SUMMER-17 EXAMINATION

Model Answer

Subject code 17558

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
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	4
1A-b	**Dangerous properties of chemicals** 1. Irritation of eyes, conjunctivitis, irritation of noise and thought. eg. Ammonia. 2. Blood cancer, eg. Irritation, burning, anaesthetic effects eg. Benzene. 3. Irritation of eyes, mucous membrane , depression , mental deterioration. eg. Bromine. 4. Fire hazard, explosion hazard eg.CO, CS_2 5. Corrosion hazard eg. Bromine. 6. Highly reactive hazard eg. Phosgene.	1 mark each for any 4

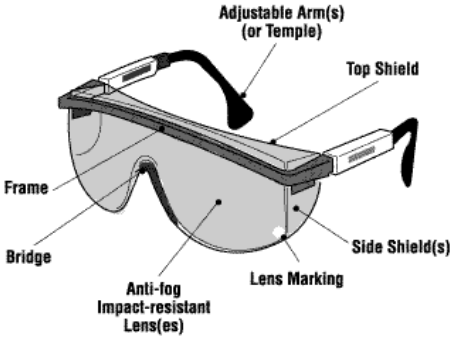
	7. Disaster potential hazard eg.SO_2, naphtha H_2S.	
1A-c	**Personal protective equipment: (any four)** **Ear Plug** : It is personnel protective device for ear which is put inside the ear. They are worn in the ear canal, sealing the entrance to the ear **Ear Muffs** : It is again a personnel protective 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. **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	1 mark each

	chemical substances. **Apron/ lab coat** for body protection	
1A-d	**Maintenance and replacement of personal protective equipment:** 1. The employer is obliged to maintain the equipment provided or replace equipment that becomes worn or defunct. Hard hats, being made of plastic will deteriorate over time. Their age of life expectancy will be advices by the maker so that the employer can budget and arrange to have them replaced at the end of their life. 2. Some personal protective equipment is for on-off use, eg. Paper boiler suits, disposable gloves or disposable respiratory protective equipment such as face masks. 3. Some equipment will have a life expectancy of a few years. If this is the case then employers should arrange for it to be adequately cleaned and sterilized so as to reduce cross infection between users. 4. Non disposable equipment must be stored in adequate accommodation to protect it from deterioration, damage, or harmful effects such as damp, sunlight, fungal attacks or general abrasion.	4
1-B	Any 1	6
1B-a	**Sources of radiation hazard:** **Natural sources:** They are mainly of cosmic radiation received from from the space, and the naturally occurring radioisotopes present in the environment and those contained within the body of the organisms. Another source is the presence of radionuclides in the lithosphere, hydrosphere	3

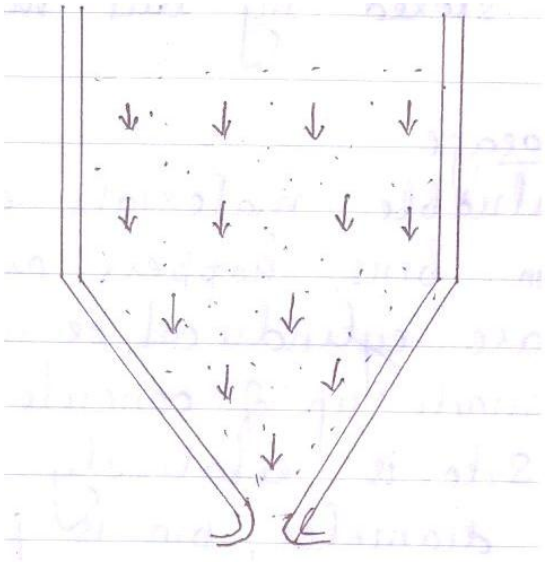
	and atmosphere. **Man made sources:** 1. Nuclear weapons 2. Atomic reactors and nuclear fuel 3. Radioactive isotopes 4. Hospital (X-ray division) The radiation is produced when atoms of natural radio active material decay or split, generating streams of photons vibrating at enormous speeds in wavelike 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.	3
1B-b	**Noise Hazard** : Un wanted sound is called noise. Sound levels that cause hearing loss begin at 85 db. Hearing loss occurs more quickly with louder noise. High sound levels cause serious health risks. Hearing damage results from an exposure to loud noises over an extended period of time. Hearing loss accumulates over time and can not be reversed. **Protections used against noise:** Two types of hearing protections are available- ear plugs and ear muffs. **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. 2-12 dBA reduction can be achieved in noise levels by their use. Proper fitting of the plug is important.	2

