3(b) Categorize types of accidents and their related causes.

The nature of accidents may vary from industry to industry. An employee may be caught in a machine while working on it. or he may fall against a machine or he may fall from a height while engaged on a Particular task, or explosives used carelessly may Explode.

These accidents may result in disablement or death. Depending upon the severity of the injury, the accidents may be typed as.

Major Accidents & Minor Accidents

An accident which result in a death or prolonged disability to the victim is a major one. A Scratch or cut, which does not seriously disable one is a minor accident.

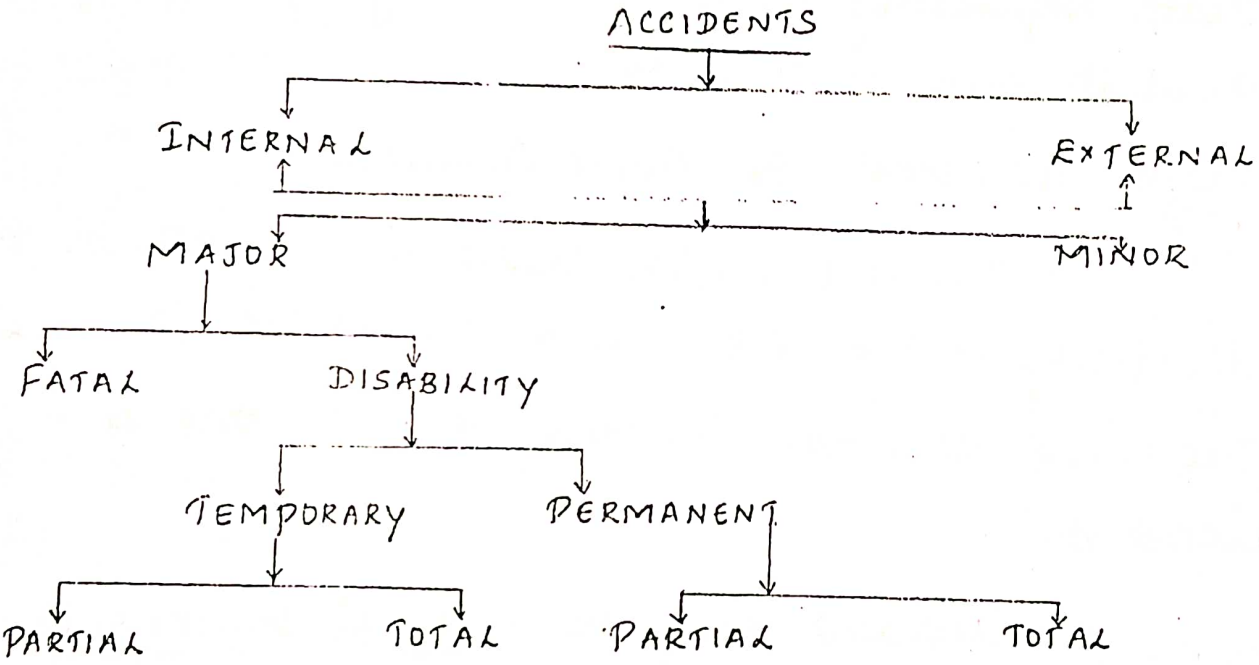
An accident may be Internal or External. If a worker falls or an object falls on him, it may not show signs of injury, but they may have fractured a bone or strained a muscle or nerve which is an internal injury. A deep scratch on the leg or shoulder may show sign of injury, which is an External injury.

A Worker may be disabled by injury for a day

or week or month or a few month. If he recovers from such disability. his disability is temporary. but if the injury is such that he will never recover fully, his disability is permanent one.

A disability may be partial or total. An accident may be fatal or non-fatal.

The various types of accidents can be summarized as below



Accidents results from a variety of causes :-

Motor vehicle accidents :- Motor vehicle accidents are the leadin cause of accidental deaths. ~~in the~~ They include deaths resulting from accidents involving mechanically or Electricall Powered vehicles (Excluding rail vehicles) that occur on or off the road.

