SUMMER-16 EXAMINATION

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 judgement 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.

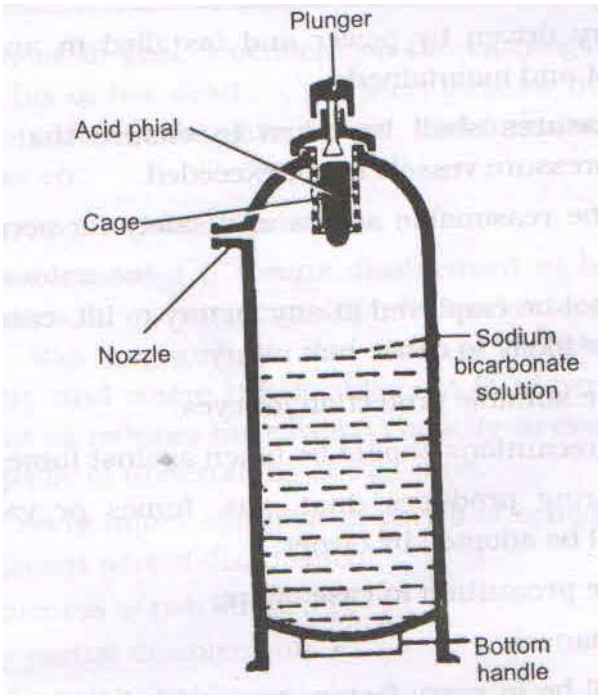
Q No.	Answer	marks	Total marks
1-A	Any 3		12
1A-a	**Hazard:** A hazard in anything in the work place that has the potential to harm people. It cal include objects in the workplace such as machinery or dangerous chemicals. **Types of hazards** : 1) Mechanical hazards 2) Electrical hazards 3) Noise hazards 4) Radiation hazards 5) Explosion hazards 6) Toxic hazards 7) Chemical hazards	1 3	4
1A-b	**Sources and protection of noise hazard:** **i) Reduction at source:** wherever possible it would be advisable to reduce the noise at the source itself.eg change the bearings if it makes noise due to wear. **ii) Vibration isolation:** In case of machine like reciprocating compressors and power presses, the mechanical vibrations are transmitted through the structures, walls and the floor which increases the noise level at the workplace. Reduction of noise levels can be achieved by, a) Using vibration resilient mounts to fix the machine to foundations. b) Special heavy foundations with a large weight compared to the weight of machine. **iii) Vibration Damping:**Machine parts, ventilation duct cause noise in this	1 mark each for any 4	4

	manner. Thenoise in these cases can be reduced by damping- by stiffening the member. **iv) Silencers:** Where noise due to movement of gases or air is the problem, silencers are the right solution. Silencers can be used at the inlet/outlet of compressors, exhausts, release of steam and gases and pressure relief valves of pneumatic machines. **v) Noise insulation:**It may be necessary to insulate the source from all the sides although insulating two or three sides also give reduction of a lower degree. **vi) Noise absorption:** Noise absorption material, normally soft and porous, prevent reflection of noise and also convert some of the noise energy into heat energy.		
1A-c	**Different respiratory equipments used as personal protective equipments in a chemical plant are:** 1. Air Purifying Type a. Mechanical filter respirators: b. Canister gas masks: c. Chemical Cartridge Respirators: 2. Air Supplied Type: This includes- a. Air line respirators: b. Fresh air or Suction Hose Masks: 3. Self Contained Breathing Apparatus: These are mainly of three types. a. With compressed air or oxygen cylinder b. Oxygen rebreathing or recirculating type c. Oxygen regenerating type	4	4
1A-d	**Comparison on respiratory and non respiratory protective equipment:**		4

