can be minimsed in butt joints by adopting a joint type which balances the thermal stresses through the plate thickness. For example, a double-sided in preference to a single-sided weld. Double-sided fillet welds should eliminate angular distortion of the upstanding member, especially if the two welds are deposited at the same time.<br>**Part fit-up:-**<br>Fit-up should be uniform to produce predictable and consistent shrinkage. Excessive joint gap can also increase the degree of distortion by increasing the amount of weld metal needed to fill the joint. The joints should be adequately tacked to prevent relative movement between the parts during welding.<br>**Welding procedure :-**<br>This influences the degree of distortion mainly through its effect on | 6m($1^1/_2$ each, any four) |

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| | | the heat input. As welding procedure is usually selected for reasons of quality and productivity. the welder has limited. | |
| **Q.5** | | **Attempt any four** | **4x4=16** |
| | **a** | **Safety Practices**<br>• The light generated by MIG welding is extremely bright, working directly on welding arc even for a short time causes arc eye therefore it is recommended to use welding cap and welding screen or welding mash or goggle.<br>• Al. alloys vapour and zinc coating are poisonous exposure can result in heavy metal poisoning flue like symptoms. The zinc coating should be removed before welding and one can wear charcoal mask.<br>• Covering of arms and legs is essential because strong ultraviolet light emitting from MIG may cause sun sum.<br>• Welding gloves are required to be wear<br>• Ear protection device to avoid too much noise<br>• Clean atmosphere i.e. Surrounding is required because molten metal may split several feet may catch fire<br><br>Use our common sense while welding | 4m<br>(any four) |
| | **b** | **PIPING WELDING CODES:- (ASME)**<br>ASME is the registered trademark of The American Society of Mechanical Engineers.<br>The ASM.E B31 Code for Pressure Piping consists of a number of individually published Sections, each an American national Standard, under the direction of ASME Committee B31, Code for Pressure Piping. Rules for each Section have been developed considering the need for application of specific requirements .ASME is the registered trademark of The American Society of Mechanical Engineers.<br>The AS1\1.EB31 Code for Pressure Piping consists of various types of pressure piping. Applications considered for each Code Section include:<br>B31.1 Power Piping: piping typically found in electric power generating stations, in industrial and institutional plants, geothermal heating systems, and central and district heating and cooling systems;<br>B31.3 Process Piping: piping typically found in petroleum refineries, chemical, pharmaceutical, textile, paper, semiconductor, and cryogenic plants, and related processing plants and terminals;<br>B31.8 Gas Transportation and Distribution Piping Systems: piping transporting products which are predominately gas between sources and terminals, including Compressor, regulating, and metering stations; and gas gathering pipelines | 4m |

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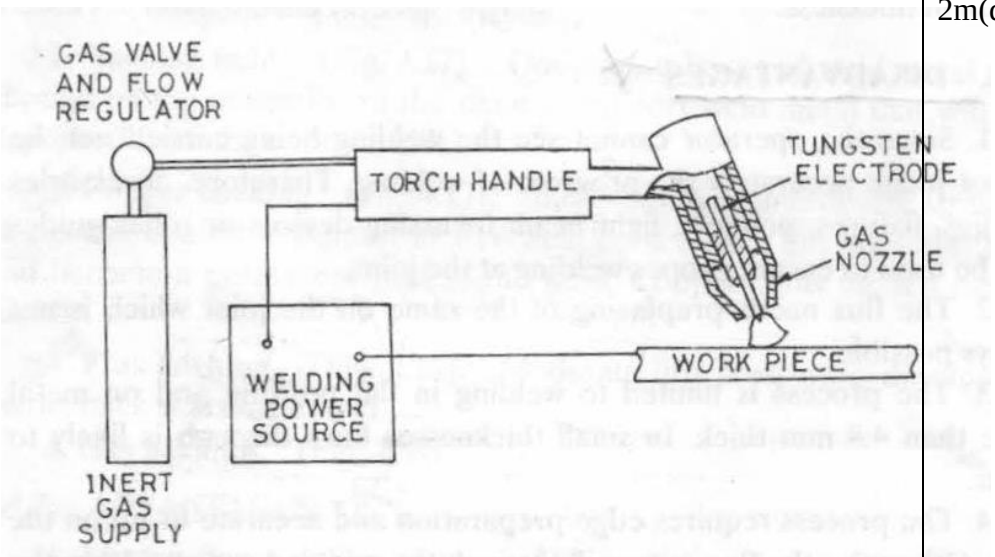
| | **c** | GTAW, frequently called as TIG welding process, is normally used for good quality and precision welding. It is an arc welding process where in joint is produced by heating the job with an electric arc between a tungsten electrode and the job. No flux is used<br><br>A shielding gas is used to avoid atmospheric contamination of the molten weld pool.<br><br>  <br><br><br>Welding current water and inert gas supply are turned on the arc is struck either by touching the electrode with a scape metal tungsten piece or using a high frequency unit.<br>In the first method arc is initially struck on as cap metal piece and then broken by increasing the arc length. This procedure repeated twice or thrice arms up the tungsten electrode<br>The arc is then struck between the electrode and per cleaned job to be welded. This method avoids breaking electrode tip .joint contamination and tungsten<br>In the second method a high frequency current is superimposed in the welding current. The welding torch is brought nearer to the job when electrode tip reaches within a distance of 2 to 3 mm from the job a spark lump across the are gap between the electrode and the job. The air path gets ionized and arc is stabilized<br>After striking the arc it is allowed to impinge on the job and molten weld pool is created. The welding is started by moving the torch along the joints as in oxyacetylene welding.<br>The shielding gas is allowed to impinge on the solidifying weld pool for a few second after the arc is generated this will avoid atmospheric | 2m(dia.)<br><br>2m (expl.) |

