MAHARASHTRA STATE BORAD OF TECHNICAL EDUCATION

(Autonomous)

(ISO-27001-2005 Certified)

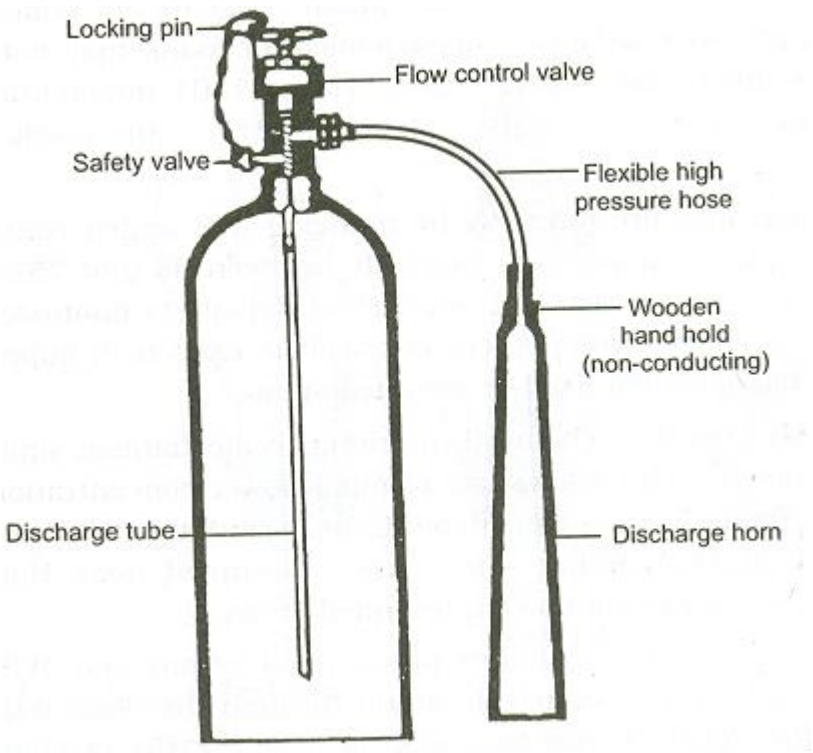
WINTER-12 EXAMINATION

Subject Code-12207 Model Answer

Q.No.	Answer	Remark
1(A) a	Advantages of Preventive maintenance are * Reduced breakdowns and connected down time. * Lesser odd-time repairs and reduced overtime to the maintenance work force. *Greater safety for worker. * Fewer large scale & repetitive repairs. * Low maintenance and repairs cost. * Less stand by or reserve equipment and spare parts. * Identification of equipment requiring high maintenance cost * Lower unit cost of manufacture. * Increased equipment life. * Better product quality.	Any Four maybe given mark 1 mark each
A. b	Objectives of safety are * To Increase the rate of production. * To reduce the cost of production. * To reduce the damage to equipment and machinery. * To protect the life and limbs of the workers.	1 mark each
A.C	 Hard helmet  Hand Gloves	Any 2 may be given marks 2 mark each

	 Ear plug  Apron	
A.d	Harmful effects of chemicals on human being are *Can cause discomfort * Irritants * Induce vomiting and headache * Corrosive * Can cause breathlessness * Narcotic * Produce allergic reaction * Depression and mental deterioration * Human carcinogen * Affects central nervous system	Any 8 Points may be given mark ½ mark each
1(B) a	Fire is defined as the self-propagating reaction of a material with oxygen in air which results in rapid energy release usually in the form of light or heat. Three types of fire in process industries are *Because of common combustible material such as rag, paper etc. *Because of flammable liquid and gases. *Because of electrical equipment. Fire can be caused and sustained by a fuel,oxygen or oxidizer and source of heat(ignition source).These three form three sides of fire triangle. It requires all three should be present simultaneously to cause fire. **Fire can be extinguished by** 1. By cutting of fuel supply 2. Cooling by water ,fog, spray or stream of water 3. Application of inert gas or dry chemical on 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, co2 etc.	2 mark 4 marks