	1. Respiratory protective equipment should only be used as a final resort to achieve health and safety, whereas non respiratory protective equipment are to be used compulsorily when working in a plant. 2. Respiratory protective equipment should be selected as the per the nature of environment whereas non respiratory protective equipment are same in all environment.	2 2	
1-B	Any 1		6
1B-a	**Sources of Radiation Hazard** : Nuclear Industry, Hospital (X-ray division)are some industries where radiation hazard takes place. The radiation is produced when atoms of natural radio active material decay or split, generating streams of photons vibrating at enormous speeds in wavelike form. Radiation has two basic forms: ionizing and nonionizing. In chemical plants workers may be exposed to various forms of nonionizing radiation. Radiation hazards occurred during testing of nuclear weapons, establishment of nuclear power plants, mining and refining of plutonium and thorium and preparation of radioactive isotope.	6	6
1B-b	**Various protections used against Eye:** Protecting eyes and faces from physical, chemical and radiation hazard are of prime importance. These protective devices are available in various types and styles. Selection should be made depending upon the nature of hazards involved. Welding shield are made of non-flammable material, are opaque to dangerous radiation and are poor conductors of heat. Face shields protect face and neck from flying particles, chemical splashes etc. Tinted transparent plastic shields protect against glare. The head band of the face shield should be such that the face piece can be pushed upwards when so required.	3	6

	In face and eye protection equipment, laminated lens should never be used. The most important thing in eye protection device is that the lens, whether glass or permanent plastic, should be optically correct and completely free from flaws and distortions. These should be comfortable for wear. These should be cleaned and kept in a good state of repair regularly and all workers should be trained for proper use of such devices. **Various protections used against Head:** There are four widely used types of head protection. 1. Industrial safety helmet s which can protect against falling objects or impact with fixed objects. 2. Caps, helmets etc. which can protect the scalp and hair from entanglement or can protect the head from contamination with toxic or nuisance dust, or protect from dirt carried within the hair. 3. Industrial scalp protectors such as Bump Caps can protect process workers from striking their heads against fixed objects when working in confined spaces. 4. Crash helmets, cycling helmets and climbing helmets which are intended to protect wearers should they be involved in a fall.	3	
2	Any 4		16
2-a	**Precautions taken against electrical hazards:** The danger of injury through electrical shock is present whenever electrical power is used. 1. All electrical should be adequately insulated, grounded or isolated to prevent bodily contact with any source of dangerous potentials. 2. To prevent electrical shock, ensure that all equipment are properly grounded. 3. To reduce the risk of shock, do not contact any electrical components,	1 mark each for any 4	4

	and keep the work area dry. 4. Check all equipment regularly and wear the proper protective equipment when working with high voltages or currents. 5. The primary effects of electrical shock are due to current actually flowing through the body. Electrical burns occur when the body completes a circuit connecting the power source with the ground. Although the resistance of dry , unbroken skin to electrical current is relatively high, the amount of current necessary to kill a person is small. Therefore it is easy to exceed lethal levels of current flow, especially if the skin is broken, wet or damp with sweat.		
2-b	**Personal protective equipment: (any four)** **Ear Plug** : It is personnel protective device for ear which is put inside the ear. They are worn in the ear canal, sealing the entrance to the ear **Ear Muffs** : It is again a personnel protective device for ear which is placed on the ear thereby covering the ear completely.This can be worn over the head, behind the neck or under the chin. The cups may also be attached to some safety helmets by adjustable side arms. **Gloves for hand and arm protection**: To safeguard workers there will be purpose-made gloves, supplied by manufacturers specializing in products , capable of protecting them from the hazards. **Helmets, hard cap for head protection** : Industrial safety helmet can protect the worker against following objects or impact with fixed objects. Caps and helmets protect the head of contamination with toxic substance.	1 mark each	4