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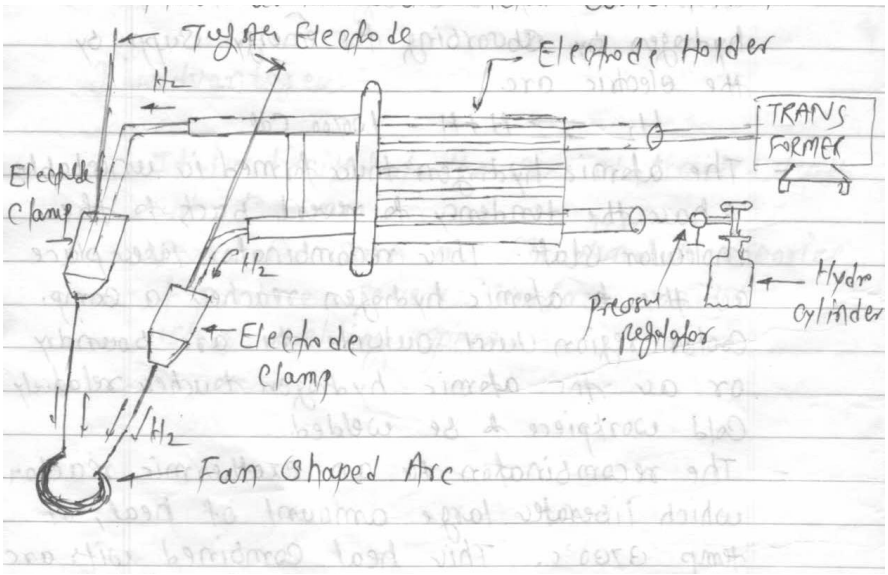
| | | contamination. | |
| | **d** |  | 4m(dia.) |
| | **e** | Holding Techniques:-<br>i)A C-clamp is good enough for most of welding jobs. It can be quickly and cheaply made in the shop.<br>ii) A simple but effective vee rest for supporting short bars or pieces of pipe for welding on the bench is shown in fig.<br>iii) Rotating fixture for making circumferential weld or for building up rollers, rings, valves, drilling bits and axles are very valuable as they speed up the job.<br>iv) Turn table also save a lot of handling time when a large no. of small part are to be welded with the same operation. The parts are laid on the edge of the turntable before welding and then all that operator has to do between welds is to turn the table a little to bring the next part into the welding position.<br>Figures on next page | 2m(expl.) any two |