(B) b	Benefits of Safety Audit • Safety audit can be used by management to uncover safety and health problems before personal injuries, property damage, or business interruptions occur. • A safety audit also serves as a visible process that management can execute to demonstrate to employees that they are interested in their safety. • A safety audit uncovers unsafe conditions and poor work practices, which are the principal causes of accident. • Safety audit can reduce illness and injuries, and associated medical, insurance and litigation. • Safety audit can improve business operation. It can maintain, and in some instances, increases productivity, by reducing interruptions caused by accidents. • Safety audit identifies conditions where machinery, equipment or tools need repair or replacement, thus increasing the efficiency of the business operation.	1 mark 1 mark 1 mark 1 mark 1 mark
Q.2.a	Advantages of process Layout • Lower capital investment on account of comparatively less number of machines and lower cost of general purpose machines. • Higher utilization of available equipment. • Greater flexibility in regards to allocation of work to equipment and workers. • Breakdown of equipment, absenteeism of the workman and/or non-availability of certain materials does not dislocate the manufacturing activity on the shop floor. • Workers attain greater skills since they have to attend to one type of machines and operations. • Imbalance of work in one section does not affect the working of the other sections. • New jobs with varying work contents and different operation sequences can be taken up without any difficulty. • Variety of the jobs makes the work interesting to the workmen.	2 marks Any four points may be given marks ½ mark each
	Disadvantages • For the volume of production, space requirement are higher. • Materials handling can not be mechanized which adds to extra cost. • Work-in process inventory is higher since jobs have to queue up for each operation. • Routing and scheduling is difficult since different jobs have different operation sequences. • Inspection requires to be done after each operation as material passes to the next department. This causes delays and results in higher cost of inspection. • Setup costs are high because of frequent changes of jobs.	2 marks Any four points may be given marks

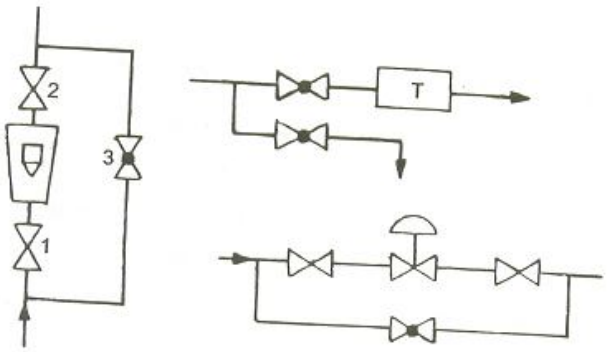
2.b	Physiological Effects of electricity The human body can receive an electric shock when the two hands are holding metal objects which have a potential difference between them. More usually, one hand touches a metal conductor which is at a potential above that of the surface on which the person is standing. In either case the current flows by the shortest route. The current density is greatest near the points of contact, and this is where the most physical damage will occur. The body behaves as a large volume of electrolyte, with a very low resistance, surrounded by a high resistance container (the skin). An indication of the resistance of the skin can be obtained by measuring the current which flows between two electrodes which are in contact with it. Much higher values are obtained at low voltages because there is no chemical breakdown of the skins, insulating properties. Electrical safety can therefore be greatly enhanced by a reduction in the voltage of the equipment. 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.	½ mark each 4 marks
2. c	 **CO_2 Fire extinguisher**	4 marks
2. d	<u>Mass flow bins</u> **Construction:** 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.	2 marks 2 marks
2.e	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, 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 identify 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.	4 marks
2. f	Objectives of Plant Maintenance. 1. To achieve minimum breakdown and to keep the plant in good working condition at the lowest possible cost. 2. Machines and other facilities should be kept in such a condition which permits them to be used at their optimum capacity without any	