	While a loose fit will give no reduction, a tight fit will make it uncomfortable. **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. The cushions are liable to degrade from mechanical abuse or sweat from the wearer and therefore need regular inspection and replacement. Ear muffs are of two types, circumaural and superaural. The former, which enclose the ears, are common and more effectiveexcept where spectacles with normal side- arms are worn. The latter, which are lighter, seal against the ears themselves and are less affected by spectacle frames. **Disadvantages of ear plug:** 1. It is difficult for a supervisor to check whether they are being used. 2. There is a hygiene problem when a worker decides to fit ear plugs when his hands are dirty. 3. The comfortable type tend to be displaced if the wearer moves his jaws sharply.	2 2
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	1 mark each for any 4

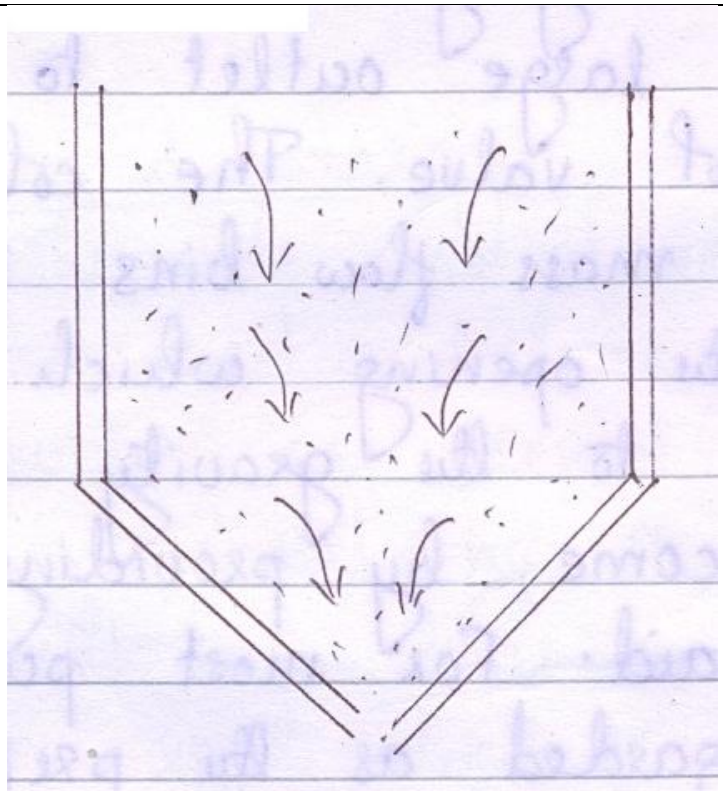
	prevent bodily contact with any source of dangerous potentials. 2. To prevent electrical shock, ensure that all equipment are properly grounded. 3. To reduce the risk of shock, do not contact any electrical components, and keep the work area dry. 4. Check all equipment regularly and wear the proper protective 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	**Diagram of non respiratory protective device(any 4)**   Helmet hand gloves	1 mark each

	  Ear plug Apron(suit)   Goggle Safety shoes	
2-c	**Safety audi**t **Types of safety audit:** 1. General: This is a facility -wide audit that focuses on basic hazards and their controls. Example: A review of the building's interior and	2

	grounds-overall housekeeping, condition of steps, parking lots etc. 2. Specific audit: This identifies safety hazards in a department or operation, or on a single piece of equipment. This is detail oriented and time consuming. Ex: inspecting compressed gas cylinders, hoses, nozzles etc. **Benefits of Safety Audit (any 2)** i) Safety audit can be used by management to uncover safety and health problems before personal injuries, property damage, or business interruptions occur. ii) A safety audit also serves as a visible process that management can execute to demonstrate to employees that they are interested in their safety. iii) A safety audit uncovers unsafe conditions and poor work practices, which are the principal causes of accident. iv) Safety audit can reduce illness and injuries, and associated medical, insurance and litigation. v) Safety audit can improve business operation. It can maintain, and in some instances, increases productivity, by reducing interruptions caused by accidents. vi) Safety audit identifies conditions where machinery, equipment or tools need repair or replacement, thus increasing the efficiency of the business operation.	1 mark each
2-d	**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	