Falls :- This category includes all deaths from falls except

those associated with transport vehicles. For example, a person who is killed as the result of falling while boarding a bus or train would not be included in this category.

Poisoning :- The poisoning category is divided into two subcategories :

1) poisoning by solids and liquids, and
2) poisoning by gases & vapors.

The first category includes death that result from the ingestion of drugs, medicine, widely recognized solid and liquid poisons, mushrooms, and shellfish. It does not include poisoning from spoiled food or salmonella.

The second category includes death caused by incomplete combustion (for example, gas vapors from an oven or unlit pilot light) or from carbon monoxide (for example, exhaust fumes from an automobile)

In a typical year, there are approximately 6,000 deaths in the first category & 1,000 in the second.

Drowning : This category includes work-related & non-work related drownings but excludes those associated with floods or other natural disasters.

Fire-related injuries :- This category includes deaths from burns, asphyxiation, falls & those that result from falling objects in a fire.

Suffocation :- This category includes deaths from the ingestion of an object that blocks the air passages. In many such deaths, the ingested object is food.

Firearms :- This category includes deaths that result when recreational activities involving firearms or household accidents involving firearms result in death. For example a person killed in the home while cleaning a firearm would be included in this category.

Others :- This category includes deaths resulting from medical complications arising out of mistakes made by health care professionals, air transport injuries, interaction with machinery, mechanical suffocation, & the impact of falling objects.

Work Injuries By type of Accident

Work injuries can be classified by the type of accident from which they resulted.

The most common causes of work injuries are:-

- Overexertion
- Impact accidents
- Falls
- Bodily reaction (to chemicals)
- Compression

- Motor vehicle accidents
- Exposure to radiation / caustics
- Rubbing or abrasions
- Exposure to extreme temperatures.

4 (a) Suggest an accident investigation plan and state its advantages.

Accidents occur when hazards escape detection during Preventive measures, such as a job or process safety analysis when hazards are not obvious, or as the result of combinations of circumstances that were difficult to foresee. A thorough accident investigation may identify previously overlooked physical, environmental, or process hazards, the need for new or more extensive safety training, or unsafe work practices. The primary focus of any accident investigation should be the determination of the facts surrounding the incident and the lessons that can be learned to prevent future similar occurrences. The focus of the investigation should never be to place blame. The process should be positive & thought of as an opportunity for improvement.

Most accidents in the workplace result from unsafe work behaviours. According to the latest research, they represent the direct cause for about 95% of all workplace accidents. Hazardous conditions represent the direct cause for only about 3% of workplace accidents. "Acts of God" account for the remaining 2%. All these statistics imply that management system weaknesses account for fully 98% of all workplace accidents. Effective accident investigation identifies these root causes and recommends strategies to eliminate management system weaknesses.

4 (b) Briefly discuss the methods adopted for acquiring accident facts.

Methods adopted for acquiring accident facts are :-

Accident Investigation plan :

(i) Isolate the accident scene
(ii) Record all evidence
(iii) photograph and/or videotape of the scene
(iv) Identify the witnesses
(v) Interview witnesses.

(i) Isolate the Accident Scene

As as emergency procedures are completed, and the injuries has been removed, the accident scene should be isolated, until all evidence has been collected, observed as recorded. This is to prevent disturbance & destroying of vital evidence.

The Purpose of isolating the scene is to maintain as closely as possible the conditions that existed at the time of the accidents.

(ii) Record all evidences

It is important to make a permanent record of all persistent evidence as quickly as possible. This required to be done for 3 reasons.

a) Certain type of evidence may be perishable,

b) The larger an accident scene is olated, the more likely is that evidence will be disturbed, knowingly or unkno -gly.

c) If the isolated scene contains a crucial piece of equip or a critical component in a large process, pressure wi be quickly developed to get it back in operation.

Evidence can be recorded in a variety of ways including written notes, sketches, photography, videotape dictated observations & diagrams.

