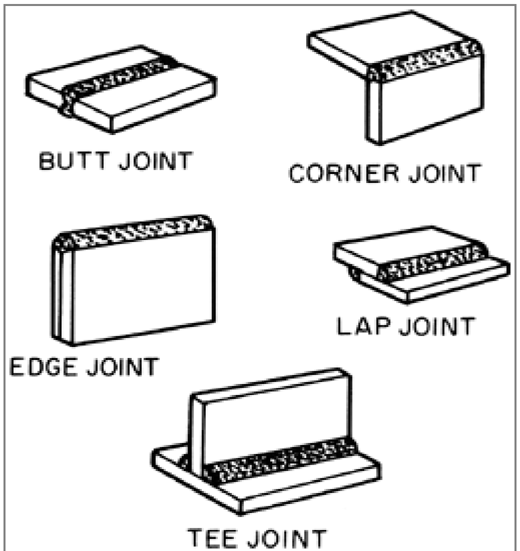
SUMMER – 16 EXAMINATIONS

Subject Code: **17455** **Model Answer**

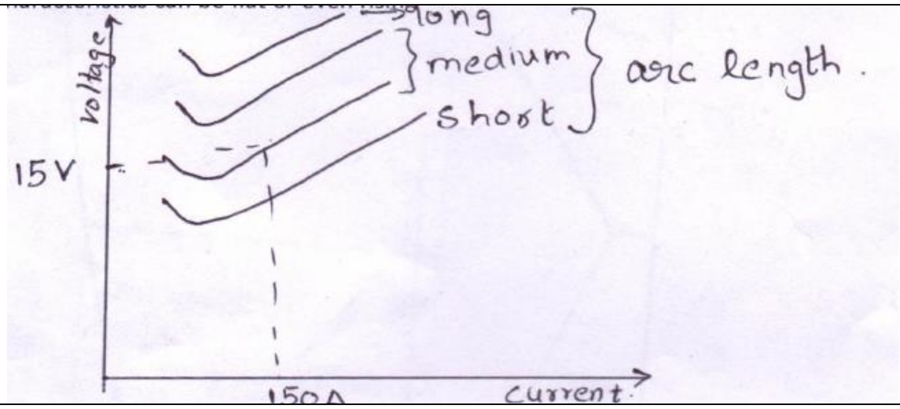
Important Instructions to examiners:

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.

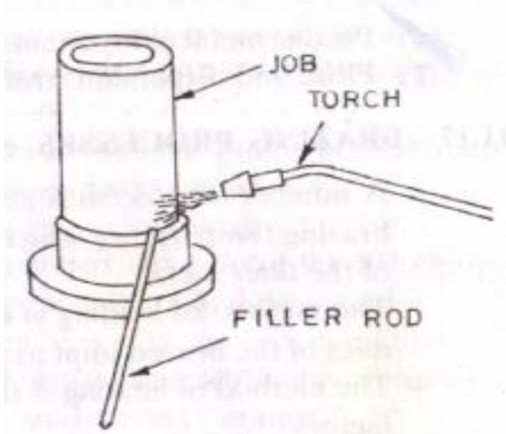
Q. NO.	MODEL ANSWER	MARKs	TOTAL
1.	**Attempt any five**	**5 X 4**	**20**
a)	It is a fusion welding process. It joins metals using the heat of combustion of an oxygen/air and fuel gas (aceylene.Propane, butane or hydrogen) mixture. The intense heat thus produced melts and fuses together the edges of the points to be welded generally with the addition of filler metals.	4m	4m

b)	 **welded joints** Butt welds These are welds where two pieces of metal are to be joined are in the same plane. These types of welds require only some preparation and are used with thin sheet metals that can be welded with a single pass. Common issues that can weaken a butt weld are the entrapment of slag, excessive porosity, or cracking. For strong welds, the goal is to use the least amount of welding material possible. Corner Joint A corner weld is a type of joint that is between two metal parts and is located at right angles to one another in the form of a L. As the name indicates, it is used to connect two pieces together, forming a corner. This weld is most often used in the sheet metal industry and is performed on the outside edge of the piece. Lap Joint This is formed when two pieces are placed atop each other while also over lapping each other for a certain distance along the edge. Considered a fillet type of a welding joint, the weld can be made on one or both sides, depending upon the welding symbol or drawing requirements. It is most often used to join two pieces together with differing levels of thickness. Edge Joint Edge welding joints, a groove type of weld, are placed side by side and welded on the same edge. They are the most commonly replaced type of joints due to build up accumulating	2m per joint(1 m diag and 1m exp)	4m

	on the edges. They are often applied to parts of sheet metal that have edges flanging up or formed at a place where a weld must be made to join two adjacent pieces together. Tee Joint Tee joints, considered a fillet type of weld, form when two members intersect at 90° resulting in the edges coming together in the middle of a component or plate. It may also be formed when a tube or pipe is placed on a baseplate.		
c)	ARC CHARACTERISTIC The behavior of the arc is generally described with the details of arc characteristic • Volt-ampere arc characteristic In order to initiate and maintain a stable arc. The study of volt-ampere characteristic is very important.If the arc characteristics are flat then to impart a high degree of self-adjustment of arc consistent with stability the volt ampere characteristics of the power sources must be slightly negatively the arc characteristics are positive the power source characteristics can be the flat or even rising.as shown in the fig it shows that in lower current range, the voltage decreases as the current increases and reverse occurs if the current is continuously increased to higher va!ues.the initial decrease in voltage is due to the fact that as current increases, arc temperature and thus electrical conductivity of arc increases. With the increased electrical conductivity the required current is able to flow with less voltage drop. • Voltage-Arc length characteristics: Arc length between the electrode and job determines arc resistance and hence potential drop across the arc. The arc length determines the arc voltage and this voltage permits a certain flow of current as predicted from the characteristics also influence the electrode erosion rate.	4m(2m per characteristic)	4m