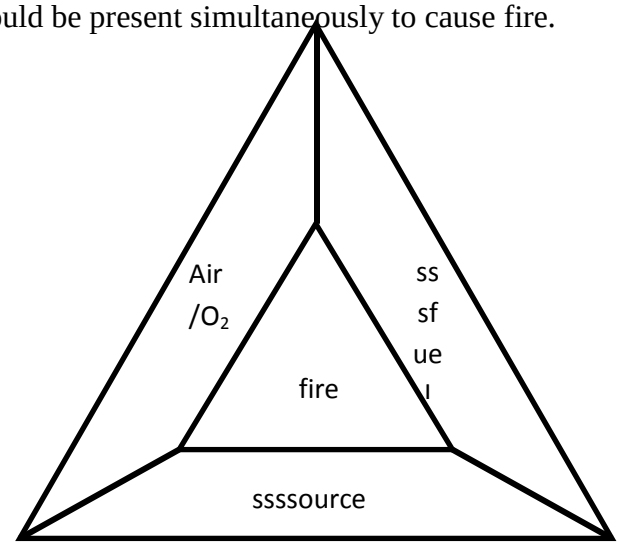
	small in diameter, bin is fairly wide and short, hopper is a small bin with sloping bottom which is used to temporarily store the solid before feeding the solid to a process. Storage bins or hoppers are generally classified based upon the flow pattern of bulk material discharged- **core flow, mass flow** 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.	1 3
	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. 	

	Advantages of Mass flow bins: i) Absence of channeling, surging and flooding. ii) Uniform and steady flow which is independent of the head of material in the bin. iii) The pressure across any horizontal section of the bin are uniform. iv) There are no dead regions within the bin. v) There is minimum segregation of bulk solid stored. **OR** **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.	



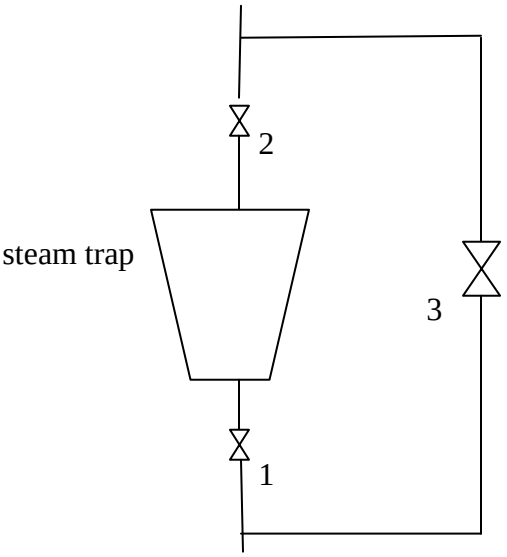
OR

Composite Flow: This is a combination of both –core and mass flow pattern. The upper section is designed for mass flow. This increases the storage capacity while still maintaining mass flow that also results in a greater uniformity of feed, at the outlet.