(iii) photograph and/or videotape of the scene

modern photographic & videotaping technology has simplified the task of observing and recording evider using a digital camera in conjuction with computer, Photographs of accident scenes can be viewed immediately and transmitted instantly to numerous different locations.

(iv) Identify witness

Compile a witness list in 3 categories

a) primary witness - are eye witness to the accident

b) secondary witness - are witness, who did not actually see the accident happen, but were in the scene vicinity and arrived on the scene immediately or very shortly after the accident.

c) Tertiary witness :- are witness who were not present at the time of accident nor afterward, but still have some

relevant evidence to present (i.e an employee, who had complained earlier about a problem with the machine involved in the accident.

(v) Interview witness

Every witness on the list should be interviewed. Preferably in the order of primary, secondary & tertiary. Interviews shall be conducted at the accident scene, immediately after preparation of list of witness, immediately after occurrence of accident.

5 (a) List and explain various models available for accident causation.

The various models available for accident causation are:

1) The Domino theory - Heinrich's theory
2) The Human factors theory
3) The Accident / Incident theory (Petersen model)
4) The Epidemiological theory
5) The Systems theory
6) The Combination theory

Heinrich's theory (axioms) :-

1. Injuries result from a completed series of factors, one of which is the accident itself.
2. An accident can occur only as the result of an unsafe act by a person and/or a physical or mechanical hazard.
3. Most accidents are the result of unsafe behaviours by people.
4. An unsafe act by a person or an unsafe condition does not always immediately result in an accident / injury.
5. The reasons why people commit unsafe acts can serve as helpful guides in selecting corrective actions.
6. The severity of an accident is largely fortuitous & the accident that caused it is largely preventable.

7. The best accident prevention techniques are analogous with the best quality and productivity techniques.

8. Management should assume responsibity for safety since it is in the best position to get results.

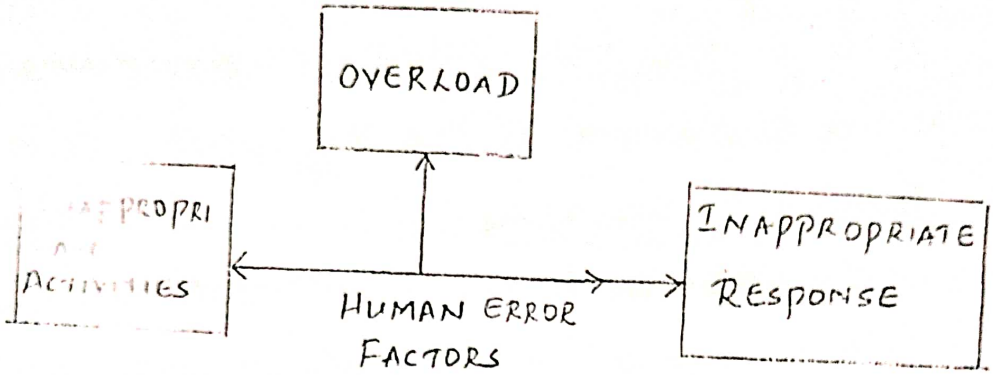
9. The Supervisor is the key person in the prevention of industrial accidents.