	interruption. 3. 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 marks
3.a	**Inspection:** Inspection is concerned with the routine scheduled checks of the plant facilities to examine their conditions and to check for needed repairs. Inspection ensures the safe and efficient operation of equipment and machinery. Frequency of inspection depend upon the intensity of the use of the equipment For e.g. belts in a machine may be checked every week, furnace equipment every month, an overhead bridge crane every four month etc. **Duty and function of maintenance department:** *Engineering * Maintenance * Repair *Overhaul * Construction *Salvage * Clerical jobs * Generation and distribution of process and other utilities. * Administration and supervision of labor force. * Providing plant protection *Insurance administration *Housekeeping involves cleaning of equipment	01 mark Any 6 points may be given mark ½ mark each point
3. b	Accident reporting : Accidental injuries and industrial diseases, which were sustained in the course of work and which keep an employee off work for more than three days should be reported by or on behalf of the employees, to the Department of Social Security (DSS). On receipt of the victim's report, DSS will send the employer two copies of a report form which gives some details of the victim's report of the accident. The employer is required to supply further details by completing both copies of the report form and returning them to DSS. The management should ensured that they are informed promptly when an accident happens, provide first aid and call for an ambulance , medical assistants and should investigate an report on the cause of the accident. In the event of serious injury, management should informed HSE, the victim's family and employer's insurers immediately and should obtain details of the injury as soon as possible. The victim's should be removed for the treatment and the supervisor should make an immediate examination.	2 marks

	Accident investigation : Serious accidents are investigated by health and safety executive and many of their accident reports are published. The investigation should start as soon as possible while witnesses' memories and evidence are fresh. Where a workers safety representative requests it, a joint investigation should be carried out. Injured person should be interviewed to obtain their version of events. Once the technical causes are clear, management needs to discover the personal and organizational factor which allowed the accident to happen. Prompt steps should be taken to remove physical causes and correct organizational weakness to prevent a repetition of the accident and to ensure that all its lessons are properly learnt.	2 marks
3.c(i)	Liquid storage: *Open atmospheric tanks are used for storing liquids that will not be harmed by water, weather or atmospheric pollution. *The closed tanks have fixed or floating roof. Fixed roofs are either domed or coned with intermediate supports. *Fixed roof atmospheric tanks require vents to prevent pressure changes which would 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 of sphere ellipsoid shapes.	02 mark
(ii)	Gas storage: *Certain gases are stored by dissolving them in liquids (eg. NH_3 in H_2O, HCl in H_2O etc.)Use of this method depends on whether the end use of stored gas requires the anhydrous or liquid state. * Gases may be stored under high pressure in pressure vessel that reduces its volume (e.g. CO_2, Cl_2, NH_3, SO_2, Freon etc.) Such pressure tanks are installed underground. *The small portable pressure vessels known as bottles are useful for storing small quantities of Freon and petroleum gas. *Pipes buried underground in connected parallel lines are used for storing gas. Cryogenic gases that liquefy under pressure at atmospheric temperature are stored at or near to atmospheric pressure and at low temperature. * Low temperature tanks may be installed underground to take advantage of the insulating effects of earth.	02 mark
3.d	 Helmet  Hand gloves	Any four points may be given marks 1 mark each

	 Ear plug  Apron	
3.e	Noise control in industry *Reduction at source * Vibration Isolation *Vibration Damping * Silencers *Noise Insulation *noise absorption	Any 4 points with explanation may be given mark 1mark each
4.A(a)	**Use of Centrifugal discharged type bucket elevators**: These are commonly used for handling free flowing fine or small lump material such as grain, coal or dry chemicals. The material is fed to the bucket by a combination of direct flow and a scooping action as the buckets turn under the bottom pulley or chain wheel. The material carried by the buckets gets discharged by centrifugal action as the buckets pass around the head pulley at the speed of 13to 2m/s. The centrifugal force is sufficient to discharged relatively free flowing materials, but it is insufficient to remove the sticky products. For complete discharge of such materials the buckets are mounted on two strands of chain and snubbed back under the head sprocket to invert them for positive discharge. The speed of these units is relatively slow and buckets must be larger or more closely spaced than the centrifugal design.	01 mark 03 mark
4.A(b)	**Procedure for start of plant:**The plant is started at two different times, i)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. Thus is the safest and cheapest way of checking the functioning of the plant equipment in total. ii) When plant is stopped for annual major shutdown, then also above cited procedure is usually followed at the starting of the plant. 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	02 mark 02 mark