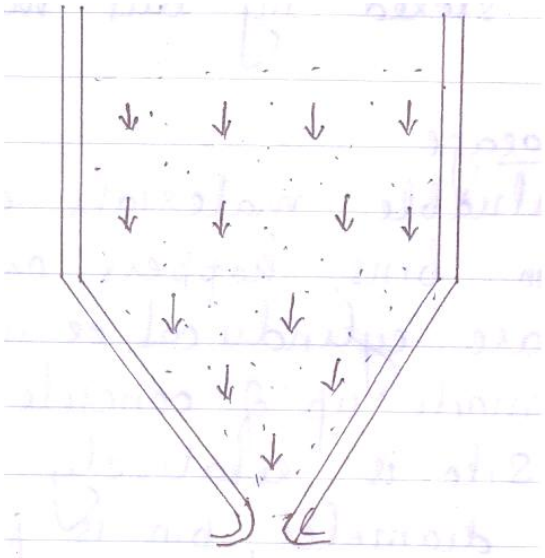
	Safety boot or shoes for foot protection : The safety boot or shoe is the most common type of safety footwear, and would normally have a steel toe cap. It helps to protect the feet from corrosive or toxic materials. **Goggles for eyes protection**: Goggles projects the eyes from dust , gases, welding arc , lesser light, toxic or chemical substances. **Apron/ lab coat** for body protection		
2-c	**Dry chemical extinguisher:**  **Working** :On fires involving either liquids in containers or spilled liquids, direct the jet towards the near edge of the fire and with rapid sweeping motion, drive the fire towards the far edge until all the flames are extinguished. On fires in falling liquids, direct the jet at the base of the flame and sweep upwards. On	2 2	4

	fires in electrical equipments, direct the jet straight at the fire. Where the equipment is closed, direct the jet into any opening with the object of penetrating the interior.		
2-d	**Objectives of Safety Audit are :** 1. Confirm that safety, health, fire and environmental program activities and controls are in place and functioning. 2. Verify that the facility is in compliance with internal benchmarks and government regulations. 3. Assess past and current practices to identify and correct safety impediments which may result in personal injuries, property damage or business interruption. **Safety audi**t is essential to determine the company's safety and is a proactive process by which and organization is able to continually evaluate and monitor the progress of its safety and health programs. Safety audit involves the examination and qualitative assessment of all activities such as research and development, design, occupational health and hygiene, environmental control, products and processes, storage and transportation, labeling and packing, operational measures, maintenance, housekeeping and training. Auditing will promote contact with individual workers as a manifestation of the management interest and concern relating to safety. It is also essential that an appropriate member of the management is directly involved in auditing and implementation of the audit report. Audits are designed to rate an organization's total safety and health program, identify it's strength and weakness , show where improvement are needed , and obtain commitment and target dates for correcting problems.	1 mark each	4
2-e	**Bin Storage:** Valuable materials are stored in bins, hoppers or siloswhich are cylindrical or rectangular vessels made up of concrete or metal. Silo is relatively tall and small in diameter, bin is fairly wide and short, hopper is a small bin with	4	4

sloping bottom which is used to temporarily store the solid before feeding the solid to a process. Storage bins or hoppers are generally classified based upon the flow pattern of bulk material discharged- core flow, mass flow and composite flow. The actual pattern of flow within the container depends upon the nature of bulk solid concerned as well as on the shape of the hopper.

