MODEL ANSWER

SUMMER– 17 EXAMINATION

Subject Title: Industrial Erection and safety Subject Code: 17623

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.	ANSWER		Marking Scheme
Q.1.	**Attempt any FIVE**		**5x4**
a.	Characteristics and features of NFR are as follow: • They are smooth glossy and strong • Stretch up to 25% on loading. • Water resistant up to certain limit • Used as core in Steel wire rope. • Last longer and not expensive • For lifting lighter loads	4m	**4m**

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b.	The selection criteria for a SWR mainly depend upon • usage • purpose • Availability of the material (grades of steel) used for preparing rope. • Lubrication of SWR is done properly. • While selecting care should be taken if strands are having broken wires • Wear on outside surface of the steel wire rope is checked while selection, the length of shiny spot on the wire is an indication of the amount of wear on the outside surface of wire	4m	4m
c.	**Inspection of hoisting chains:** • As the length of the chain depends on the purpose of use therefore proper care should be taken of these hoisting chains throughout its length. • Each and every link should be properly inspected at regular interval of time for any kind of damage. • Proper lubrication of chains should be conducted regularly. • Any sign of rust, these chains reduce the strength and hence it should be placed in cool and dry place in order to avoid rust.	4m	**4m**

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d.	Major causes of accidents. The following list of possible causes should be included while considering a failure of any industrial installation. 1)Component failure 2)Deviation from normal operating condition. 3)Human and organization error 4)Outside accident interference 5)Natural forces. 6)Act of mischief 7) Unsafe working condition	4m	**4m**
e.	Needs of erection costing: • To find out the overall cost of the project. • To plan financial resources properly. • To ensure it is completed at the optimum cost. • To try to minimize the cost which is increased in a particular area of erection work. Over Head Overhead costs, referred to as overhead or operating expenses, refer to those expenses associated with running a business that can't be linked to creating or producing a product or service. They are the expenses the business incurs to stay in business, regardless of its success level.	**3m for steps and 1 m for define**	**4m**

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f. Importance of pressure vessels:

1. They are used to store & transmit liquid vapors & gases under pressure. Generally used to store liquid under pressure

2. Used in various operation ranging from industrial to domestic.

3. Other usages include nuclear plants, petro-chemical plants, mining industries etc

4. It is actually very important as the vessel which comes in the shape of closed container is designed to hold the gas or liquid at a pressure substantially different from ambient pressure

(2 m for importance and 2 m for difference)

4m

difference between erection and installation

Erection	Installation
Erection is to keep the machine idle till the foundation work is completed	The act of installing means a system of machinery or other apparatus set up for use .
The act of erecting, or raising upright; the act of constructing,or as of fitting together the parts of, as a machine; the act of founding or establishing.	It is the act of putting the machine in to service
It is the action of placing the equipment in proper position i.e erection of the equipments like pressure	It means to install the machine with putting all equipments in working condition

	vessels ,heat exchangers			
	After erecting the machine only installation can be done	Installation cannot be done before erecting		
g.	Spur gear hoist • This contains hand chain and load Chain and train of gears assembled in a case. • The drive pinion that actuates the gear train is mounted on hand chain wheel shaft and it gets into the motion from hand chain in to wheel shaft. And it gets into motion from hand chain wheel to lower the load ,the load chain must be pulled continuously in reverse direction. • This type of chain hoist is made with the capacity of 10 tones with simple gear Train and multi gear trains gives the capacity of 50 tones or more. • These are most efficient manually operated having an efficiency of more than 80%. • However they are costlier than any other type of chain hoist. This mechanism of spur gear hoist consist of what is known as planetary gear train. It is most Efficient of several types of hand chain hoist.it is specially design for production services speed and ease of operation are essential.		4m (3 m for construct and 1m for uses)	**4m**