	is taken up to full capacity	
4.A(c)	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 .e.g. suppose there is a rotameter in a pipe line. If we desired to replace a broken glass pipe of rotameter we can closed valve 1 and 2 and open 3 & divert the fluid 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.  If we provide a stand b y 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 temperature.	01mark 03 mark
4.A(d)	Commissioning procedure of plant : A general sequence of steps in Commissioning of process plant may include * System configuration check *Instrumentation system check – verification of alarms and trips. *Flushing and cleaning of lines and vessels with water. *Assessment of ancillary equipment *Calibration of vessels and instrumentation	Any 8 points may be given mark ½ mark each point

	*Start up protocol *shut down protocol *Chemical trials *Hand over	
4.B(a)	Types of personal protective equipments 1. Respiratory protective equipments are further classified as a. Air purifying type i)Mechanical filter respirators : These give protection against dust and particulate matter s only and don't provide any protection against harmful vapors , gasses or oxygen deficient atmospheres ii)Canister gas masks: The canister contains certain neutralizing chemicals Which can absorb a particular contaminant iii)Chemical cartridge respirator : This masks are effective only at very low concentration and can not be used in emergency b. Supplied air type: Here is supplied to the full face mask or hood so that wearer gets constant supply of breathable air drawn from a non contaminated area away from his place of work. c. Self contained breathing apparatus : These are designed to supply complete respiratory protection in any concentration of toxic gasses or even in environment deficient of oxygen 2. Non respiratory personal protective equipment consist of * For protection of eyes goggles and spectacles are used may be needed from sparks, glares,. Dust, gasses, vapours etc. Use of goggles is compulsory for operations such as gas cutting, welding, grinding, chipping etc. * For a face and eye protection face shield and hoods are used. Face shields Protect face and neck from flying particles, chemical splashes etc. Tinted transparent plastic shields protect against glare. *Helmets, hard hats and caps are used for the protection of head. Industrial Safety helmets can protect against falling objects or impact with fixed objects. Caps , helmets etc which can protect the scalp and hair from entanglement. *For protection of foot and legs , safety shoes, boots, foot guards, leg guards are used. The common types of safety shoes are generally with leather or rubber or PVC sole and having reinforces metal toe cap, which protects to toes against falling objects, accidental kicking against sharp objects. *Ear muff, ear plug can be used for protection of ear.	Any 3 points may be given mark 1mark each point Any 3 points may be given mark 2 mark each point
4.B(b)	Methods use for controlling fire 1. By cutting of fuel supply 2. Cooling by water, fog, spray or stream of water 3. Application of inert gas or dry chemicals on fire.	6mark

	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 i)Blowing down the vessel and piping contents ii)Pump out or 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. **(Explanation of any 2 Fire suppression system may be given marks)**	
5.a	Types of Maintenance : I) Preventive maintenance 2) Predictive maintenance 3) Scheduled maintenance 4) Breakdown or connective maintenance <u>Breakdown Maintenance</u> : This method of maintenance is used for or implies that repairs are made after the equipment is out of order and it con not perform its normal function any longer e.g. an electric motor will not start, if a belt is broken or any other reason is involved behind etc. In such situation, production department calls the maintenance dept. to rectify the defect. The maintenance people checks into the difficulty and makes necessary repairs. After removing the fault, maintenance engineers do not attend the equipment again until another failure or breakdown occurs. <u>Definition</u> ….. Breakdown maintenance is quite justified in small factories which i) are in different to the benefit of scheduling. (ii) do not feel a financial justification for scheduling technique (iii) get seldom (temporary or permanent) demand in excess of normal operating capacity and are indifferent to the benefits of scheduling. <u>Causes of Breakdown Maintenance</u> 1) Failure to replace worn out parts. 2) Lack of Lubrication	1 mark 3 marks