2-e	**Fire Triangle:** A fire can be caused and sustained by a fuel, oxygen or oxidizer and source of heat(ignition source).These three forms three sides of a fire triangle. It requires all three should be present simultaneously to cause fire.  **Fire may be extinguished** by withdrawal of flammable contents, interrupting flammable flow, isolating fuel from air, heat removal to below reaction temperature. **Withdrawal of flammable contents** can be accomplished by 1).Blowing down the vessel and piping contents (2)Pump out or 3)draining Flammable flow may be interrupted by the shutdown of pumps, closing of valves. **Isolation of flammable flow** from the air is accomplished by blanketing with steam or water spray, foam, CO_2 etc.	2 2
3	Any 4	16

3-a	**Physiological effects of electricity:** The primary effect of electric shock is due to current actually flowing through the body. Electrical burns occur when the body completes a circuit connecting the power source with the ground. If the skin is very dry, a high voltage may cause a severe burn but there may be no other damage. On the other hand, a lower voltage applied to wet skin could cause death, particularly if the current passed through heart, but there might be no sign of burning. Four different kinds of damage can result from the passage of an electric current through the body. First is burning close to the contact point particularly at high voltages. Second effect is that breathing becomes increasingly difficult or suffocation. The third and fourth type directly concerns the heart and may rapidly become fatal.	4
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	4
3-c	**Advantages of breakdown maintenance:** 1. It is economical for non critical equipments whose down time and repair costs are less this way than any other type of maintenance.	½ mark each

	2. It involves less administrative work 3. Requires few records 4. Requires small staff. **Disadvantages of breakdown maintenance** : 1) Breakdown generally occurs at inopportune time. This leads to poor, hurried maintenance and excessive delays in production. 2) Reduction of output. 3) Faster plant deterioration 4) Increased chances of accidents and less safety to both workers and machines. 5) More spoilt material. 6) Direct loss of profit.	½ mark each for any 4
3-d	**ON LINE MAINTENANCE**; In a chemical plant it is normal practice to do on line maintenance work. This avoids total shutdown of the equipment or plant. This is possible if proper pipe fittings are installed at the time of erection. If we provide a stand by pump in a process pipe line, it is possible to attend the faulty pump, without stopping the production by using a stand by pump. When a valve is to be attended for its maintenance by removing it from pipe line then blind flange is useful e.g. The suction side valve of a pump is provided with blind flange and the only suction valve can be removed for maintenance without loss of materials. When the pressure vessels like reactor, distillation column, evaporator is leaking then it is difficult to do maintenance work without stopping the production. When the insulation get damaged due to any reason, it is possible to attend it without stopping the production since insulation is fixed externally. Only precaution is to be taken if the pipe line or equipment is at high	2

	temperature. e.g. suppose there is a steam trap in a pipe line. If we desired to replace a steam trap, we can close valve 1 and 2 and open 3 & divert the fluid through by-pass line. After replacement of the steam trap close valve 3 and open 1 & 2. Thus it is possible to attend maintenance jobs in the line without stopping the production.  	2
3-e	**Objectives of Plant Maintenance :** 1. To achieve minimum breakdown and to keep the plant in good working condition at the lowest possible cost. 2. To keep the plant in good working condition at the lowest possible cost. 3. Machines and other facilities should be kept in such a condition which permits them to be used at their optimum capacity without any	1mark each

	interruption. 4. Maintenance division of the factory ensures the availability of the machines, buildings and services required by other section of the factory for the performance of their function.	
4-A	Any 3	12
4A-a	**Based on state of completion in the manufacturing process materials are classified as raw material, goods in process and finished goods.** i) Raw materials: Raw materials are the goods on which the manufacturing process will operate to produce saleable products. The finished goods of one manufacturer often become the raw materials of another. The characteristics of raw materials depend on the nature of industry. ii) Goods in Process: This category refers to goods which have completed some but not all of the manufacturing process. Typically a manufacturing process involves several operations utilizing different equipments , skills and materials. Goods in process are stored while awaiting the next manufacturing operation. iii) Finished Goods: These goods are those which have completed the manufacturing process and are stored in inventory to fill consumer orders.	1 1 1 1
4A-b	**Based on material of construction pallets are classified as** :- i)Expandable wood pallets ii) Metal pallets iii) Corrugated-metal pallets	½ mark each