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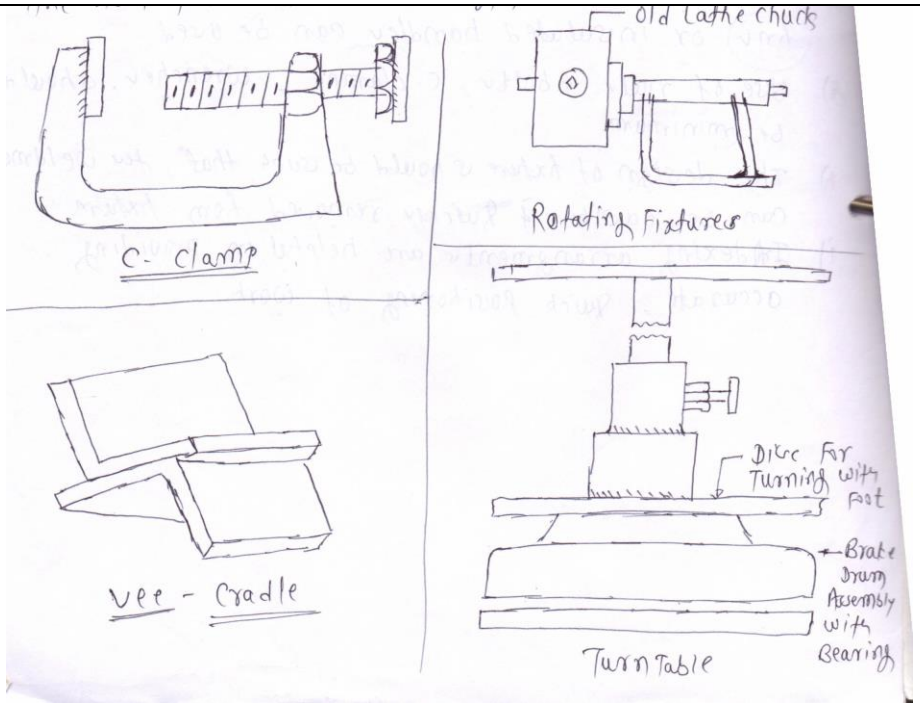
| | |  | 2m(dia.)<br>any two |
| | **f** | **AWS D1.1:-**<br>All standards (codes, specifications, recommended practices, methods, classifications, and guides) of the American Welding Society (AWS) are voluntary consensus standards that have been developed in accordance with the rules of the American National Standards Institute (ANSI).<br>When AWS American National Standards are either incorporated in, or made part of, documents that are included in federal or state laws and regulations, or the regulations of other governmental bodies, their provisions carry the full legal authority of the statute.<br>In such cases, any changes in those AWS standards must be approved by the governmental body having statutory jurisdiction before they can become a part of those laws and regulations.<br>In all cases, these standards carry the full legal authority of the contract or other document that invokes the AWS standards. Where this contractual relationship exists, changes in or deviations from requirements of an AWS standard must be by agreement between the contracting parties.<br>AWS American National Standards are developed through a consensus standards development process that brings together | 4m |

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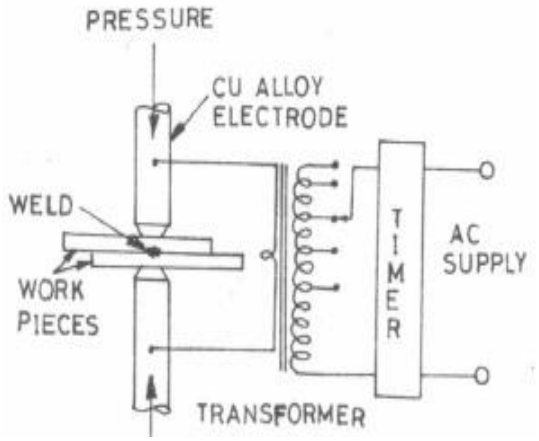
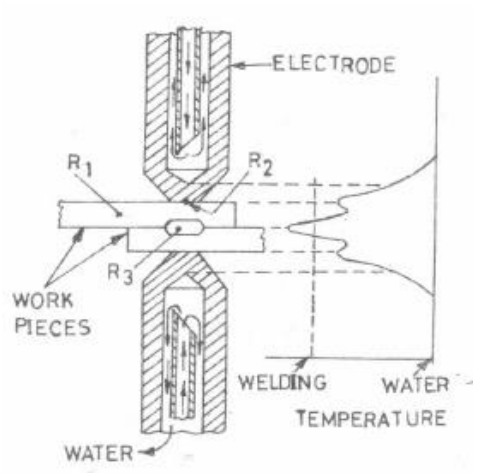
| | | volunteers representing varied viewpoints and interests to achieve consensus.<br><br>While AWS administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in its standards.<br><br>AWS disclaims liability for any injury to persons or to property, or other damages of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, or reliance on this standard. AWS also makes no guarantee or warranty as to the accuracy or completeness of any information published herein. In issuing and | |
| **Q.6** | | **Attempt any TWO** | **8X2=16** |
| | **a** |  <br>  | 2m(dia.) |

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| | | The two factors or variables mainly responsible for resistance welding are<br><br>1. The generation of Heal at the place where two pieces are to be joined.<br><br>2. The application of pressure at the place where a weld joint is to be<br><br>formed.<br><br>**1. Heat**<br><br>- The heat, H, for electrical resistance welding is generated by passing a large electrical current (of the order of 3000 to 100,000 Amps with a voltage between 1 and 25 volts) through two pieces of metal that are touching each other<br><br>**2.Resistance, R**<br><br>- The total resistance of the system between the electrodes consists of<br><br>(i) The resistance of the work piece R<br><br>(ii) The contact resistance between the electrodes and the work, R2.<br><br>(iii) The resistance between the faying surfaces of the two metal pieces to be welded together, R3. | 2m<br><br>4m (expl.) |
| | **b** | The following basic welding processes are used to join plastics,<br>1. Heated tool welding.<br>2. Hot gas welding.<br>3. High frequency welding.<br>4. Ultrasonic welding.<br>5. Friction welding.<br>6. Induction welding.<br><br>**2. Hot gas welding.:-**<br>Hot gas welding is one of the most widely used thermoplastic welding rocesses.<br>**Principle of operation:-**<br>Hot gas welding is a technique which basically consists of using a stream of hot gas to soften both filler rod and parent metal.<br>The filler rod becomes tacky on its surface when suitably softened and | 4m(any four)<br><br>2m (expl.) |