	 USE The spur gear type hoist is generally used with a trolley aud cranes for production services These are used for frequent and repetitive handling of large loads when required and when the labor availability is minimum.		
Q.2	**Attempt any FOUR**		**4x4**
a.	**Manila rope sling** : It is made up of Manila type natural fibre rope and used for comparatively lighter loads. Manila rope is rapidly damaged when exposed to sudden loading or extreme weather condition. This ropes sling can be used for handling cylindrical objects as it is easy to handle and light in weight. It can also be used for lifting small boxes as the rope can easily bent around the edges , some heavier jobs like handling steel shafts must not have large length and must not be handled for a long time in such case Manila sling is used.	4m	**4m**

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b.	Personal Injury Accident	Property damage Accident	4m	**4m**
	Personal injury is a legal term for injury to the body, mind or emotion as a post to an injury to the property.	Property damage is the damage to the destruction of public or private property cost either by a person who is not its owner and by natural phenomenon's like natural calamity, tsunami.		
	Injury caused to an individual due to certain reasons and factors is known as personal injury.	Injury caused to the property or the industrial infrastructure is called as property damage		
c.	Knot: A knot is a method of fastening or securing a linear material such as rope by tying or inter twisting. It may consist of a length of one or several segment of rope, string, strap or even a chain inter woven such that it can bind to itself or do some other object. Bends When the wire rope is terminated with a loop, there is a risk that it will bend .when the rope is not properly kept after use or not winded properly bends may take place. Hitch: It is a type of knot used for binding a rope to an object.It is a type of knot used to connect a rope to a cylindrical object. Hitches are essential knots for climbers, arborists, sailors and anyone needing to tie a rope to something.		4m	**4m**

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d.	Plain Lay construction Rope: This type of construction is mostly used for general purpose synthetic fiber rope. It is made by 3 strands lying together, each strand is made from uniform filaments of specific polymer so as to obtain ropes of specific strength. It has higher number of twists as compared to natural fiber rope. Braided construction Rope: In this type of construction, the core is surrender by a braided shield. The rope is balanced in such a way that the load is equally distributed on the shield. It has good flexibility and absorption, easy handling in wet and dry condition. It has more gripping power. If the shield wears out gradually regardless to wear or damage the core will remain undamaged.	4m(2m for plain and 2m for braided)	**4m**

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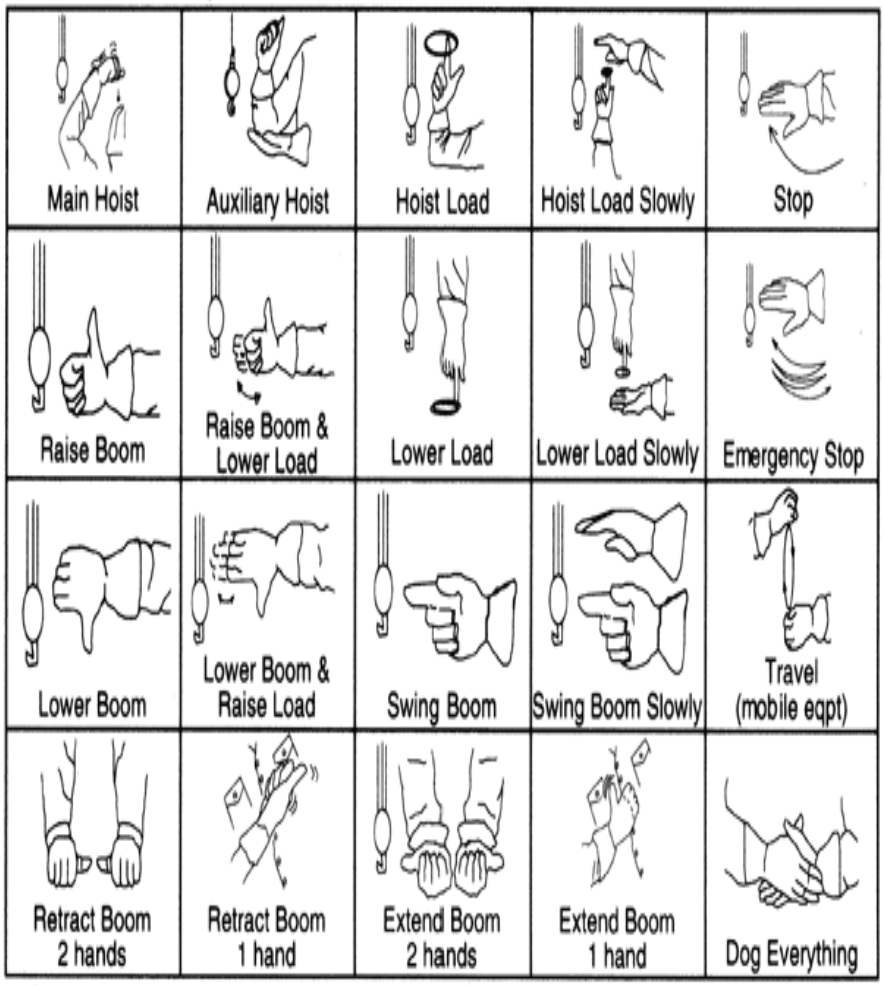
e.		4m(1m per signal)	**4m**