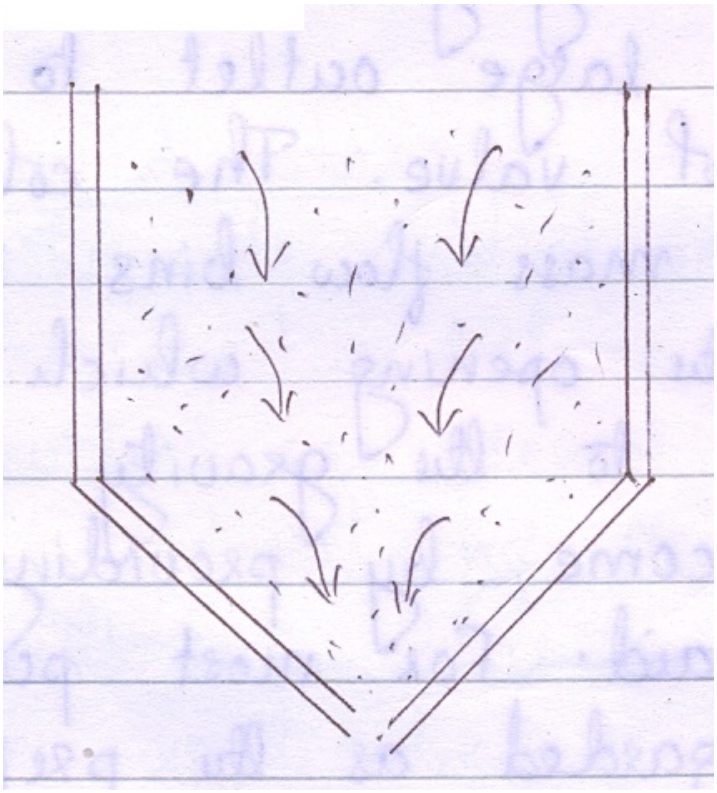
Mass flow bins

Working: These are characterized by shallow angle of converging section. In mass flow bin, every particle of the bulk material in the hopper begins to move when the outlet is opened. Hence mass flow bins has steep wall slopes of the converging sections. It has relatively large outlet to the feeder or flow control valve. The cohesive solids stored in mass flow bins form cohesive arch at the opening which acts as the obstruction to the gravity flow of material. It is overcome by providing some discharge aid.



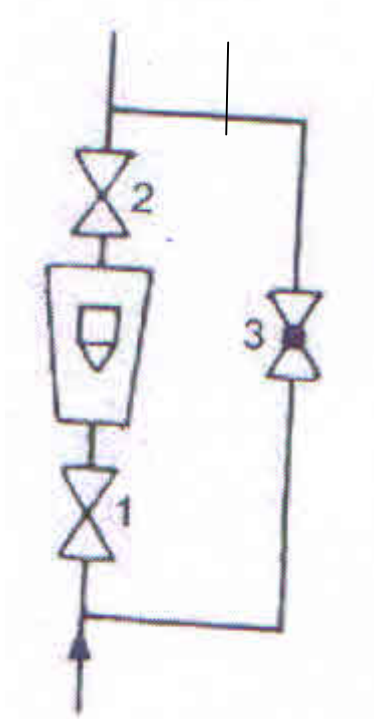
Core flow bins

Construction: In core flow bins the discharge of the bulk solid is essentially irregular with the material flowing through a vertical channel called rat hole,

	which forms within the bin. The material around this central channel is stationary. The main characteristics of core flow bin are 1. First – in- last-out 2. The material gets spoil or degraded by caking in the non flow region. 3. The material which segregate on charging, there is no remixing in the hopper. 4.Non uniform flow is obtained. 		
3	Any 4		16
3-a	**Causes of explosion hazard:** 1. External source of energy **2.** Internal exothermic reaction in which large volume of gases are produced.	1 mark each for any 4	4

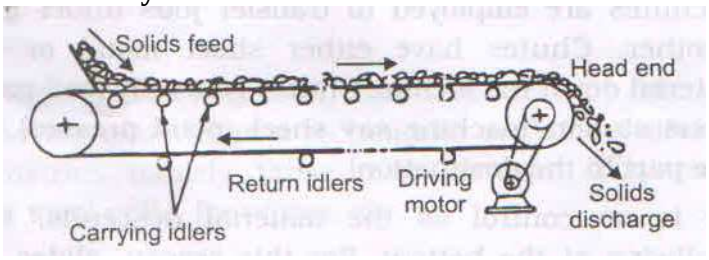
	3. The result of the release of internal energy during an uncontrolled reaction. **4.** High pressure inside the vessel due to heating 5. Dust explosion		
3-b	**The objectives of material handling are:** i) Safety in material handling. ii) Better housekeeping iii) Minimization of fatigue. iv) Speed and economy in movement of materials. v) Minimization of cost of material handling. vi) Improvement in productivity. vii) Greater utilization of material handling equipment. viii)higher plant efficiency	1 mark each for any 4	4
3-c	**Types of plant maintenance:** **1.** Preventive maintenance **2.** Scheduled maintenance **3.** Predictive maintenance 4. Breakdown maintenance	1 mark each	4
3-d	**Objectives of Preventive Maintenance are :** i) To minimize the possibility of unanticipated production interruption or major breakdown by locating or uncovering any condition this may lead to it. ii) To make plant equipment and machinery always available and ready for use. iii) To maintain the value of equipment and machinery by periodic inspection repairs etc. iv) To maintain the optimum productive efficiency of the plant equipment and machinery. v) To maintain the operational accuracy of the plant equipment.	1 mark each for any 4	4