	iv) All steel single face pallets v) One piece, formed metal pallets vi) wire mesh pallets vii) Cardboard pallets viii) Plastic pallets	
4A-c	**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 and 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. 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.	1 mark each for any 4
4A-d	. **Foam type fire extinguishers:** It is used to extinguish fire due to flammable liquids and vapors. In foam extinguishers, chemical foam is formed by a chemical reaction in which masses of bubbles of CO_2 gas and a foaming agent produce froth. To use these extinguishers, pull the plunger up and turn it right and left to rest on the cap. Turn the extinguisher upside down. A powerful frothy foam jet will be	1 3

	coming out. Direct this jet at the level of the burning liquid. The foam builds up and flows across the surface of the liquid. The foam can then cool the liquid surface, provides a barrier to exclude air and suppresses vapor formation. Thus foam can be effective in extinguishing the fire as well as preventing reignition. Also the physical ability of the foam to adhere to surfaces can also provide a high degree of protection from heat damage to surrounding structure and equipments.	
4-B	Any one	6
4B-a	**Solids are packed in different ways as:-** 1) Bags: The multiwall paper bags made from piles of Kraft paper are used for packaging of most palleted or powdered material. There are two commonly used bag designs, the open mouth type and the valve type. The Open-mouth bags have one end closed , while the other end is closed after filling the material. These bags are closed after filling the material mainly by sewing. The valve bags has both ends closed during the fabrication , the filling being done through a small opening in one coener of the bag. 2) Boxes: Bulk boxes of corrugated craft paper are used for dry, bulk products. A bulk box also called as bag in box, consists of a box within a box alongwith end pads, polythene bag liners and closing materials like tape, glue, staples etc. These boxes are reclosable but they require storage space for box components. 3) Drums: The fibre drums are used for storing dry solids and slurries, while metal drums are used for storing liquids. Advantages of drums are	1 mark each for any 6

	protection of contents, ease of enclosure and appreciable reuse-resale value. 4) Metal containers: Welded wire mesh containers are fabricated from welded wire collapsible containers having folding sides while rigid wire containers use additional vertical structural members to increase the strength of the containers. 5) Wood containers: Bins , boxes or crates are made of wood, which are used for mechanized handling and storage for solids having irregular shapes and granular materials. 6) Corrugated Cardboard containers: These containers consists of outer facing board, corrugated medium and inner facing joined by adhesive, The cardboard are usually made of fourdrinier Kraft, pulpwood or combination of reclaimed fiber and pulp. The corrugating medium is straw, reclaimed fibers or wood. 7) Tote boxes and bins: Tote boxes are used for smaller unit loads of smaller parts that can be moved manually through the operation or can be stacked in a larger container to become part of a unit load.	
4B-b	**Documentation of safety audit :** The safety audit must be documented in two major portions. The first part involves checklists; the latter part involves the final report. Checklists are an integral component of the overall safety audit. These forms should suit the organization and the type of safety audit (general and/or specific). In the planning stages, key employees should be involved to ensure that all safety programs, operations, and hazards are addressed. At a minimum,	6

	include checklists for housekeeping, smoking, personal protective equipment, machinery/equipment and hand tools, fire safety, electrical safety, and chemicals. At the end of this paper is a checklist that you can use to help you identity areas to include in your safety audit. The checklist covers general safety programs and regulatory compliance; facilities and equipment; and specific hazards and operations. The second portion of the documentation, the final report, identifies the safety audit findings, makes observations and recommendations, and offers an overall opinion. The report should provide detail on specific suggested enhancements to remedy deficiencies, and should highlight serious and "repeat" observations. The final report should be communicated to management in a timely manner. Management should take ownership of the audit results and should approve improvements to safety and health programs, processes, and equipment.	
5	Any 2	16
5-a	**Classification of fire:**	8

	Class	Description	Suitable type of extinguishes	
	A	Fires involving ordinary combustion materials like wood , paper, cloth etc where effect of water is essential to extinguish.	Soda acid	
	B	Fires in flammable liquids like oil, solvents, petroleum prod, varnish paint where blanketing effect in essential	Foam , CO_2, gas, dry chemical powder	
	C	Fires involving gaseous substances under pressure where it is necessary to dilute burning gas at a very high rate with an inert gas or powder.	CO_2 Gas, chemical power	
	D	Fires involving metal like Mg, Al K etc. where its burning is reacting to water and which require special extinguishing media or technique	Special powder	
	E	Fires involving electrical equipment where the electrical non conductivity of the extinguishing media is of prime importance	CO_2, gas, dry chemical powder but when the ele3ctrical equipmentsis dancercised. Even soda acid or foam is suitable.	
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.			1 mark each