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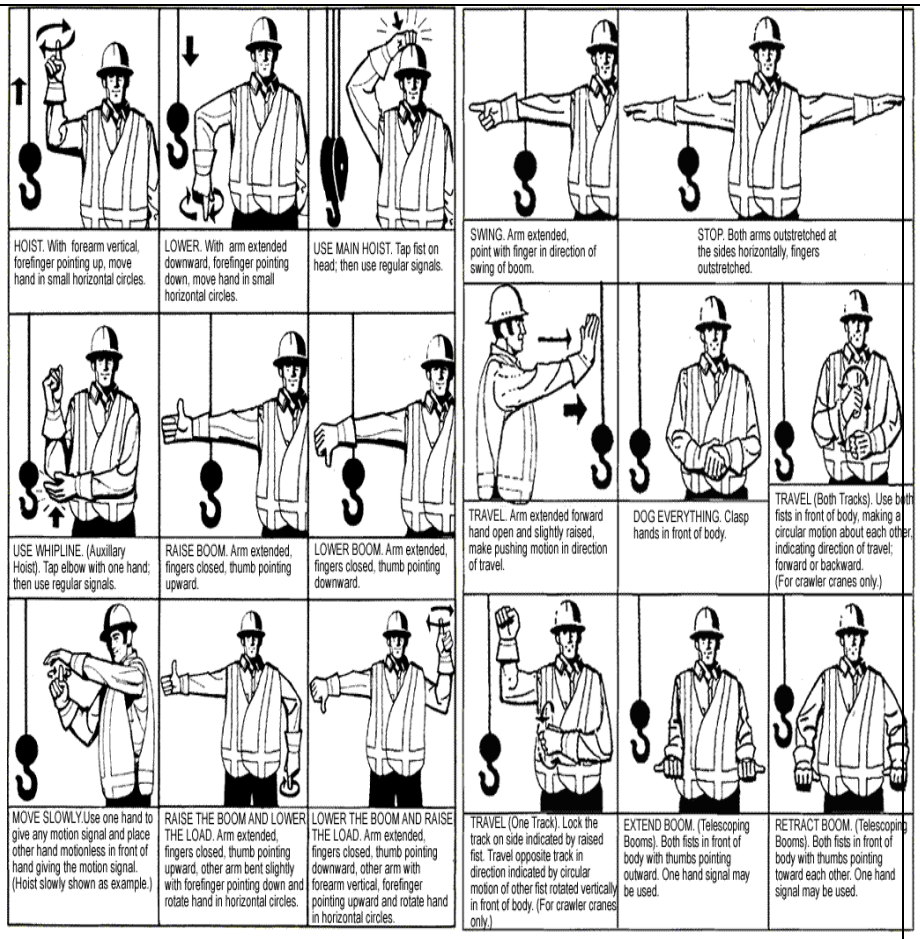