	vi) To reduce the work content of the maintenance jobs. vii) To achieve maximum production at minimum repair cost. viii) To ensure safety of life and limbs of the workmen.		
3-e	**ON LINE MAINTENANCE**; In a chemical plant it is normal practice to do on linemaintenance work. This avoids total shutdown of the equipment or plant. This is possible if proper pipe fittings are installed at the time of erection .e.g. suppose there is a rotameter in a pipe line. If we desired to replace a brokenglass pipe of rotameter we can closed valve 1 and 2 and open 3 & divert thefluid through by-pass line. After replacement of the glass pipe in the rotameter close valve 3 and open 1 & 2. Thus it is possible to attend maintenance jobs in the line without stopping the production.	4	4

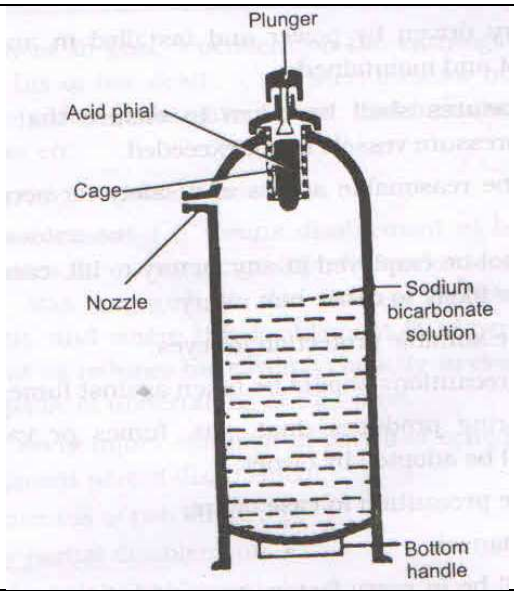
			
4-A	Any 3		12
4A-a	**Fire:** Fire is defined as the self-propagating reaction of a material with oxygen in airwhich results in rapid energy release usually in the form of light or heat. Three types of fire in process industries are **Fire may be extinguished** by withdrawal of flammable contents, interruptingflammable flow, isolating fuel from air, heat removal to below reactiontemperature. **Withdrawal of flammable contents** can be accomplished by 1).Blowing down the vessel and piping contents (2)Pump out or 3)drainingFlammable flow may be interrupted by the shutdown of pumps, closing ofvalves. **Isolation of flammable flow** from the air is accomplished by blanketing withsteam or water spray, foam, CO_2 etc.	1 3	4
4A-b	**The causes of equipment breakdown are:**	1 mark	4

	a) Failure to replace worn out parts. b) Lack of lubrication. c) Neglecting cooling system. d) Indifference towards minor faults. e) External forces e.g. too low or too high voltage, wrong fuel etc. f) Indifference towards equipment vibrations, unusual sounds coming out of rotating machinery, excessive heating of equipment etc.	each for any 4	
4A-c	**Palletization** is the method of storing and transporting goods stacked on a pallet and shipped as a unit load. It permits standardized ways of handling loads with common mechanical equipment such as fork lift trucks. **Based on design pallets are classified as:** i) Two way pallets ii) Four way pallets **Based on basic construction style pallets are classified as** i) Single face pallet ii)double face pallet **Based on construction pallets are classified as** i) Flush stringer ii) Single wing iii) Double wing	1 1 1 1	4
4A-d	Methods of liquid storage: **Underground storage**: *Liquids are stored underground in porous media between impervious rocks. Cavities are formed in salt domes by dissolving the salt and pumping it out. This method has application for storing petroleum product, both liquid and gasses. Hazardous or radioactive materials are stored in underground tunnels or storage tanks	4	4