			
d)	Arc Stability Arc is said to be stable if it is uniform and steady. A stable arc will produce good weld bead and a defect-free weld nugget. Defects commonly introduced by unstable arc are slag entrapment, porosity, blow holes and lack of proper fusion. The stability of a welding arc is governed by many factors .Arc stability is determined in high current welding tests in two ways: by measuring the vibration, welding current and voltage; and by recording the brightness variations of the arc	4m	4m
e)	Weldability Weldability is the capacity of the material to be welded under fabrication conditions imposed into a specific suitable designed structure to perform sarisfactorily in the intended service. Importance:- 1)This implies that metal with good weldability can be welded so as to perform saisfactorily in the fabricatied structure. 2)It will have full strength and toughness after welding 3) It contribute to good weld quality even with high dilution 4) It should have unchanged corrosion resistance after welding	2m def 2m import	4m
f)	Factors affecting weldability are: 1. Meting point of metal. 2. Thermal conductivity 3. Reactivity 4. Coefficient of thermal expansion of metals 5. Electrical resistance 6. Surface condition	4m (1m per point)	4m
g)	WELD METAL SOLIDIFICATION - The solidification of metals is usually considered to be a nucleation and growth process i.e., the transformation of a liquid phase to a solid normally occurs by a process of nucleation and growth Nucleation involves the creation of critical sized particles, (j.e. nuclei) of the new, (i.e., solid) phase and considerable supercoiling is usually necessary before the	4m	4m

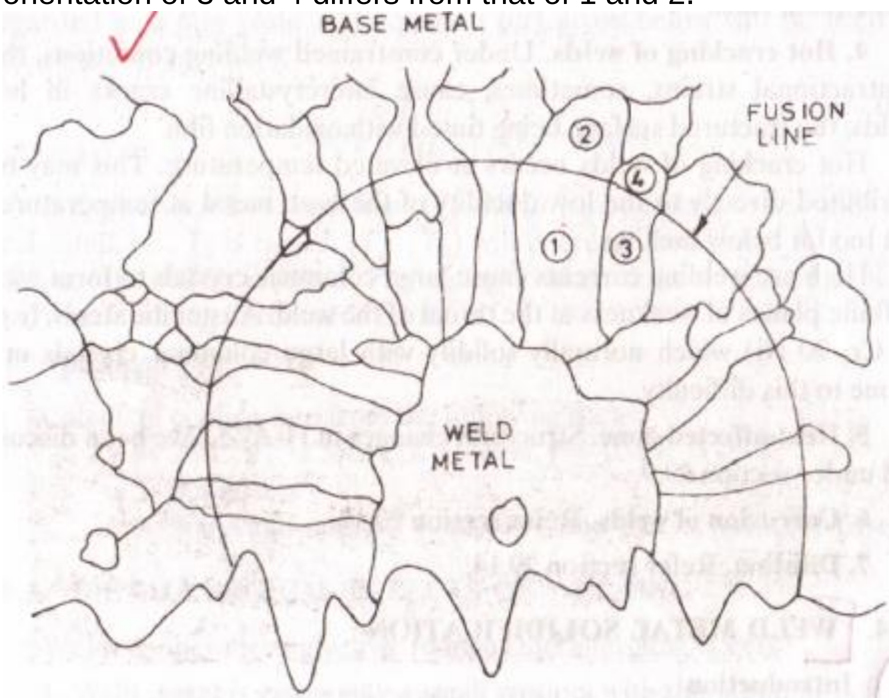
	first solid nuclei are formed from which growth may proceed. In all metallic system solidification is accompanied by the evolution of heat.In a pure metal the rate of growth is determined by the rate of heat extraction from solid liquid interface. In all metallic systems, solidification is accompanied by the evolution of heat. In a pure metal the rate of growth is determined solely by the rate of heat extraction from the solid-liquid inter- face. This situation, however, is of purely academic interest in welding, since this level of purity is never achieved. - The level of purity in welding operations is such that Segregation always occurs on solidification. As the alloy cools through the solidification range, solute is rejected at the -1)lid-liquid inter- face. - Since very little mechanical mixing of the liquid occurs in the immediate vicinity of the advancing interface, the rejected solute must be redistributed in the liquid by diffusion. - The freezing process is so rapid that diffusional processes cannot effectively remove the excess solute near the interface. Hence, solute enrichment occurs at the moving interface until a dynamic equilibrium is reached. The resulting dynamic equilibrium provides an excess of solute in the liquid near the interface with the solute content decreasing to the nominal liquid composition at some distance from the interface. As a result, the effective liquidus temperature varies with distance from the interface		
2.	ATTEMPT ANY TWO	8 X 2	**16**
a)	Equipment of gas welding : 1.Oxygen cylinder: 2.Acetylene cylinder: 3.Welding Torch: 4.Welding tip: 5.Pressure regulator: 6.Hoses and hose clamp and hose couples: 7.Gas lighter: Applications of torch 1) it provides the lowest flame temperature 2) It is used to join ferrous and non ferrous metals , maintenance as well as fabrication process	2m for diag 2m for app 4m for equipments	

	 		
b)	There are two different power sources used in manual arc welding i)AC type ii)DC type AC power source An arc welding power source is designed to change high voltage low amperage current into a safe low voltage (between 50 and 100 volts) heavy current supply (even above 500 Amperes) suitable for arc welding. Power source is required to supply the current that supports the arc column for fusion welding. - The power sources used to supply the electric current for arc welding can be divided into tbree main categories: (a).Those that supply direct current(DC)e.g.Motor generator sets, diesel engine driven generators and TrailSrormer-Rectifier sets. (b) Those that supply alternatin current AC) e.g., transformers and AC generators. (c) AC/DC arc welder combinations supplying either AC or DC. Such power sources are transformers with DC rectifiers. DC POWER SOURCES In the early days of welding, DC was used because of difficulties in stabilizing the AC arc. (1) DC Generator sets - A DC welding generator produces direct current in either straight or reverse polarity. The polarity selected for welding depends upon the kind of electrode used and the material lo be welded.	2m for stating 3m for exp AC 3m for exp DC	8m