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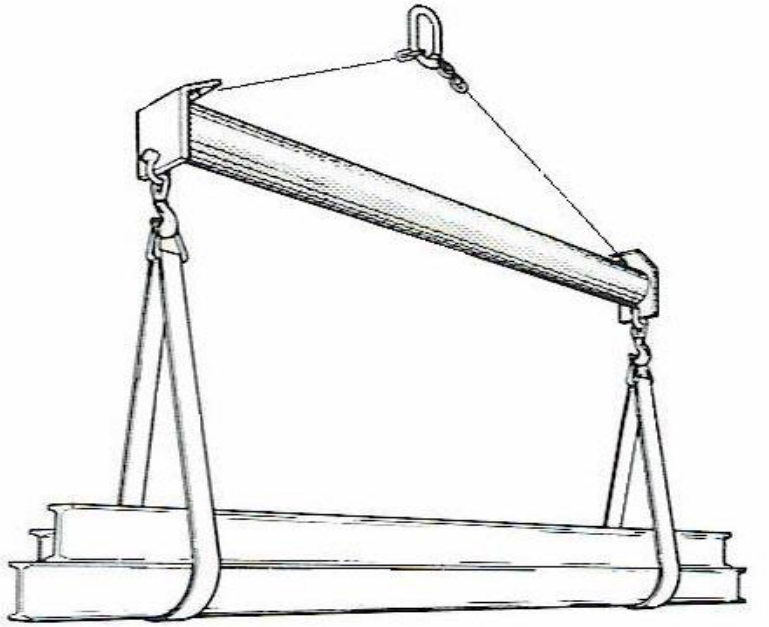
f.	 Use of spreader bar: • Spreader bar are used while lifting huge containers as shown in the fig. • The spreader bar is used to avoid toppling of the load and for better balance. • The bar is used even to avoid damage to the sling or rope used for lifting. • The horizontal bar used usually to hoist loads that are not sufficiently protected from crushing by sling legs in such cases spreader bar is used . • They are short or pipe like structure with eyes on each end. • In the sling above the spreader bar determines safe lifting capacity of the sling in tension.	4m	**4m**

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Q.3.	**Attempt any FOUR**		**4x4**
a.	Precaution in handling and storing synthetic fibre rope 1. Although it has strong water resistance it should be stored in a dry place so as to avoid damage to prolonged exposure to water. 2. It should not be used in places where there is a possibility direct contact with concentration acid or chemical. 3. Proper inspection of the synthetic fibre rope should be carried out to regular intervals 4.It should be storage of a synthetic fibre rope stored in a cool and dry place but not in, frozen condition 5. Synthetic fiber rope should be coiled, or kept, so that it is ready for use when needed: kink free, knot free, and twist free. 6. Synthetic fibre rope should be stored in a suitable clean, dry place out of direct sunlight and away from extreme temperature 7. Do not store Synthetic fiber rope on dirty floors or drag over rough ground – dirt and grit can work between the fibers and cause abrasion damage	4m	**4m**
b.	Kinking A wire rope resists bending and do not absorb turns or bends so easily as naturals fiber rope or synthetic fiber rope as a result they are easily kinked. A kink is produced when steel wire rope with loops it turns is pulled tight against an object which damages the rope permanently.	4m (3m for exp and 1m for causes)	**4m**

	kinking can be removed to certain extinct by pushing the ends of rope against the kink and slowly unwinding it. After that the ropes should be made straight so that twist can be removed. Causes: Rope made from hemp, cotton or nylon is generally stored in a cool dry place for proper storage if they are not properly placed it may cause kinking If the ropes are not properly coiled it may cause kinking. If Proper inspection of the synthetic fibre rope is not carried out at regular intervals it may cause kinking.		
c.	**Endless sling :** -This type of sling are usually form into a loop which is slipped around the job to be lifted. It involves folding one end of the rope and pushing the other end around the object. -However one has to take into account the swinging of loads or toppling of loads and to avoid this, ropes should be exactly placed on the centre of an object and these sling are used for light or wooden components. -The first step is to position the gravitational centre of gravity of the object in vertical line with the hook . If both are in same line than only we can lift the load safely. Uses: It is most suitable for lifting cylindrical objects. It is used in rigging industry,climbimg purposes Easy liftng of components	4m (3m for exp and 1 m for uses)	**4m**