	Open atmospheric tanks: *Open atmospheric tanks are used for storing liquids that will notbe harmed by water, weather or atmospheric pollution. **The closed tanks:** *The closed tanks have fixed or floating roof. Fixed roofs are either domed orconed with intermediate supports. *Fixed roof atmospheric tanks require vents to prevent pressure changes whichwould result from temperature changes and withdrawal or addition of liquid. *Vent loss is prevented by using variable volume tanks which have floating roofs.Floating roof must have a seal between roof and tank shell. *For storing liquids under pressure, the tank has curved surface in the form ofsphere ellipsoid shapes. *Plastics or glass coating are applied to the corrosive liquids which are to be stored in glass lined tanks.		
4-B	Any one		6
4B-a	**Procedure for safety auditing:** Safety audit is carried out by a team whose members are not involved in the plant or activity being audited. The expertise of the team should be compatible with the type of audit. It is beneficial to include the managers of other plants or units in an audit team as well as one previous auditor of the same unit. Audits are carried out in a formal way using a carefully drawn up checklist of items and descriptive standards for each item. A line manager or supervisor of the plant under audit should be asked to accompany the auditor inspecting it. He should be informed of all corrections and improvements required by the auditors so that he can start taking the necessary steps before the audit report is submitted to management. The main object of inspection should be to	6	6

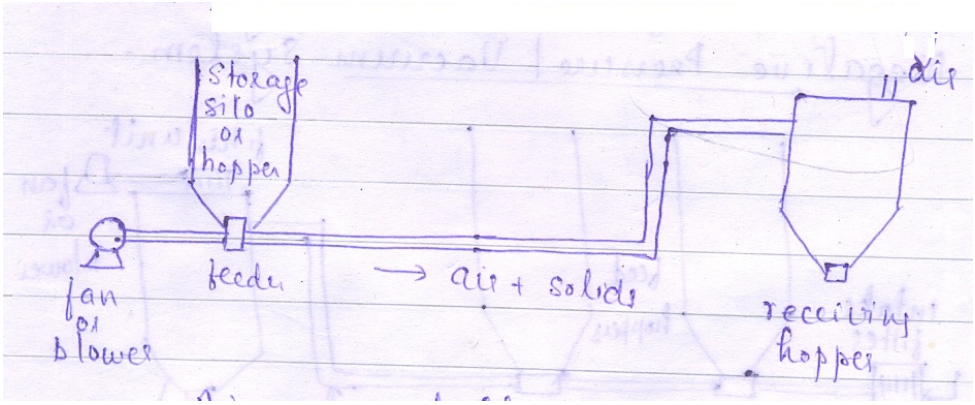
	determine whether the layout design and condition of equipment and protective features are up to standard and to ensure that the protective features will work in an emergency. The auditing should give a verbal report to the management on completion of audit followed by a clear and concise written report within two weeks. The main aspects of safety audit are: i)Identification of possible hazardous situation ii) Assessment of consequences associated with these hazards iii) Selection of measures to minimize consequences. iv) Implementation of these measures within the organization v) Monitoring and documentation of the changes. The methodology generally accepted and adopted for safety audit is the preparation and submission of a questionnaire or checklist to the plant management		
4B-b	**Belt conveyor:**  **Working:** Conveyors are gravity or power devices commonly used to move uniform loads continuously from point to point over fixed paths. Belt conveyor as shown in figure consists of an endless moving belt of flexible material, stretched between two drums / pulleys and supported at intervals on idler rollers. The pulley that drives conveyor belt rotating is called drive pulley or transmission drum; the other one only used to change conveyor belt movement directions called bend pulley. Drive pulley is driven by the motor through reducer and conveyor belt	2 4	6