	- A DC generator is powered either by an electric motor or a diesel engine. Diesel operaed generator sets ace suitable out door applications or other areas where power is not available. 2) AC-DC Rectifiers - An AC-DC rectifier can supply any type of current needed, although some transformer-rectifiers are designed to supply only -Such machines are essentially transformers containing an electrical device known as rectifier which changes AC to DC. The rectifier may consist of, metal plates coated with a compound or silicon diodes, each unit having the special property allowing the current to flow in one direction only.		
c)	Welding of mild steels: Mild steel may be welded using the following process: 1.Flux shielded metal arc welding 2.Oxy acetylene welding 3.Resistance welding 4.Themit welding 5.Submerged arc welding 1.Flux shielded metal arc welding: Low hydrogen electrodes may be used to reduce weld cracking Pre heating temperature between 150^0C to 260^0C are recommended to eliminate and reduce hard and brittle area. The heavier the section thickness and greater the carbon content of steel the higher would be the pre heating temperature. After welding the jobs should be allowed to cool to room temperature slowly by being buried in ths sand or by using asbestos Pat heating the job between 595^0 C to 675^0C for 1hour per	2m stating method 6m for exp	8m

	25mm and section thickness. This improves the metallurgical structure increases the ductility ,reduces the residual stresses.		
3.	**ATTEMPT ANY TWO**	**2X 8**	**16**
a)	Welding of alloy steels: The different welding process are as follows: 1. Oxy acetylene welding. 2.Submered arc welding 3.Thermit welding 4.Flux shielded metal arc welding 5.Resistance spot welding Welding of stainless steel When 11.5%or more chromium is added to iron, a fine film of chromium oxide forms spontaneously on the surface exposed to air. The film acts as a barrier to retard further oxidation, just or corrosion. As the steel cannot be stained easily, it is called as stainless steel. It is suggested that austenitic stainless steel should be pre heated prior to welding. All stainless steel can be grouped into three metallurgical classes i.e i)austenitic ii) ferritic iii) martensitic based on their microstructures.each of the classes has different welding requirement.	3m for stating 3m for exp	8m
b)	def Heat affected zone is that portion of the base metal whose mechanical properties and microstructure have been altered by the heat of welding. Structure of weld metal - The solidification of metals is usually considered to be a nucleation and growth process i.e., the transformation of a liquid phase to a solid normally occurs by a process of nucleation and growth. Nucleation involves the creation of critical sized particles(i.e. nuclei) of the new, (i.e., solid) phase and considerable supercooling is usually necessary before the first solid nuclei are formed from which growth may proceed.	2m for def 6m for exp	8m

Concept of Epitaxial Growth. Fig. shows that the adjoining Incompletely melted grain 2 of base metal serves as ideal substrate upon which molten weld metal crystallizes. In other words grain 1groos directly from the incompletely melted grain 2. It can be noted that the grain boundaries of the original grain 2 are continuous across the fusion line towards grain 1 though they have bent. This is more clear in case of grains 3and4. Moreover, grains 1 and 2 are identical in orientation. Similarly grains 3 and 4 are identical in orientation, although the orientation of 3 and 4 differs from that of 1 and 2.



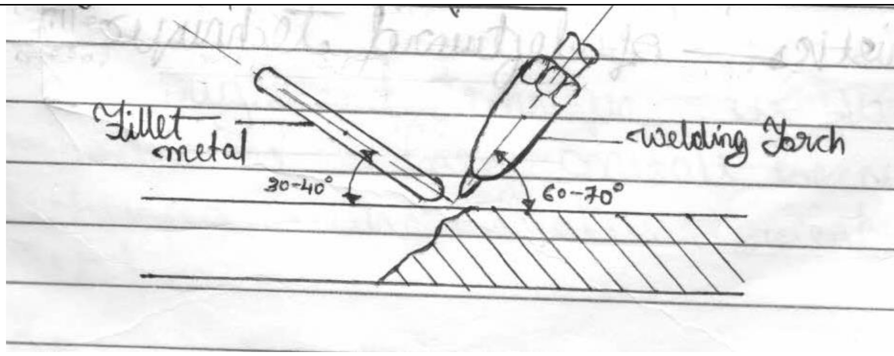
c)

SR.NO.	BRAZING	SOLDERING
1	These are stronger than soldering but weaker than welding. These can be used to bear the load up to some extent	These are weakest joint out of three. Not meant to bear the load. Use to make electrical contacts generally
2	It may go to 600C in brazing	Temperature requirement is up to 450C
3	Work pieces are heated but below their melting point	No need to heat the work pieces

8m (1m per point) — 8m

	4	May change in mechanical properties of joint but it is almost negligible.	No change in mechanical properties after joining		
	5	Cost involved and skill required are in between others two	Cost involved and skill requirements are very low.		
	6	No heat treatment is required after brazing.	No heat treatment is required		
	7	Preheating is desirable to make strong joint as brazing is carried out at relatively low temperature	Preheating of workpieces before soldering is good for making good quality joint.		
	8	Cost involved and sill required are in between others two	Cost involved and skill requirements are very low.		
	9	No heat treatment is required after brazing.	No heat treatment is required		