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d.	**Manila rope sling**	**Steel chain sling**	4m	**4m**
	It is made up of Manila type natural fibre rope	It ismade of steel chain		
	It is used for comparatively lighter loads as compared to steel chain sling	It is used for heavier loads		
	Manila rope sling is rapidly damaged when exposed to sudden loading or extreme weather condition.	It does not get damaged easily		
	This ropes link can be used for handling cylindrical objects as it is easy to handle and light in weight.	These are mainly used in casting purpose of foundry shops or steel melting shop where slings are exposed to high temperature		
e.	**Estimation of centre of gravity:** The point at which whole weight of the body is set to be concentrated is known as its centre of gravity of whole body.It is appoint in any object about which it is perfectly balanced no matter how it is turned or twisted.It is calculated and accordingly the position of hook is said to be balanced		4m(2m for estimation and 2 m for importance)	**4m**

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	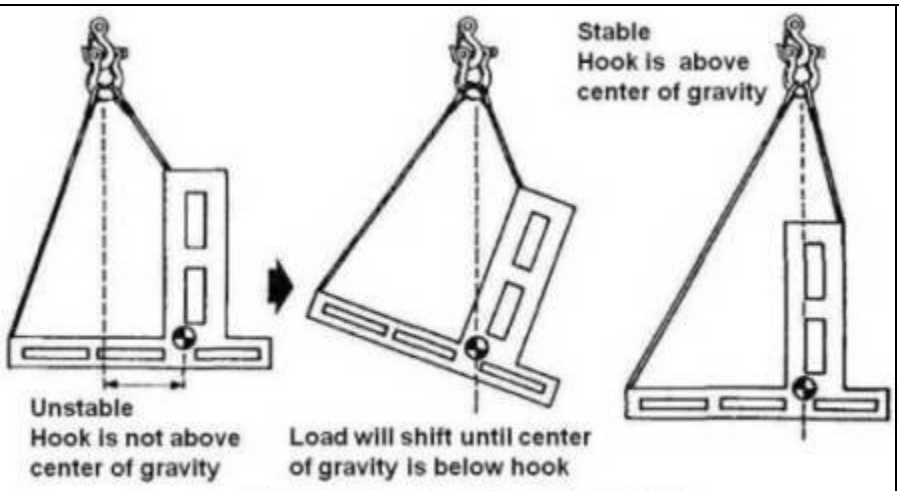 Effect of Center of Gravity on Lift **Importance of Handling of loads:** • If the centre of gravity is not estimated the hook cannot be positioned properly • If the hook position is improper then toppling of component may take place The slingis securely attached on one side to hooks and othe side loads if there is imbalance the kinking of slings may take place		
f.	Steps in erection costing : • To find out the cost of direct material used for installation or erection purposes these also involve indirect expenditure or material handling equiments along with other attachments such as jigs and fixtures. It also involves the cost of lubricants and coolants. • To find out the labour involved in certain installations or erection work. These labours are mostly paid on daily or weekly basis. Hence it is necessary to have an	4m	**4m**

	overview of the members involved. • To find out the overhead which cannot be categorized in any particular area. This cost involves the cost of maintenance, insurance of various people and machines. These also include electricity charges and water utility takes.		
Q.4.	**Attempt any TWO**		**2x8**
a.	**Importance of Hook position:** • Hook plays a very important role in holding or hoisting the loads. • It acts as a connecting tool between the rope or chain and the material to be lifted. • Hence it should be properly ensured that hook is correctly placed such that the stress get equally distributed on the hook. • There should not be only unexpected stresses or unbalanced forces that may cause the dropping of the material to be hoisted. • The hook should be positioned exactly along the line of centre of the material. Adjustment of sling length between hook and lifting lugs To adjust the sling length between hook and lifting lugs we should know were exactly the centre of gravity is located such that the equipment gets balanced while lifting. The diag shows how to adjust the sling length between hook and lifting lugs	8m (3m for importance ,3m forexp of adjust and 2 m for sketch)	**8m**