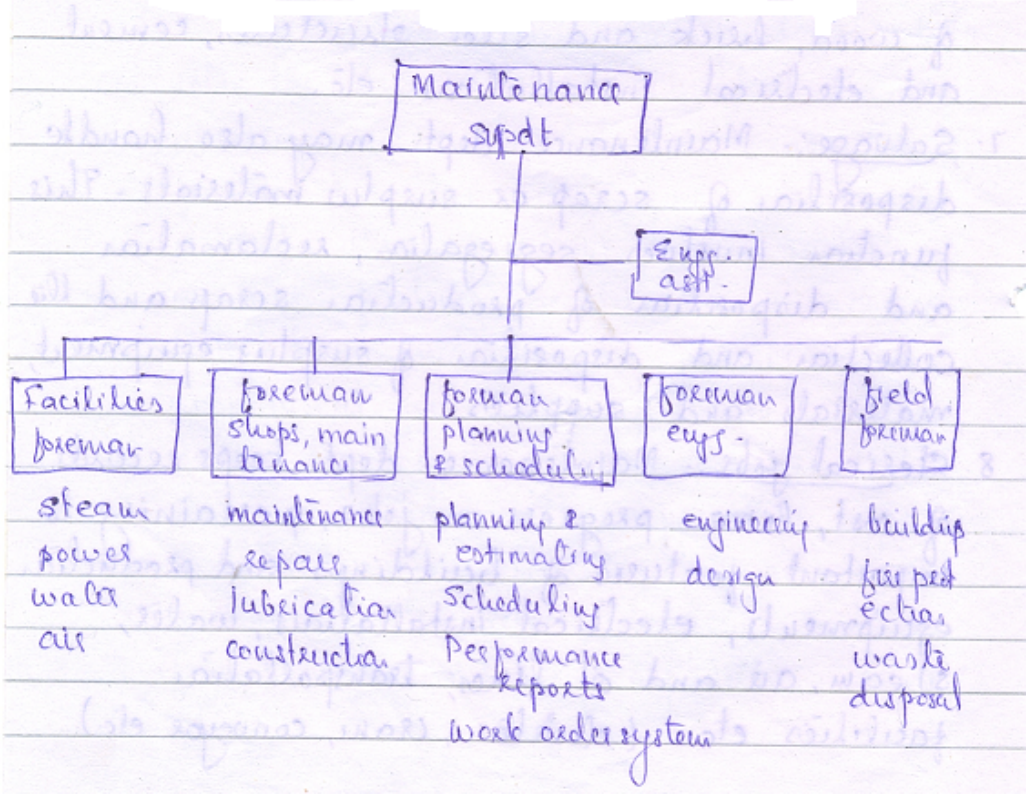
	dragging relies on the friction drag between the drive pulley and the conveyor belt. The drive pulleys are generally installed at the discharge end in order to increase traction and be easy to drag. Material is fed on the feed-side and landed on the rotating conveyor belt, then rely on the conveyor belt friction to be delivered to discharge end. Belt Conveyors are the most commonly used type of equipment for the continuous transport of solids. They can carry wide range of materials economically over long & short distances, both horizontally and at an appreciable angle.		
5	Any 2		16
5-a	**Construction & Working of Soda Acid Fire Extinguisher :** **Construction:** In soda acid fire extinguisher the material used are dry chemical, bicarbonate of soda designed to be dissolved in water and a liquid chemical sulphuric acid. Sulfuric acid is kept in the acid bottle and sodium bicarbonate in the outer body. Nozzle is provided near the top and aplunger at the top. **Working:** When the plunger is struck, it breaks the acid bottle. The sulfuric acid and the sodium bicarbonate solution react together to release CO_2 gas. The gas generated creates pressure, which forces the water out of the extinguisher nozzle. Before using these extinguisher, it is advisable to check whether these extinguishers are upright type or turn over type. Direct the jet at the base of the fire and sweep it across the area of fire. Attack a vertically spreading fire at its lowest point and follow it up. Search out for hot spots and ensure that the fire is completely extinguished and that it is not smouldering.	2 3	8

		3	
5-b	**Functions and responsibilities of plant maintenance department:** 1)Inspection 2)Engineering 3) Maintenance 4) Repair 5) Overhaul 6)Construction 7) Salvage 8) Clerical work **1)Inspection:** i) Inspection of the plant facilities to examine their condition and to check for repairs needed. ii) Inspection to ensure the safe and efficient operation of plant equipment and machinery. **2)Engineering :** i) Engineering involves alternations and improvement in existing plant equipment to minimize breakdown. ii) Engineering and consulting services to production supervision. **3) Maintenance** : i) Maintenance of existing plant equipment. ii) Engineering and execution of planned maintenance, minor installations of equipment building and replacements.	1 mark each	8