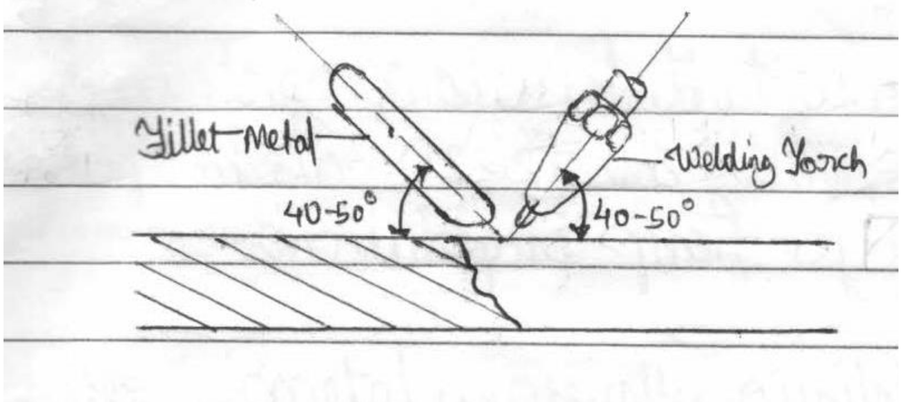
4.	**ATTEMPT ANY FOUR**	**4 X 4**	**16**
a)	Welding techniques: Depending upon the ways in which welding rod and welding torch may be used there are usually two techniques which as follows. 1.Leftward technique 2.Rightard technique: 1.Leftward technique	1m for stating 3m for exp any one	4m

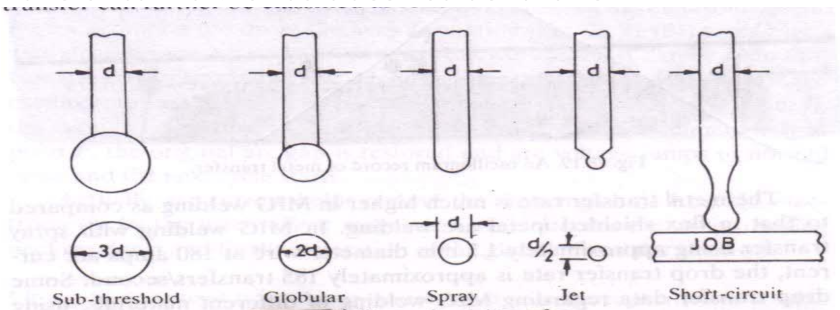


Generally the welder holds the welding torch in his right hand and the filler rod in his left hand.
The welding flame is directed away from the finished weld is towards the unwelded parts of the joint
The welding torque is given a small side way movement. The head of the welding torch is held at an angle between 60-70^{0}plane of the weld and the welding rod(Filler metal)at 30-40^0
This technique us usually used on relatively the in metals i.e. having thickness less than 5mm
Since the flame is pointed in the direction of welding, it preheats the edge of the joints.
Good control and neat appearance is the characters of leftward technique.

OR

2.Rightard technique:
Welder holds the welding torque in his right hand and filler rod in left hand.
The welding flame is directed towards the finished weld.
The head of the welding torque is held at an angle 40-50^0 from the plane of the weld.
The rightward technique is used in heavier or thicker base metals because in this technique the heat is concentered into the metal
The weld quality is better than obtained with leftward technique, also due to less consumption of filler rod the rightward technique involves lower cost of welding than leftward technique

			
b)	Advantages of Gas welding: 1.It is the probabity the most versatile process 2.It can be applied to a wide variety of manufacturing and maintenance situation 3.Welder has considerable control over the temperature of the metal in the weld zone 4.The rate of heating and cooling is relatively slow 5. This equipment is versatile, low cost. Self-sufficient and usually notable. 6. The cost and maintenance of the welding equipment id low when compared to that of other welding process.	4m (1m per point)	4m
c)	Welding of aluminum by TIG welding It involves striking an arc between tungsten electrode the work piece to provide heat for joining. A separate filler rod is used when welding thickener work piece TIG welding makes use of inert gases to prevent any reaction between molts an weld metal atmosphere. Thickness of aluminum alloys weld by TIG process ranges from 1-10mm for manual welding from 0.25-25 mm for automatic welding Oil, grease, paint, moisture, oxide and other contaminates is removed from the surface to be weld. Argon is generally used in TIG welding of aluminum; also helium is sometimes uses for thicker section. A mixture of argon and helium is also used for welding aluminum where balanced characteristic is deserved Initially arc is struck by scratching action. The operator holds welding torch in one hand and filler rod in the other hand. The arc length is kept approximately equal to tungsten electrode diameter. The welding torque is kept vertical to the center line of the joint at afore hand angle of about $75\text{-}85^0$ from the none of the work. Unalloyed Tungsten and Tungsten zirconium electrode are usually recommended for use.	4m for exp	4m