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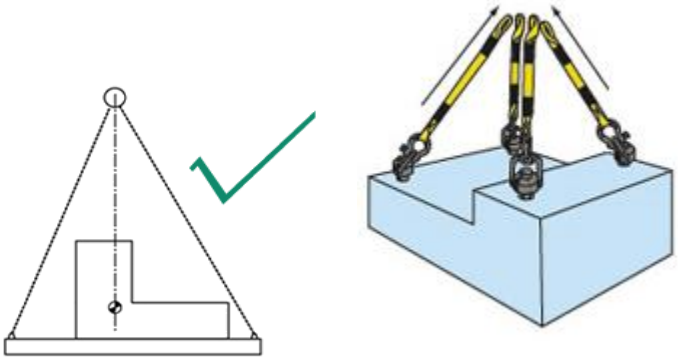
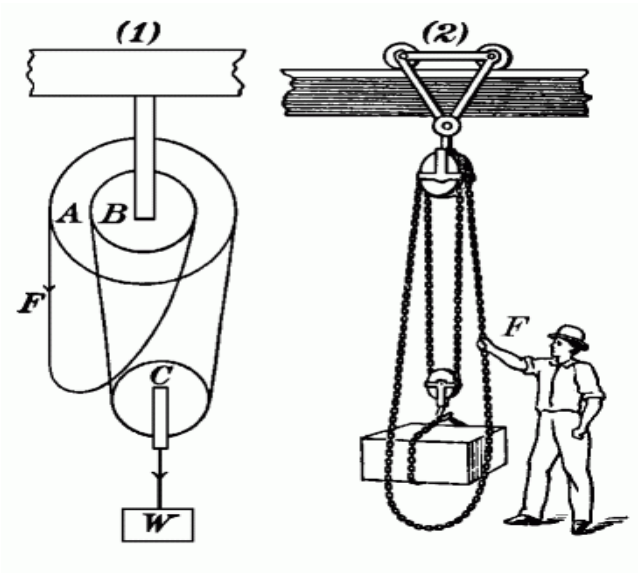
			
b	Differential chain hoist Differential hoist is similar to simple rope block it consists of single endless chain operating system .The hoist hook can be raised or lower by pulling downwards on either side of endless chain. The differential hoist may be suspended from a stationary hook or a Bolt,eye chain secured to same a part of several structure.It is the simplest form of mechanical lifting and less expensive.It is generally considered in practical for handling loads for more than 10 tons. 	8m (3m for describe, 3m for use,2m for sketch)	**8m**

	Uses: -Primarily this hoist is used by occasionally were light lifting load is required -Where ever time and effort are not the important factors differential chain hoist s used. Used for lifting loads very easily without any stress or pain.		
c.	Leak test Aand Alignment Test 1. The type of leak opening include a very tiny pin hole,crack or micro –cracks or inadaquate sealing between components or parts to be joined. 2. Container ,vessels or other fluid system are sometimes tested for leaks to see if there is any leakge to find the leak and also to take corrective actions against it. 3. There atre several methods for leak testing depending on the sitaution,depending on material,presuure etc.different methos can be applied 4. Pressure test are performed to ensure safety,relabilty etc 5. There are two major methods of pressure test hyrostatic test and pneumatic test 6. hydsrostatic test is performed by using water as the test medium,whereas pneumatic test uses air,nitrogen or any other non toxic gas Alignment Test 1)Alignments test can be done by using spirit level,squre gauge,dial gauges,wainess meter,squreness test,straight adjust	(4m for leak and 4m for alignmen t)	**8m**

	test etc 2)The machine should be carefully levelled up by means of spirit level befor starting with the actual installation. 3)Before various tests on any machnine are carried out,it is veryessential that it should be installed in truly horizontal and vertical plane.In horizontal plane,both longitudinal and transverse direction are equallyy important.		
Q.5	**Attempt any TWO**		**2x8**

a	• Check the important limits and dimensions of the pressure vessel as per the drawing with particular reference to (a)length, height, width (b)height, of nozzle (c)nozzle orientation.
	