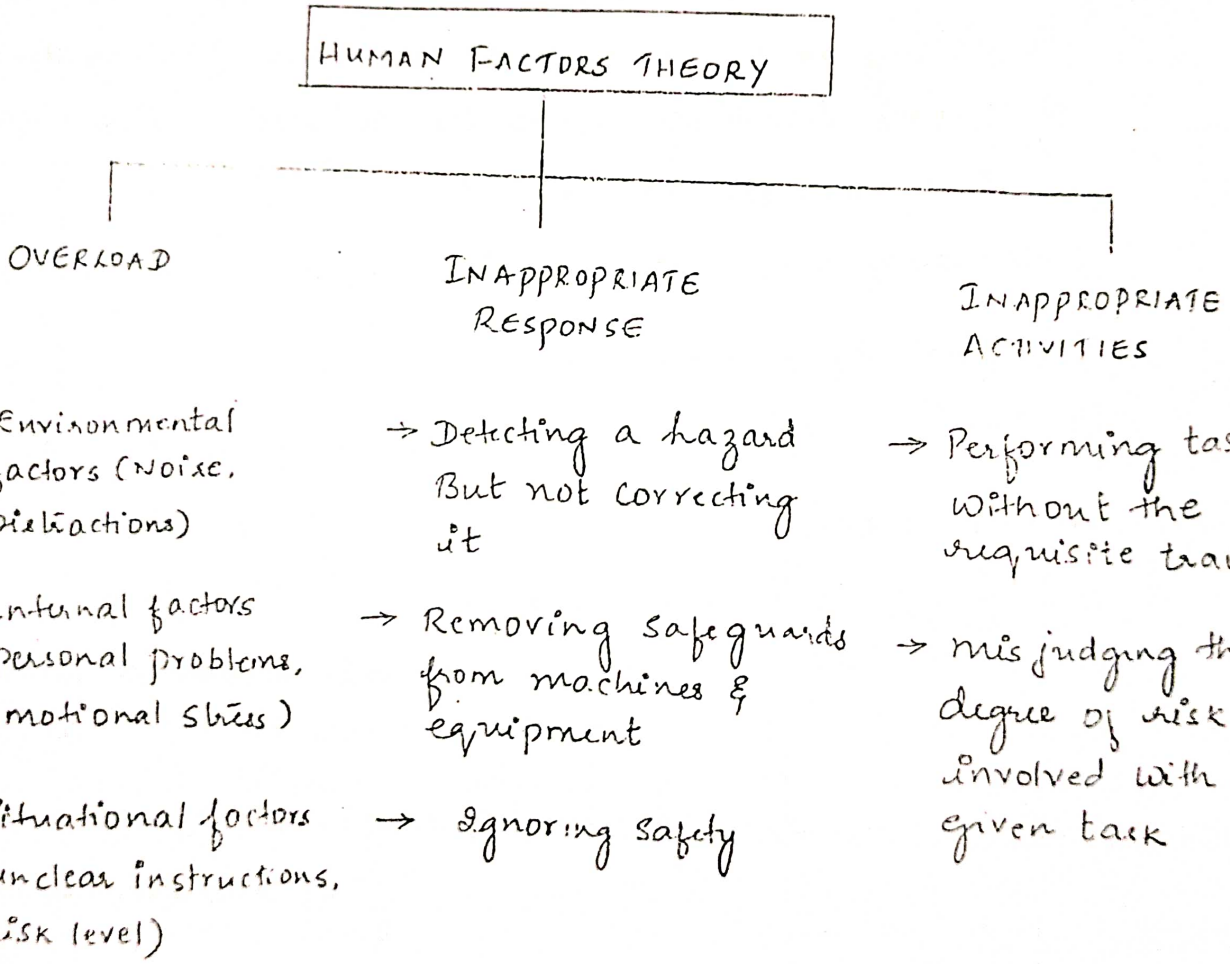
10. In addition to the direct costs of an accident (i.e compensation, liability claims, medical costs, and hospital expenses) there are also hidden or indirect costs.

According to Heinrich, there are five factors in the sequence of events leading up to an accident, These factors can be summarized as follows:

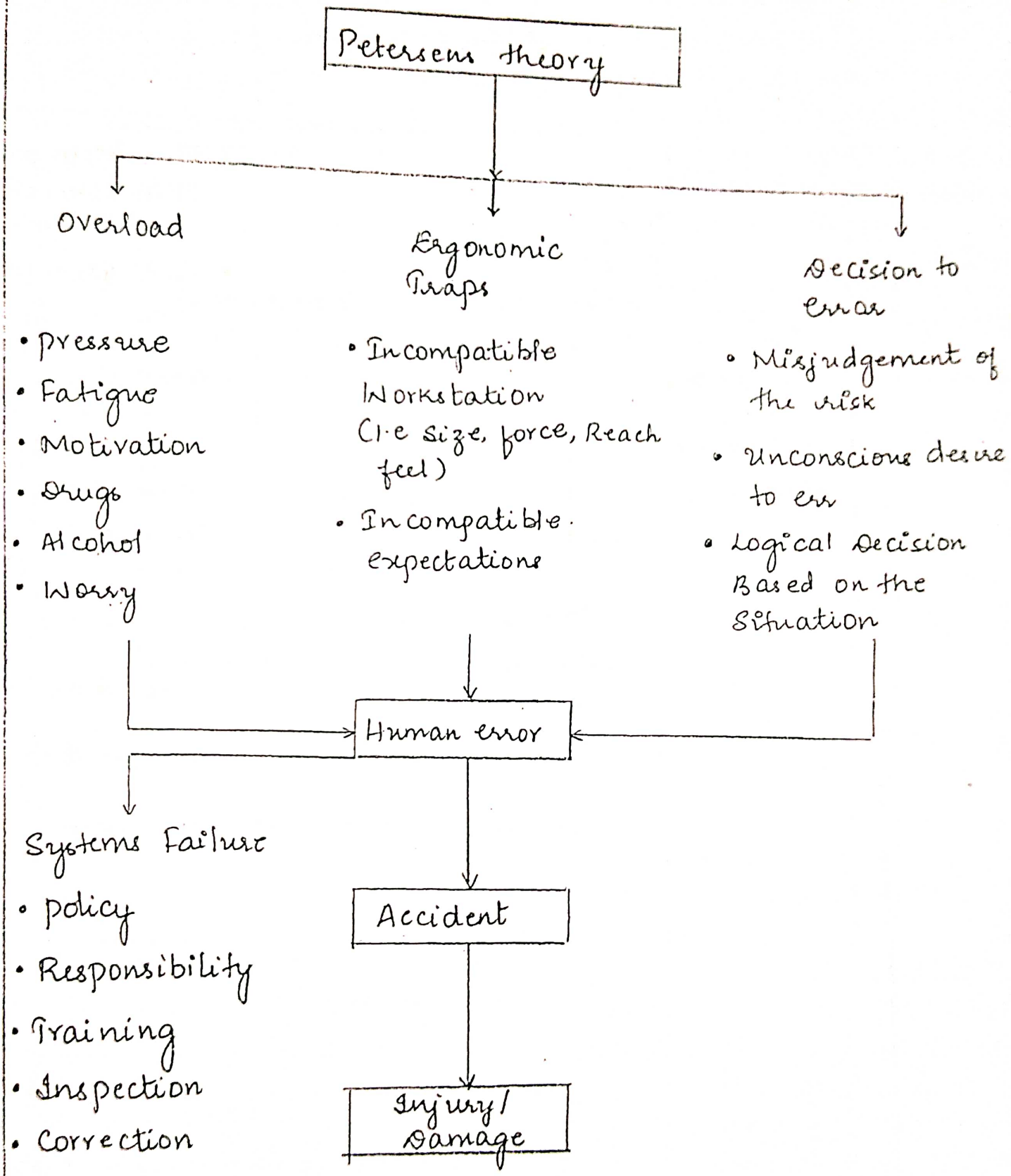
1. Ancestry and social environment
2. Fault of person
3. unsafe act / mechanical or physical hazard
4. Accident
5. Injury