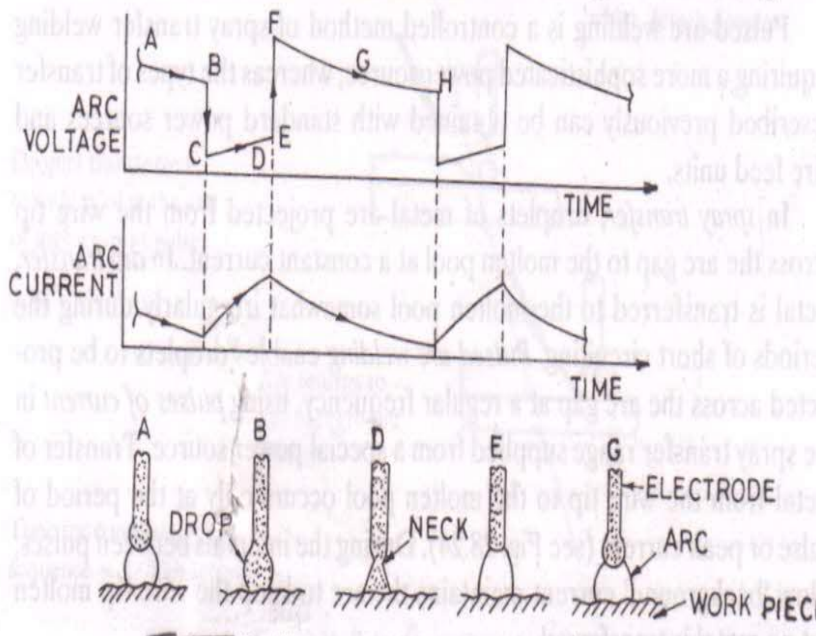
d)	TYPES OF METAL TRANSFER There are two main types of metal transfer: (a) Free Flight Transfer. In which metal drops get detached from the electrode, pass through the arc and fall on the job. This category of metal transfer can further be classified as follows:  [redacted]. Types of metal transfer. (i) Sub-threshold type. The drop diameter is approximately equal to three times the electrode core wire diameter. (ii) Globular type. The drop diameter is approximately twice the electrode core wire diameter. This type of transfer is observed in both flux shielded metal arc welding and MIG welding processes. Globular transfer is observed at low arc currents or with longer arcs. The globules may pass freely through the welding arc or depending upon their size and arc gap they may short-circuit the arc. The number of drops transferred per second are very less. Globular transfer is associated with spatter loss and shallow penetration height. (iii) Spray type. In this case the drop diameter is approximately equal to electrode core wire diameter. The rate of drop transfer is much higher than that in globular transfer. There is a continuous spray of drops from the electrode to the job. This type of transfer occurs at high arc currents and low arc lengths. Spray transfer is observed in both flux-shielded metal arc welding and MIG welding. A mixture of argon and oxygen promotes spray transfer in MIG welding. Though associated with some spatter, spray mode of transfer produces a stable are, good weld bead, deep penetration, a strong joint and is recommended for thicker plates. (iv) Jet type. In jet type of transfer the drop diameter is approximately equal to half the diameter of the wire. In this case the electrode end becomes tapered and a jet of drops comes out from the electrode .The temperature of the droplet formed from a steel electrode just as it detaches, ranges from 1800-2000 ^{0}C.The size of a droplet ranges	4m for any one exp	4m

between 0.5 to 5 mm. The velocity at which drop transfer takes place depends upon drop size.

OR

(b) Short-circuiting or Dip Transfer

drop grows, hangs, thus arc resistance and arc voltage start reducing.



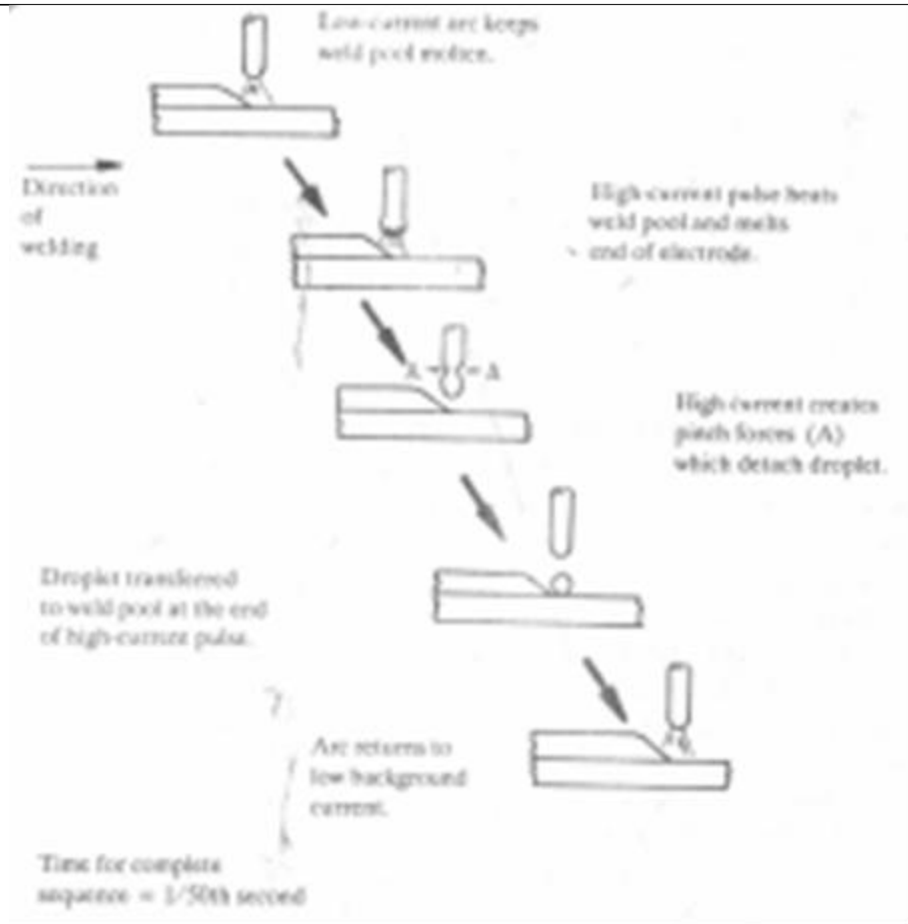
Oscillograms and steps of short-circuiting transfer.

In short-circuiting type of metal transfer, the arcing end of the electrode starts melting, develops to a spherical shape, makes 'contact with the molten pool in the base metal and gets detached from the' electrode. When the hanging drop touches the base metal, the circuit is shorted and the arc extinguishes. .During this period A to B, the drop grows, hangs and thus the arc voltage decreases. At point B short circuit occurs, arc extinguishes and the voltage drops down. Short circuit remains from C to E, during which current increases because of reduced resistance between electrode and workpiece. There should be a sufficient increase in current so that neck does not freeze. At point F once again the drop formation starts, drop grows, hangs, thus arc resistance and arc voltage start reducing.