	3) Neglecting cooling system 4) Indifferent towards minor faults. 5) External forces e.g. too low or too high voltage wrong fuel etc. 6) Indifference towards equipment vibrations, unusual sounds caring out of rotating machinery etc.	
5 b.	**The Advantages of screw conveyors over other are :** a) Low investment cost. b) Compact design and easy fabrication. c) Low maintenance cost on account of less number of moving parts. d) Can be handle wide range of solids. e) Can be used as feeder to assist and are to control the material flow from storage hopper. **The limitations of screw conveyor are :** a) Unsuitable for handling lumpy. Fibrous and sticky materials. b) The Conveyor Length is limited by the allowable torque, compatibility of the drive and coupling shafts. c) High power requirement for conveying sticky solids. d) Unsuitable for steep inclines.	Any 2 points may given mark 1mark each Any 2 points may given mark 1mark each
5 c.	<u>High Efficiency Dust Respiration</u> are designed specially for protection against the higher levels of toxic particulate material. The masks can be adapted for breathing apparatus hence it is difficult to estimate how many sold or in use. Their life expectancy is between one and five years and the filters are likely last only two months. <u>Blasting Helmets</u> are used when operators are <u>carrying out blast cleaning of structures, castings etc.</u> A full protective suit made in rubberized canvas is donned by the operator. External clean air is supplied via a compressor with a filter or from compressed air supply again with a suitable filter.	2 mark 2 mark

5d. Classes of Fire : (4 marks)

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 equipments is dancercised. Even soda acid or foam is suitable.

5.e Objectives of good plant layout : Any 4points may given mark 1mark each

1) Economy in handling of materials, work-in-progress and finished goods.
2) Minimization of production delays.
3) Efficient utilization of available space.
4) Easy supervision and better production control.
5) Greater flexibility for changes in product design and for future Expansion.
6) Lesser work-in –progress and minimum manufacturing cycle time.
7) Better working conditions by eliminating causes of excessive noise, objectionable odious, smoke etc.

5.f In factory, there must be provided safe and adequate means of escape in case of fire. Firefighting equipment must be provided in every factory and proper training should be given to workers to use such equipment. 1mark

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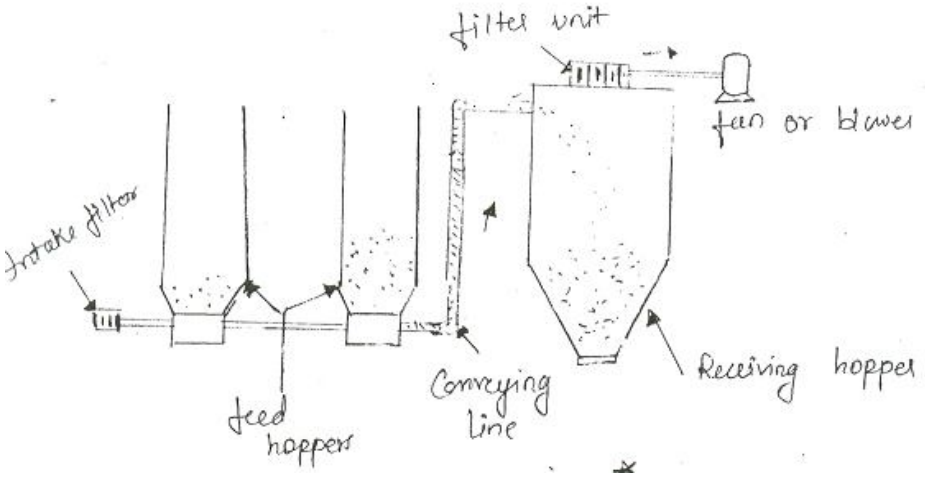
	To avoid mechanical hazards, PPE available are as follows. 1) Hand gloves. 2) Hard Hats 3) Industrially safety Helmets. 4) Disposable respiratory protective equipment. 5) Climbing suits. 6) Full body covering suits. 7) Safety boots or shoes. 8) Foundry boots. 9) Ear plugs and ear muffs. 10) Nasal masks which also called as half masks. Note: Explanation of any one PPE ….	Any 4points may given mark 1/2mark each 1mark
6.a	<u>PERT Techniques</u> PERT: - Programme Evaluation and Review Techniques. CPM :- Critical Path Method Are the scheduling techniques which are used to plan, schedule and control a project consisting of member of interrelated activities. These techniques provide a frame which defines the jobs to be done integrates them in a logical sequence and provides a system of control over the progress of the plan. Objectives:- 1) To plan, schedule and control the project consisting of number of interrelated activities. 2) To define and integrate the tools in a logical sequence 3) These techniques show the prudence relationship i.e. they show how the activities are dependent. 4) With the help of these techniques, the management can know which operation should be done after completing a particular operation. 5) To know the progress of the work as related to the scheduled timing. 6) To plan the best possible use of resources to achieve a given goal within overall time and cost limitations. 7) To provides the basis for determining manpower, material and capital requirements. 8) Network analysis helps in designing, planning, Co-ordinating, controlling and decision-making in order to accomplish the project economically in the minimum available time, with the limited resources	(definition of each carries 1 mark) Any 4 points ½ mark each
6. b	Pneumatic Conveying is nothing but transportation of dry bulk particulates or granular materials through a pipeline by a stream of air or gas. Pneumatic Conveying systems are classified based on whether positive pressure or vacuum is applied	2 Marks