	• To check the physical dimension of foundation layout where the pressure vessel is to be erected as per the drawing with respect to-
	  • location of foundation bolt
	  • Reference levels.
	  • Piping system around nozzle.
	  • Orientation of the axis.
	
	• Select suitable method for handling pressure vessel depending upon the following-
	  • Weight of the pressure vessel.
	  • Space available for operation
	  • Time allowed for erection.
		8m	**8m**

	• Orientation of the axis. • Hoist the pressure vessel by 6 inch and lower it to confirm the proper balance of pressure vessel. • Hoist the pressure vessel to required height and lower it slowly to match the legs of pressure vessel with foundation bolt with foundation pocket. • The position of the pressure vessel has to be levelled by planning plates below the base of pressure vessel. • Now check the alignment and level of pressure gauge using spirit level gauge. After adjustment levelling can be done by adding or removing the packing plates. • After confirming the pressure vessel is properly aligned and levelled anchor the bolts with rich mixture of concrete is taken and levelling is done. • After that level is again checked so as to consider if any packing plate is to be added at the base of the pressure vessel. • If necessary a hydro test of pressure vessel is carried out to check for any leakages at a particular point.		

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b.	**Care in Handling of loads:** • Never use damaged / defective slings. • Never use kinked sling legs. • Never load slings in excess rated capacity. • Attach sling securely to loads. • Pad/ protect slings securely to loads. • Keep suspended load clear for obstructions. Care for enviromental factors • Before lifting or carrying, plan out your lift. • Be aware of extreme temperatures that can affect lifting and material handling. • . Low visibility or poor lighting increases the chance of trips and falls. • Enviromental temperatures affect the ropes and sling that is used for lifting and make them damaged • Use appropriate ropes and slings depending on the temperature working • Use mechanical means (e.g. hand trucks, pushcarts, etc.) when possible for heavier or awkward loads.	**4m for handling and 4 m for environ mental factors**	**8m**
c	Advance Planning: It is the planning in advance of all the reuirements that is reuired before erecting and installing process equipments like	2m for advance planning and 6m for exp.	**8m**

making availability of drawings, its dimensions, scheduling the man power and material etc.

Various activities performed in Advanced planning before erction and installation of process equipments are as follows:

- Availability of everything requires drawing, giving a detailed dimensions, weight of equipment, etc. that has to be erected.
- Drawing for foundation and erection manuals i.e instructions for the erection and installation should be provided.
- Layout drawing of the site indicating the position of material handling equipments other utilities, raw materials, etc. should be prepared for good housekeeping.
- The erection schedule specifying the time required in material handling should be made.
- A scheduled man power requirement for installation particularly in regards of fitter, welder, rigger, etc. is to be planned as erection and installation is highly skilled and specialized job, hence a proper selection of man power is required.
- A schedule for estimated cost for erecting is to be prepared in order to control the cost of the project.
- Arrangement of safety equipments, gloves, shoes, goggles should be made available at site according to work force.

Arrangement for receiving and unloading the material, first aid

	kit, food, ventilation are to be made available at the site.		
Q.6.	**Attempt any FOUR**		**4 x 4**
a.	Benefits of accident prevention -Regular plant maintenance -Good management and safety on site -regular inspection of installation with repair and replacement of component whenever necessary. -The work management should control the hazard installation by the management.	4m	**4m**
b.	Use of protective equipments are as follows: The purpose of personal protective equipment is to reduce employee exposure to hazards safety glasses are effective in preventing eye injury from chemical splashes, impact, dusty environments and welding,flying objects etc Earplugs and earmuffs are used as hearing protection by the employers, Use proper slings and ropes according to the requirement otherwise it may cause damage to slings or ropes and may cause accidents. Leather gloves are used to protect their hands from Skin absorption of harmful substances ,etc. Protective clothing safety jackets or apron and helmet is used to protect the human body from accidents and other injuries like falling and flying of objects, risk of injury from electrical shocks etc. Employees who face possible foot or leg injuries from falling	4m(1m per point)	**4m**