Short circuit transfer is generally recommended on thinner sheets, of course thicker gauges can also be welded using large wire diameter (1.5 mm or around). This mode of transfer is suitable especially when welding intricate shapes and in positions other than flat.

OR

	c) Pulsed transfer (pulsed-arc welding) Pulsed-arc welding is a controlled method of spray transfer welding requiring a more sophisticated power source, whereas the types of transfer described previously can be obtained with standard power sources and wire feed units. In spray transfer, droplets of metal are projected from the wire tip across the arc gap to the molten pool at a constant current. In dip transfer, metal is transferred to the molten pool somewhat irregularly during the periods of short circuiting. Pulsed-arc welding enables droplets to be projected across the arc gap at a regular frequency, using pulses of current in the spray transfer range supplied from a special power source. Transfer of metal from the wire tip to the molten pool occurs only at the period of pulse or peak current (see Fig.). During the intervals between pulses a low 'background' current maintains the arc to keep the wire tip molten but no metal is transferred. Pulsed transfer means that the weld metal is projected across the gap at high current, hut the mean welding current remains relatively low. The operator can vary the pulse height and the background current to obtain full control of both the heat input and the amount of metal deposited; however, in many modern power sources the pulse procedure is preset by the manufacturer to simplify use. Pulsed-arc transfer can be used on mild and low-alloy steels, stainless steel and is particularly useful with aluminum and its alloys on light to plate sections as dip transfer cannot be used on these alloys.		


Low-current arc keeps weld pool molten.
Direction of welding
High current pulse heats weld pool and melts end of electrode.
High current creates pinch forces (A) which detach droplet.
Droplet transferred to weld pool at the end of high-current pulse.
Arc returns to low background current.
Time for complete sequence = 1/50th second

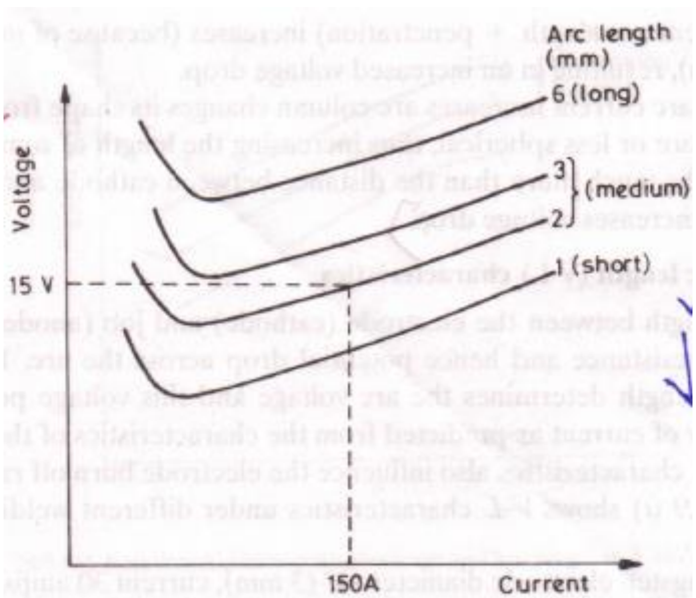
e)	The following are the process for welding cast iron are: • metal arc welding • oxy acetylene welding • Braze welding • brazing • thermit welding	4m(1m per point)	4m
f)	Factor that influence power sources are 1.Avaible floor space 2.Type of electrode to be used and metal to be weled. 3.Type of work that is light or heavy wok. 4.Location of operation. 5 available power AC or DC 6 initial cost and running cost 7 personal available for maintenance 8 type of electrode 9 efficiency	4m (1m per point)	4m
5.	ATTEMPT ANY FOUR	**4 X 4**	**16**
a.	(i) POLARITY • The term polarity in welding may be attributed to the fact that every electrical circuit has a negative and a positive terminal. • In DC circuit the current flows in one direction only, the line that carry current from the supply is called positive side ,the line that restores the current to the supply is called negative side • It is believed that 60-70% of the heat is liberated at positive side of the circuit and 40-45%at negative side • Therefore in DC welding with bare or light coating steel electrode the work piece is usually connected to positive side of the circuit and electrode is attached to negative side. This condition is referred to as straight polarity. (ii) Current voltage: In lower current range voltage decreases as the arc current increase and reverse occurs If the current is continuously increased to higher values. The initial decrease in voltage is due to the fact that as current increases, arc temperature and thus electrical conductivity of the arc increases. With increased electrical conductivity the required current is able to flow with	2m per def	8m

less voltage drop.

The increase of arc voltage with current, thereafter, can be due to the following reasons:

(a) Voltage drop is proportional to total arc length. As current increases, even at constant apparent arc length setting, the total arc length(i.e., apparent arc length + penetration) increases (because of increased penetration), resulting in an increased voltage drop.

(b) As arc current increases arc column changes its shape from cylindrical to more or less spherical, thus increasing the length of some of the current paths much more than the distance between cathode and anode. This again increases voltage drop Voltage



(iii) Electrical travel

The direction of current used in arc welding also plays an important role in welding. When a current flows through a conductor heat which is a form of energy Is generated because the conductor has some resistance. If the current in any cable is doubled, 4 times as much as heat is generated in the circuit. If the current is trebled, nine times as much as heat is generated. This loss due to heating effect is known as I^2R loss.

iv) Arc length

The distance between the tip of the electrode and the weld puddle.

Arc too short: This irregularity causes irregular masses of weld metal, which are likely to include slag.