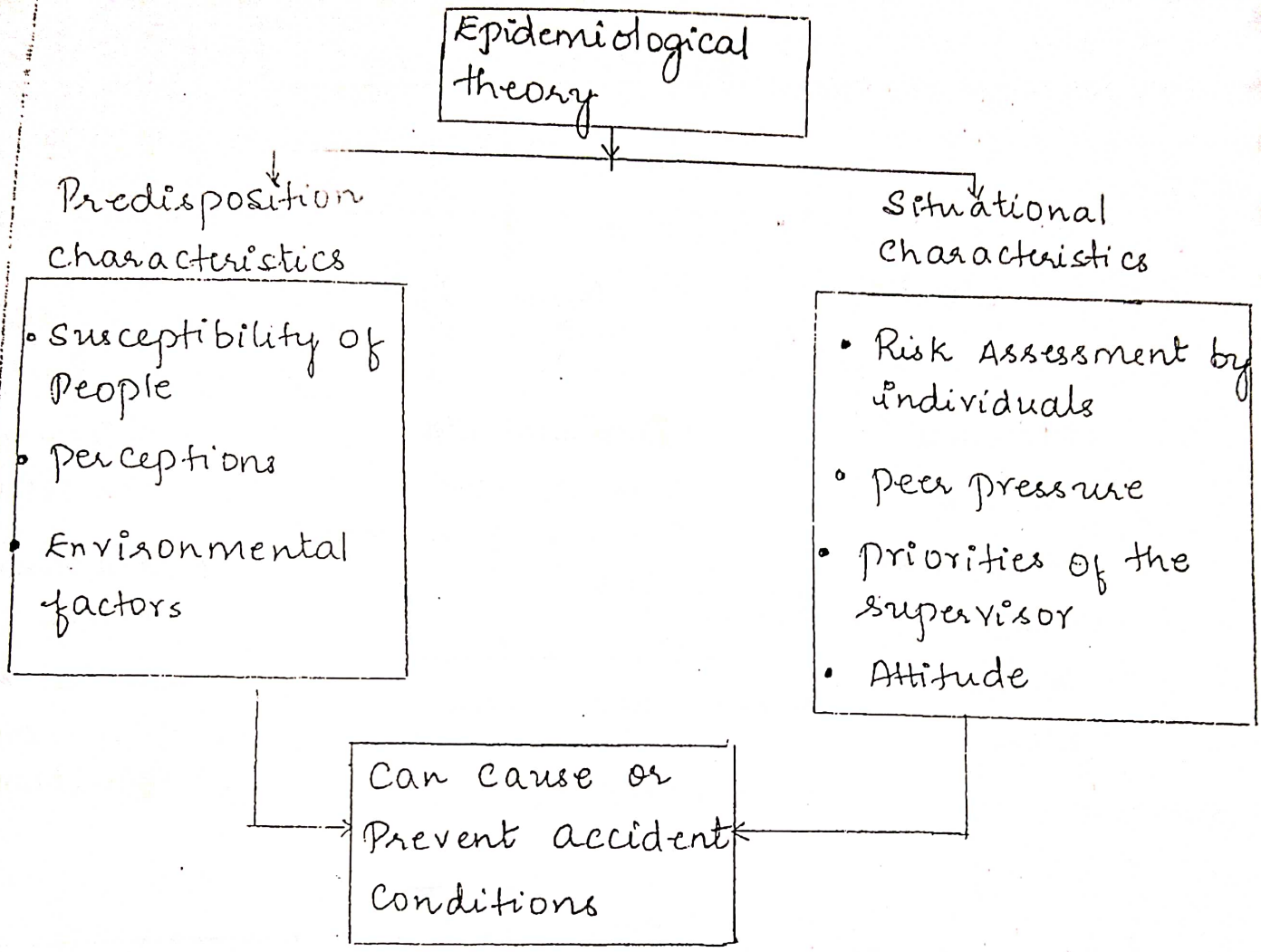
The Human Factors Theory



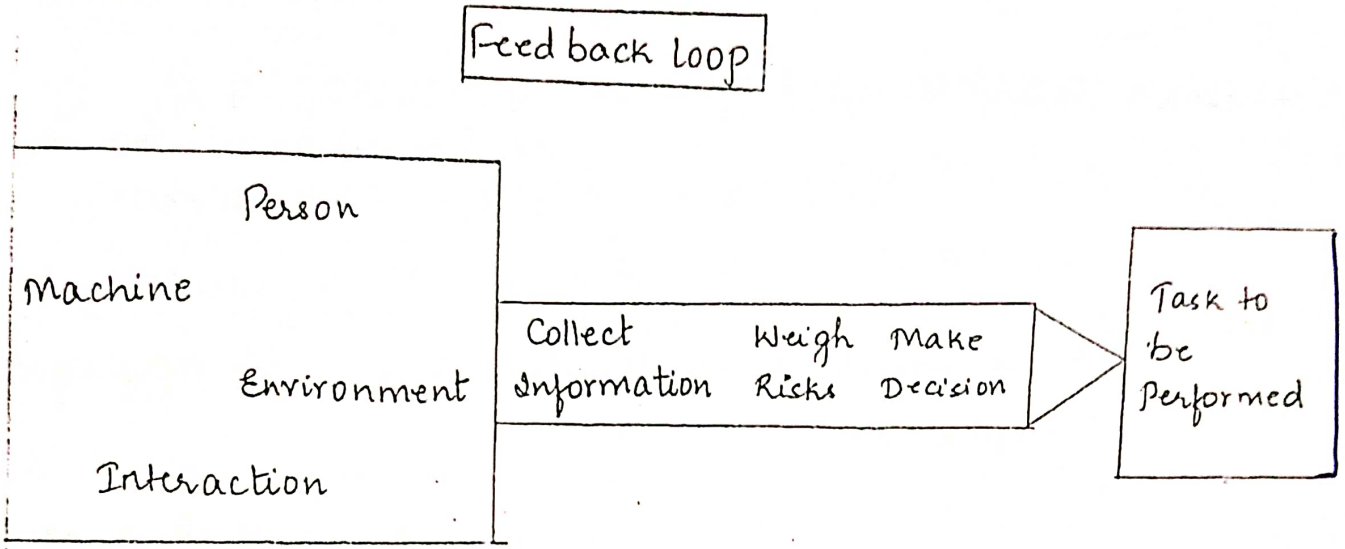


Petersens model




Epidemiological theory
Predisposition characteristics
Susceptibility of People
Perceptions
Environmental factors
Situational Characteristics
Risk Assessment by individuals
Peer Pressure
Priorities of the supervisor
Attitude
Can Cause or Prevent accident Conditions

Systems theory model



Factors to be Considered

→ Job requirements

→ Worker's Ability & limitations

→ Gain if the task is successful

→ Loss if the task is attempted but fails

→ Loss if the task is not attempted

The Combination theory

- Degree of difference between any theory and Reality
- Avoid applying one theory to all accidents
- No theory is common for all accidents
- The cause of an accident cannot be accurately explained by any model.
- The combination theory combines parts of several different theories.

5b State the requirements of health & basic safety measures as per Factories Act

The requirements of health & basic safety measures as per Factories Act are:

1. To ensure cleanliness of the workplace.
2. Make effective arrangement for treatment & disposal of waste & effluent.
3. Make suitable & effective provisions for adequate ventilation.
4. Maintain temperatures to secure reasonable comfort for workers.
5. To remove any dust or fumes from the workplace which may be injurious to workers.
6. To prevent overcrowding by maintaining a specific cubic area for each worker.
7. To provide sufficient & suitable light.
8. Make suitable arrangements to provide clean drinking water conviniently situated for all workers.
9. Provide suitable Latrines & Urinals to specified standard.
10. To provide required personnel protective equipments

Basic safety measures - As per Factories Act

1. Severely guarding all parts of dangerous machinery
2. Precautions for working on Machinery.
3. Emergency devices for cutting of Power.
4. To maintain hoists & lifts.
5. Lifting machines, chains, ropes & other lifting tackle must be maintained in good condition
6. Test Pressurized Vessels regularly
7. Ensure walking surfaces are of sound construction
8. Provide personnel protective equipments (PPE)
9. Measures to remove gas & dust before entering Confined places.
10. Measures to prevent fire

3 (b) Write briefly on the precautionary measures to be taken for accidents prevention.