	Negative Pressure or Vacuum Systems: It is similar to domestic vacuum 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	2 Marks
6. c	**Equipments & Assessment** Under the Management of Health and safety at work Regulations 1992, Management have an obligation to carry out a hazard and risk assessment and it follows that they must also assess the type of PPE they are supplying to their workers. The large employer within the process industry will in all probability have qualified experienced personnel Capable of carrying out this function within their own staff, but The smaller organization can always seek expert help and advice either from the suppliers of equipment or from competent consultants.	1 Mark
	Maintenance and Replacement of PPE The employer is obliged to maintain the equipment provided or replace equipment that becomes worn or defunct So that the employer can budget and arrange to have them replaced at the end	3 Marks

	of their life. Some PPE is for on-off use, e.g. paper boiler suits, disposable gloves, or disposable respiratory protective equipment such as face marks. 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 cleared and sterilized so as to reduce cross- infection between users.	
6. d	**Effects of noise :** 1) The main ill-effect of a high noise level is that the persons exposed to it may lose their hearing capacity. 2) A very high noise level like that of an explosion can bring about complete hearing loss instantaneously. 3) High Noise levels also affect work 4) Communication between people becomes difficult in noisy areas which can result in it becoming necessary for the speaker to shout or the listener getting the wrong message. 5) High Noise Levels have psychological effects as well. 6) High Noise Levels can affect body functions in many ways such as rise in blood pressure, increased heart rate, muscular and nervous tension, reduction in the functions of digestive organs and increased fatigue.	2 Marks
	<u>Legislative Measure</u> Sound can be measured by 1) Sound level meter 2) Octave Band Analyzer coupled with sound level meter 3) For measurement of continuous sound level in 8 hours of exposure 4) Integrating Meters 5) Dose Meters 6) Digital Sound Level Meter	2 Marks
6. e	**<u>Maintenance Schedule</u>** a) Be such that the maintenance work can be carried out during lunch hours, between shifts, or at weekends etc. b) Take advantage of planned stoppage such as tool change, loading and unloading of job etc. c) Plan Major requires and overhauls during holidays. d) Make use of reserve plant if the need arises.	4 Marks
	<u>Procedure</u> Steps are 1) Preparation of master maintenance schedule 2) Preparation of detailed weekly or daily schedule Master maintenance schedule indicates the nature and magnitude of each repair and construction task segment of maintenance for a specified time span.	
	<u>Scheduling tools (Devices)</u> They are classified as: a) Visual charts b) Scheduling boards & c) Individual Cards.	