Arc too long: This causes poor penetration, sticking, blowing

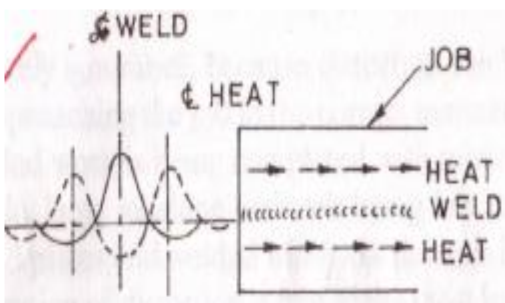
	and considerable spraying. The weld is also likely to be defective. The optimal length corresponds approximately to the electrode diameter.		
b)	1) When welding the properties of metal its microstructure changes 2) If the cooling rate is not proper it may cause weld defects like distortion and cracks. 3) The cooling rate depends upon the preheat the thickness and the geometry of the part 4) welding of structure with small thickness, with the pulling rate is normally slow,which decreases the mechanical properties that is 0.2 % proof strength and the impact properties 5) When high strength steel is welded, non-uniform heating and cooling in weld metal and base metal generate harder heat affected zone (HAZ), cold crack susceptibility and residual stress in weldments. 6) If the deformation process does not act uniformly on all the parts of the metal being rolled or drawn then the internal stresses may be setup. 7) If the deformation process is carried to its limit the metal loses all of its ductility and breaks in brittle manner		

c)	A welding defect is any flaw that compromises the usefulness of a weldment. Their occurrence is given as follows: • susceptible microstructure (e.g. martensite) • hydrogen present in the microstructure (hydrogen embrittlement) • service temperature environment (normal atmospheric pressure) • high restraint • high welding current • poor joint design that does not diffuse heat • preheating, speed is too fast, and long arcs 1) Inclusions There are two types of inclusions: linear inclusions and rounded inclusions. Inclusions can be either isolated or cumulative. Linear inclusions occur when there is slag or flux in the weld. Slag forms from the use of a flux, which is why this type of defect usually occurs in welding processes that use flux, such as shielded metal arc welding, flux-cored arc welding, and submerged arc welding, but it can also occur in gas metal arc welding. This defect usually occurs in welds that require multiple passes and there is poor overlap between the welds. The poor overlap does not allow the slag from the previous weld to melt out and rise to the top of the new weld bead. It can also occur if the previous weld left an undercut or an uneven surface profile. To prevent slag inclusions the slag should be cleaned from the weld bead between passes via grinding, wire brushing, or chipping. 2 Undercut Undercutting is when the weld reduces the cross-sectional thickness of the base metal, which reduces the strength of the weld and work pieces. One reason for this type of defect is excessive current, causing the edges of the joint to melt and drain into the weld; this leaves a drain-like impression along the length of the weld. Another reason is if a poor technique is used that does not deposit enough filler metal along the edges of the weld. A third reason is using an incorrect filler metal, because it will	2m def 2m occur 4m for any two exp	8m

	create greater temperature gradients between the center of the weld and the edges. Other causes include too small of an electrode angle, a dampened electrode, excessive arc length, and slow speed. 3 Cracks Cracks are the most dangerous amongst all types of defects as it reduce the performance of a welded joint drastically and can also cause catastrophic failure. Depending on the position, location and orientation these can be categorized as longitudinal cracks, transverse cracks, crater cracks, under-bead cracks, and toe cracks. 4 DISTORTION Distortion in a weld results from the expansion and contraction of the weld metal and adjacent base metal during the heating and cooling cycle of the welding process. Doing all welding on one side of a part will cause much more distortion than if the welds are alternated from one side to the other.It can be avoided by Reducing the metal weld volume to avoid overfill and consider the use of intermittent welding,Minimising the number of weld runs,Positioning and balancing the welds correctly round the axis ,Using backstep or skip welding techniques, which involves laying short welds in the opposite direction,Making allowance for shrinkage by pre-setting the parts to be welded out of position ,Shortening the welding time 5 INCOMPLETE PENETRATION/ FUSION: Lack of fusion is the poor adhesion of the weld bead to the base metal; incomplete penetration is a weld bead that does not start at the root of the weld groove. Incomplete penetration forms channels and crevices in the root of the weld which can cause serious issues in pipes because corrosive substances can settle in these areas. These types of defects occur when the welding procedures are not adhered to; possible causes include the current setting, arc length, electrode angle, and electrode manipulation. 6 under cut Undercutting is when the weld reduces the cross-sectional thickness of the base metal and which reduces the strength of the weld and workpieces. One reason for this type of defect is excessive current, causing the edges of the joint to melt and drain into the weld; this leaves a drain-like impression along the length of the weld. Another reason is if a poor technique is used that does not deposit enough filler metal along the edges		

	of the weld. A third reason is using an incorrect filler metal, because it will create greater temperature gradients between the center of the weld and the edges. 6 POROSITY AND BLOW HOLES OR GAS POCKETS Porosity in welding is a result of dissolved gases or gases released during the welding process, being trapped in the metal when there is insufficient time to escape prior to solidification. If in the shape of rounded holes, the gas is called spherical porosity or just porosity.it can be reduced by Use low-hydrogen welding process, filler metals high in deoxidizers; increase shielding gas flow, Use preheat or increase heat input, Clean joint faces and adjacent surfaces, Use specially cleaned and packaged filler wire, and store it in clean area, Preheat the base metal, Use electrodes with basic slagging reactions 6 SPATTER Weld spatter consists of droplets of molten metal or non-metallic material that are scattered or splashed during the welding process. These small bits of hot material may fly and fall on the workbench or on the floor, while others may stick to the base material or any surrounding metallic material. Spatter can be minimized by correcting the welding conditions and should be eliminated by grinding when present. 7 OVERLAPPING An imperfection at the weld toe of a weld caused by molten metal flowing on to the surface of the parent material without fusing to it.The overlap can be repaired by grinding off excess weld metal and surface grinding smoothly to the base metal. Causes: Contaminated weld preparation; Travel speed too slow; Too low arc energy; Poor welding technique; Position of work.		
6)	**ATTEMPT ANY TWO**	**8 X 2**	**16**
a.	1. Peening 2. Vibratory stress-relief 3. Thermal treatment 4. Thermo-mechanical treatment 1. Peening: Peening has been employed with success for stress relieving purposes.	2m for listing 6m for any one exp	8m