	4**) Repair:** i) To carry out corrective repair to alleviate unsatisfactory conditions found during preventive maintenance inspection. **5) Overhaul:** i) Overhaul is a planned, scheduled reconditioning of plant facilities such as machinery etc. ii) Overhaul involves replacement, reconditioning, reassembly, etc. **6)Construction :** i) In some organization, maintenance department is provided with equipment and personnel and it takes up construction job too. **7) Salvage :** i) Maintenance department may also handle disposition of scrap or surplus materials. **8) Clerical work:** i) Maintenance department keeps records at i) of costs, ii) of time progress on jobs pertaining to important features of building and production equipment.		
5-c	**Start up of a plant:** A chemical plant is started at two different times, 1. When it is constructed, erected and to be commissioned first time for production. The procedure here to be followed is to take water in the plant to check the fluid flowing through equipment and pipelines without any leakage, at the desired flow rate, pressure and temperature. If any leakage is observed, it can be rectified. This is the safest and cheapest way of checking the functioning of the plant equipment in total. 2. When plant is stopped for annual major shutdown, then the procedure to be followed for start- up of a plant is	4	8

	i) To take water in the plant to check the fluid flowing through equipment and pipelines without any leakage, at the desired flow rate, pressure and temperature. If any leakage is observed, it can be rectified. Thus is the safest and cheapest way of checking the functioning of the plant equipment in total. **ii)** Once it is assured that fluid flow takes place without any problem, the total plant water is drained off and water is removed and then slowly loaded in stepwise and retched to desire capacity in stepwise. It is always advisable to operate the plant with 50% capacity for few days and after full satisfaction of plant working, it is taken up to full capacity	4	
6	**Any 2**		16
6-a	**Pneumatic conveyor:** **Different types are:** 1. Positive pressure pneumatic conveyor 2. Negative pressure pneumatic conveyor 3. Pressure-vacuum system 4. Fluidising system 5. Blow tank **Positive Pressure or Vacuum Systems:** Air or suitable gas is blown along a pipeline, which carries the bulk solid to be conveyed. Fan or blower is used to deliver air into the pipeline. Feeders are used to introduce the material into the pipeline against the conveying gas pressure. Gas/ solid disengaging device is used at the discharge end of the pipeline, which separates the conveyed bulk solid from the conveying air stream. The cyclone separator or bag filter units are used for this purpose. The clean gas/ air coming out from these devices is fed back for conveying purpose. These systems are useful for picking up solid from one point band delivering	3 5	4

	them to various discharge points. They are used for free flowing materials upto ¼ inch size. But it is unsuitable for multiple pick up points on account of excess air leakage.  		
6-b	**Block diagram of organization of maintenance department**	8	8

			
6-c	**Predictive maintenance:** Predictive maintenance makes use of human sense or other sensitive instruments such as audio gauges, vibration analyser, amplitude meter , pressure , temperature and resistance strain gauges etc. to predict trouble before the equipment fails. Unusual sounds coming out of a rotating equipment predict a trouble , an electric cable excessively hot at one point predict a trouble. Simple hand touch can point out many unusual conditions and thus predict a trouble. In predictive maintenance , equipment conditions are measure periodically or on a continuous basis and this enables maintenance men to take a timely action such as equipment adjustment , repair or overhaul. Predictive maintenance extends the service life of an equipment without fear of failure. **Four senses adopted for predictive maintenance technique** (Human senses) :	4	8

	1. Ear :eg. Unusual sound coming out of rotating equipment. 2. Eye :eg. Excessive vibration of equipment or dislocation of moving part. 3. Touch :eg. Excessive temperature of equipment. 4. Smell :eg. Unusual smoke coming out of equipment. **Four sensitive instruments adopted for predictive maintenance technique:** 1. Audio gauges :eg. Unusual sound coming out of rotating equipment. 2. Vibration analysor: eg. Excessive vibration of equipment 3. Amplitude meter:eg. Excessive temperature of equipment. **4.** Pressure, temperature and resistance strain gauges: eg. Excessive temperature of equipment. **Scheduled maintenance:** Scheduled maintenance is a stich-in-time procedure which is aimed at avoiding breakdowns. Breakdowns can be dangerous to life and hence should be minimized. This method of maintenance incorporates inspection, lubrication, repair and overhaul of certain equipments which if neglected may result in breakdown. Scheduled maintenance practice is generally adopted for overhauling of machines, cleaning of water and other tanks, white washing of buildings etc.	4	