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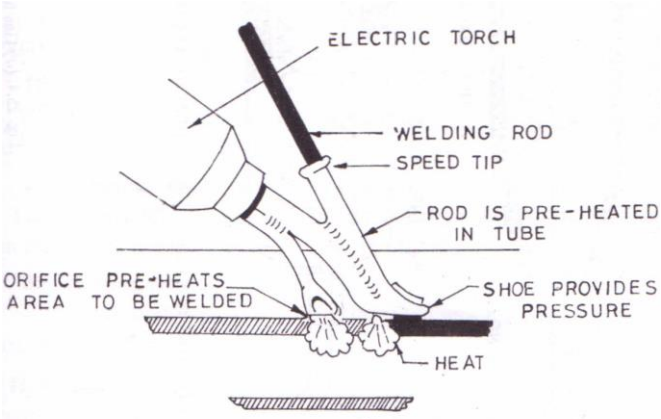
| | | the same applies to the surface of the material to be welded. The tacky surfaces bond together under pressure of shoe (Fig.).<br>  <br><br>Fig. Principle of hot gas welding. | 2m(dia.) |
| | **c (i)** | **Process equipment code (ASME)**<br>The ASME Code section 8 is the construction code for pressure vessel and cover design, manufacturing and pressure vessel inspection and testing in the manufacturing shop.<br>This code section addresses the mandatory requirement, specific prohibitions, and non-mandatory guided for pressure vessel material design fabrication, examination, and inspection, testing, certification and pressure relief.<br>In this article you will learn about different subsection s and guidelines for the use and application of this code.<br>For ASME code section 8 Scope and boundaries, review the pressure vessel definition article.<br>You may ASME code section 8 has three division. Division 1 covers pressure up to 3000psi, Division 2 Has an alternative rule and covers up to 1000psi and Division 3 can be used for pressure higher than 10000psi. | 4m |

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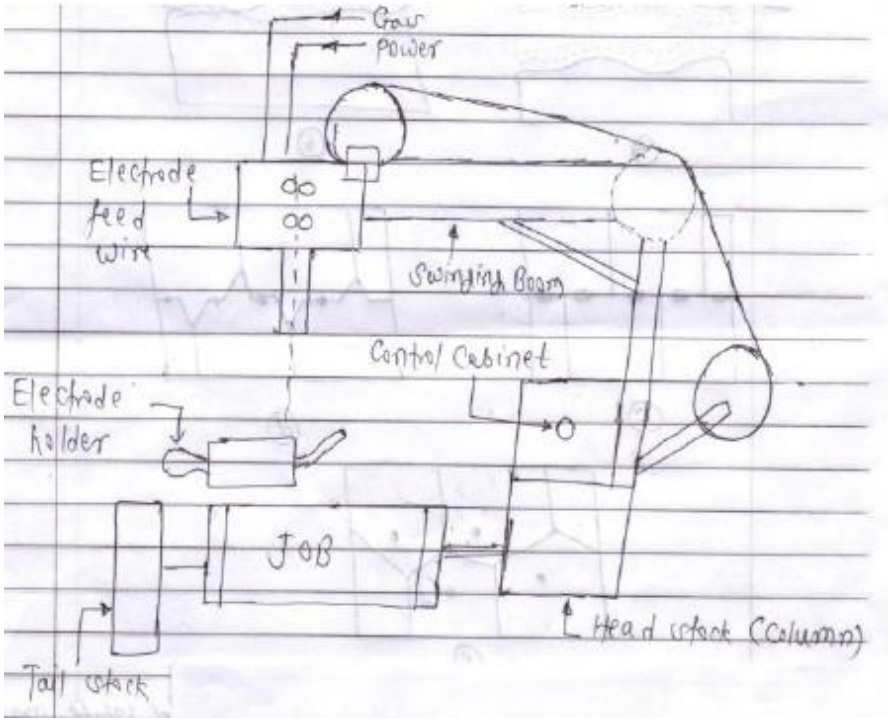
| | **c (ii)** |  <br>Manipulators are singularly the most variable piece of equipment directly associated with automatic welding. They can be designed to<br>weld sequentially different procedure on the same weldment.<br>It provide consistency and accuracy by bring the welding head nearer to the work piece.<br>It mainly consists of column, boom, electrical equipment and hand control box.<br>Column can perform leftward and rightward and also up and down movement to meet weld need.<br>Hand control box is designed to control the operation. | 2m(dia.)<br>2m (expl.) |