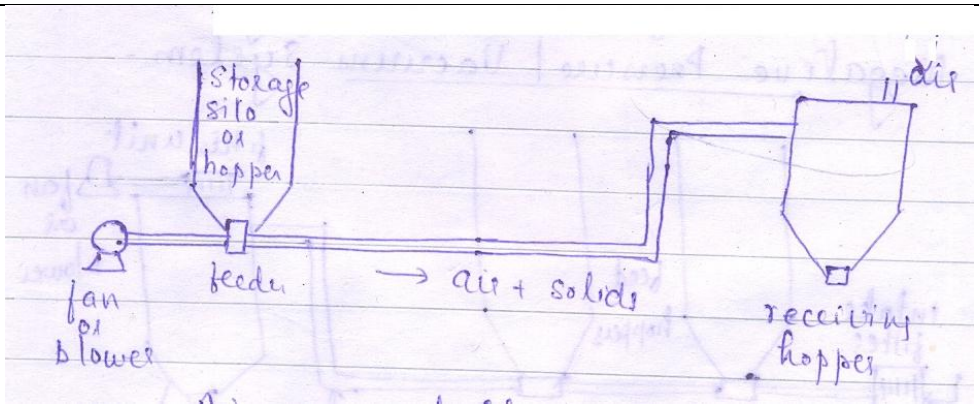
	2)Engineering : i) Engineering involves alternations and improvement in existing plant equipment to minimize breakdown. ii) Engineering and consulting services to production supervision. **3) Maintenance** : i) Maintenance of existing plant equipment. ii) Engineering and execution of planned maintenance, minor installations of equipment building and replacements. 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.	4

5-c	**Types of maintenance:** 1. Corrective or breakdown maintenance 2. Scheduled maintenance 3. Preventive maintenance 4. Predictive maintenance **Corrective or breakdown maintenance:** This method of maintenance implies that repairs are made after the equipment is out of order and it cannot perform its normal function any longer. In such situation, production department calls on the maintenance department to rectify such defect. The maintenance people checks into the difficulty and makes necessary repairs. After rectifying the fault, maintenance people do not attend the equipment again until another failure or breakdown occurs. **Advantages:** 1. It is economical for non critical equipments whose down time and repair costs are less this way than any other type of maintenance. 2. It involves less administrative work 3. Requires few records 4. Requires small staff. **Disadvantages**: 1) Breakdown generally occurs at inopportune time. This leads to poor, hurried maintenance and excessive delays in production. 2) Reduction of output. 3) Faster plant deterioration 4) Increased chances of accidents and less safety to both workers and machines.	2 6 marks for description of any one type

	5) More spoilt material. 6) Direct loss of profit. **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. **Preventive maintenance :** A system of scheduled, planned or preventive maintenance tries to minimize the problem of breakdown maintenance. It is a stitch–in-time procedure. It locates weak spots (such as bearing surface, parts under excessive vibrations etc.) in all equipments, provides them regular inspection and minor repairs thereby reducing the damage of unanticipated breakdowns. The principle of preventive maintenance is that prevention is better than cure. Advantages : 1. Reduced break down and connected down time. 2. Lesser odd time repairs and reduced over time to be maintenance work force. 3. Greater safety for workers. 4. Fewer large scale and repetitive repairs. 5. Low maintenance and repair cost.	

	6. Less stand by or reserve equipment and spare parts. 7. Identification of equipment requiring high maintenance cost. 8. Lower unit cost of manufacture. 9. Increased equipment life. 10. Better product quality. **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. **senses adopted for predictive maintenance technique** (Human senses) : 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. **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. Pressure, temperature and resistance strain gauges: eg. Excessive temperature of equipment.	
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:** 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 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.	4



Negative Pressure or Vacuum Systems:

It is similar to domestic vacuum cleaner.