	or rolling objects or from crushing or penetrating materials should wear protective footwear.		
c.	Wires are designated by using two no's "MxN" Where M- indicates no of strands N indicates no. of wire in each strand e.g. 6 x 7 Where 6= number of strands 7 = Number of wire in each strand. Including the above given For steel wire rope the following is the specification: Length for example = 200 M of coil or 300 M of coil Grade of Steel Size = diameter Lay: - regular lay or long lay Performed or not Galvanized or black Similarly in natural fibre rope the following is the Specification: Grade: - it denotes the quality and strength. Size: - it denotes the circumference diameter which has to be	4m	**4m**

	specified Construction:- 3 stranded or 4 stranded Length:-500 m of coil Lay:-Lay right or left lay		
d	Whipping of ropes -it is a process of firmly binding with a small string or twine along with a small string or twine along with a rope at the end so that the open end do not open out or broom out. The whipping can be made neat and permanent by tying it off or sewing it at the ends of the twine through the rope. It is suitable for synthetic fiber rope including 3 strand rope and four strand rope. Seizing of ropes -the method of fastening of two ropes or parts of same rope together by a twine sufficiently strong enough to prevent them from moving with respect to each other and withstand respect to each other and withstand a strain under loading. -Seizing are a class of knots used to semi permanently bind together two ropes, two parts, of same rope or a rope and another object.	4m(2m for seizing and 2m for whipping)	4m
e	Wire rope attachments Shackles It is U shaped piece of metal secured with the bolt across the opening or hinged metal loop secured with quick release pin mechanism it is primary used in all mechanism	4m (2m for any one)	4m

	uses it is primarily used in boats or ships and industrial crane rigging. OR Thimbles When a wire rope assembly is terminated with an eye or loop at the end a thimble is inserted to form the eye of the loop before the rope is secured it protects against wear and deformation of the rope eye. Design with proper bending radius to maintain rope strength and provide longer service life the thimble prevents the load from coming into direct contact with the wire. when the wire rope is terminated with the loop there is a risk that it will bend too tightly especially when the loop is connected to a device that concentrates a load on literally small area .Athimble can be installed inside the loop to preserve the national shape of the loop and to protect the cable wire. uses Wire rope thimbles are used in wire rope assemblies to keep an eye from being crushed OR Hooks A rod is bent is curved shape typically with one and free and other and screwed into a rope or same other attachment. a hook is Equipped with safety latch to prevent the disengagement of the lifting wire rope or rope to which load it is attached. Use		

	used to secure one end of a rope. Used to prevent the disengagement of the lifting wire rope sling, chain or rope to which the load is attached OR Wedge socket : it is a basket made of cast Steel the pin diameter and the jaw opening allows wedge socket to be used in fitting needs to be replaced frequently as a load increases the wedge becomes more secured gripping the rope tighter use it is used for lifting heavy components safely. OR Cross clips Across clip clamp used to fix loose end of rope to another end and two ropes can be clip together with the help of cross clips. Uses It is used so that the 2 or more than 2wires don't get entangled and finally form a knot		
f	<u>Polypropylene ropes</u> This rope is most popular and is all purpose rope for most of the average consumer. It is lighter in weight as compared to other fibre rope. The strength of the slope is almost similar to polyester rope. It stretches to about 0.5 % of its original length under loading. It is resistant to water and less resistant to chemicals as compared to other synthetic fibre rope. Uses	4m(3 m for exp and 1 m for uses)	**4m**

	Polypropylene rope is particularly suited for **use** around water and will not rot due to water and is resistant to mildew. Because **polypropylene** floats, it is **used** to designate swimming lanes in pools		