	When properly applied, peening causes plastic flow and subsequently relieves the restraint that set up in the residual stress. Peening reduces internal stresses of a very low intensity- far below any affected by heating below the critical point, because low temperature reduces only those internal stresses that are above the long-time yield point of the steel at the stress-relieving Peering also reduces distortion. Excessive peening should not be carried out as it may result in (i) cold working and strain hardening of the weld metal, (ii) bending, and (iii) cracking of the weld. - Peening should be employed only when the weld metal possesses sufficient ductility to undergo necessary deformation. 2. Vibratory Stress-relief - Welded structures (e.g., press frames) are subjected to vibrations to relieve residual stresses. - In this method of stress-relieving an oscillating or rotating wave generator is mechanically coupled to the part to be stress relieved. The welded structure is placed on a platform that vibrates and in turn, the welded structure vibrates at one of its natural (resonant) frequencies Since vibratory stress-relief treatment does not change the metallurgical structure of welds or heat -affected zone, it does not alter mechanical properties, i.e., the strength or toughness of the weldment 3.Thermal treatment Thermal treatment proves to better substitute than vibratory stress relief because it improves strength or toughness of the weldment by bringing changes in microstructures. - Thermal stress-relief treatment consists of heating a welded Structure uniformly to a suitable temperature (preferably in-a furnace) below the critical range of the parent metal, holding It at this temperature for predetermined period of time, followed by uniform cooling. Still air is very desirable after the furnace is opened and until the structure is fully cooled. - A desirable thermal stress relieving treatment for a welded steel structure is heating uniformly to 595 to 650^{0}C, holding at that temperaturer-2hour per 25 mm of thickness and cooling slowly in the furnace to approximately 125°C and preferably lower. After treatment, the structure may be removed and allowed to cool to room temperature		

	595 to 650°C temperature is high enough to reduce the residual stresses rapidly; in addition, this relatively low temperature avoids undue distortion of the weldment. - The temperature used for stress-relief heat treatment may be in the range of 525-740^{o}C When lower temperature in the specified range is used, longer soaking times are necessary The residual stress remaining in a material after thermal stress relief will depend on the rate of cooling .The percentage relief of welding stresses is dependent on steel type, composition or yield strength 4. Thermo-mechanical stress relief-treatment - This technique aims at using thermal expansion to provide the mechanical forces required to set up another residual stress system to counteract and thereby cancel the original already set-up due to welding. - In this process two bands of heat (using two oxy-fuel gas torches moving in an e we are applied to either side of a longitudinal welds (Fig.).  Fig. Application of bands of heat. The positions of heat bands are chosen such that this way developed residual stresses counteract and cancel the original stresses set-up due to welding. - The metal on either side of a welded joint{s heated to a temperature of 175 to 205°C, while the weld itself is kept relatively cool. - Reductions in transverse residual stresses ranging up to 60%, as well as a considerable reduction in the longitudinal stresses, have been reported using thermo-rnechanical stress relief treatment. - Since this low-temperature treatment in most metals does not improve metallurgical properties of weld metal and heat affected zone, it is not considered as a good substitute for thermal stress relief treatment to provide ductility and notch toughness		

b)	Brazing filler Alloys: 1.Aluminium silicon 2.Magnesium 3.Copper and copper zinc 4.Copper-phosphorus 5.Gold 6. Nickel. 7.Silver Brazing Alloys Filler metal in brazing is the material that added to weld pool to assist in filling the gap(or groove). Filler metal forms an integral part of the weld Filler metal have the same or nearly the same chemical composition as the base metal. filler metal are available in a variety of compositions(For brazing different materials)and sizes The filler metal flows into the gap between close-fitting parts by capillary action The filler metal is brought slightly above its melting (liquidus) temperature while protected by a suitable atmosphere, usually a flux. It then flows over the base metal (known as wetting) and is then cooled to join the work pieces together. The filler metal for a particular application is chosen based on its ability to: wet the base metals, withstand the service conditions required, and melt at a lower temperature than the base metals or at a very specific temperature.	4m for listing 4m for imp	8m

c	Soldering can be defined as a group of joining process where in coalesce is produced by heating to a suitable temperature and by using a filler metal having liquids not exceeding 300^0F(427^0C) and below the soliding of the base metal. PRINCIPLES OF SOLDERING PROCESS The principles of good soldering practice include the following: (i) Selection of the proper joint design and clearance. (ii) Selection of the right solder and flux (iii) Adequately cleaning the joint components. (iv) Fluxing and assembling components with proper preplacement or addition of solder. (v) Heating the joint to the right soldering temperature for optimum time. The soldering operation is performed by bringing molten solder in contact with the preheated surfaces and heating the joint area to a good wetting temperature. This is roughly 55 to 80^0C above the melting point of the solder alloy itself. Under these conditions, good wetting can occur. (vi) The solder is then left to cool and freeze as quickly as possible in order to avoid disturbing the joint during solidification and causing internal micro cracks to form. (vii) The soldered joint is then cleaned to remove any undesirable flux residues on the surfaces and to ensure the integrity of the soldered joint.	3m def 5m for principle(1m per point)	8m