Complete removal of solids from the conveyed gas, which otherwise may damage the fan or blowers.

These systems do not require separate material feeding devices due to absence of adverse pressure gradients. Hence these systems have simple feeding mechanism but larger air filtration plant. Vacuum systems are useful in installations involving picking up of material from several points and discharging them to common point. Hence these systems are well suited for unloading the material from several hoppers and discharging them into pipeline.

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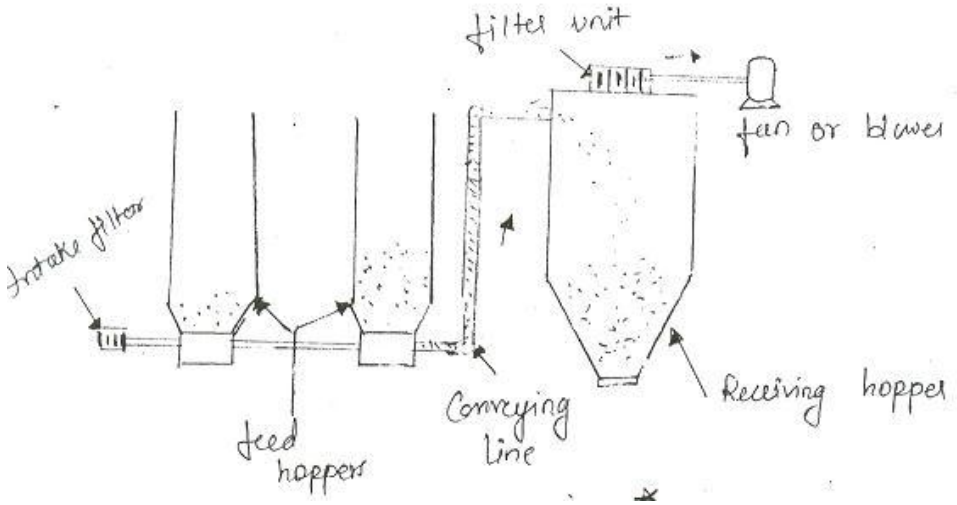

6-b **Cause and trouble shooting of centrifugal pump:** 8

Trouble	Cause	Correction
No water being delivered	Pumps may not be primed	Priming to be done
	Speed may be too low	Check whether motor is directly across the line and receiving full voltage
	Discharge head too high	Check operating conditions
	Suction lift too high	Check with gauges
	Impeller and/or piping may be plugged	Inspect piping, suction strainer and impeller
Not enough water	Air leaks may exist	Plug inlet and put line under

		being delivered	in suction line or stuffing box	pressure. A gauge in line will indicate leakage with a drop in pressure.	
			Discharge head may be higher than anticipated	Check operating conditions, see that pipe suction and discharge heads are as specified	
			Suction lift may be too high	Check with gauges	
			Impeller or suction line maybe partially plugged	Inspect piping, suction strainer and impeller	
			Casing packing may be defective	Replace all worn packing	
			Foot valve or suction opening may not be submerged enough	Submerge entrance of suction pipe at least three feet below surface of the liquid	
		Not enough pressure	Speed may be too low	Check whether motor is directly across the line and receiving full voltage	
			May be air in the water	Plug inlet and put line under pressure	
			Impeller damaged	Repair or replace	
			Casing packing	Replace all worn packing	

		defective		
	Pump works for a while and then loses suction	May be leak in suction line Water seal may be plugged Air or gas may be found in the liquid	Plug inlet and put line under pressure. Inspect line and position of seal cage stuffing box Vent suction back to source of supply	
	Delivery pressure	Not enough pressure	Check whether motor is directly across the line and receiving full voltage. Plug inlet and put line under pressure.	
	Pump takes too much power	Speed too high Liquid may be heavier than water Mechanical defects such as a bent shaft Rotating elements may be binding	Check speed of driver Check the specific gravity and viscosity of the liquid Check runout of shaft Check for too tight stuffing boxes, wearing-ring fit and defective packing	
6-c	**Startup 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			8

	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 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	