There are several ways by which the accidents can be prevented. The National Safety council U.S.A say that accident prevention depends on the three 'E's etc Engineering, Education & Enforcement.

a) Improved Engineering could prevent accidents

b) The employees should be educated in safe procedures and safety rules.

c) Safety rules could be established.

a) Engineering

The engineering aspects of a safety program involve making design improvements to both products & process. By altering the design of a product, the processes required to manufacture it can be simplified & as a result make less dangerous & less hazardous.

b) Education : The education aspect of a safety program ensures that employees know how to work safely. Safety education typically covers that, when, where, why and how of safety.

c) Enforcement :- The enforcement aspect of a safety Program involves, making sure that employees abide by safety policies, values, regulations, practices & Procedures. Supervisions & fellow employees play a

Key role in the enforcement aspects of modern safety Program.

Widely used accident prevention techniques includes:

(i) Failure minimisation

(ii) Fail-safe design - by proper planning & design including structural design at the grass root level.

(iii) Personal Protective equipments: supply and maintaine -ce of proper protective equipments such as noise contro light, helmets etc at work place.

(iv) Timed Replacement - proper repair and maintainence of the factories, equipment, plants etc

(v) Isolation

(vi) Screening

(vii) By proper selection and placement of employees, safety training to new employees in safe practices & procedures

(viii) By installing the concept of safety in the workers & the management through safety conservous programme i.e safety weeks, safety slogans, safety campaigns, safety quizzes.

(ix) Regular review of all written suggestions of work to ensure.

(x) Regular feedback to all concerned - possibly by safety commitments & Job contract training sessions following anay changes in existing safe systems of work.

1 a Discuss the causes for fire. List types of fires and effects of fire.

Fire hazards are conditions that favour fire development or growth. Three elements are required to start and sustain fire.

(1) Oxygen
(2) fuel and
(3) heat

Since oxygen is naturally present in most earth environments, fire hazards usually involve the mishandling of fuel or heat.

Fire, or combustion, is a chemical reaction between oxygen and a combustible fuel. Combustion is the process by which fire converts fuel and oxygen into energy, usually in the form of heat. By-products of combustion include light and smoke.

Causes for fire

1> Deliberate
2> Carelessness (including smoking)
3> Burning rubbish / waste
4) poor housekeeping
5> Electrical faults
6) Misuse of electrical installations.

1(b) List the do's and don'ts at the time of fire.

Do's in case of High-Rise Buildings

1) Good housekeeping must be ensured.
2) Switch off the electrical mains before fighting the fire.
3) Use stair case only for evacuation.
4) Keep means of escape clear of obstructions.
5) Impart fire fighting training to occupants.
6) Conduct fire / evacuation drills regularly.
7) Keep smoke/ fire check doors close.
8) Emergency organisation must be set up.

Don't's in case of high-rise Buildings

1) Do not use lifts in times of fire.
2) Do not dispose off lighted cigarette buds carelessly.
3) Do not paint fire detector / sprinkler heads.
4) Do not plug too many electrical appliances in one socket.
5) Do not make unauthorised electrical connections.
6) Do not store inflammable materials inside the building.
7) Do not refill the oil stoves when Burning.
8) Do not obstruct fire exist staircases with old / unused furniture.

9) Do not return to collect valuables in case of outbreak of fire.

Do's in case of Industrial Buildings

1) Make all employees 'Fire conscious' and observe one day as fire safety day every year.

2) provide all fire safety measures and personal clothing/ gadgets.

3) Ensure Regular house keeping.

4) Unauthorised entries must be checked

5) Be sure all employees are familiar with the emergency alarm sounds / modes and escape routes.

6) Ensure no smoking in the workplace.

7) Store flammable liquids, Gases, Solvents properly and correctly Labeled.

8) use fuses and Circuit breakers of correct capacity.

9) Carry out fire drills regularly.

Don'ts in case of Industrial buildings

1) Do not smoke in prohibited areas.

2) Do not Tamper with fire fighting and fire detection equipment.

3) Do not key exits chained or locked.

4) Do not block access to fire fighting equipment.

5) Do not keep fire extinguisher unrefilled / uncharge

DO's in case of fire emergency.

1) Evacuate without panic.

2) Follow the instructions conveyed through public address system.

3) put emergency escape masks & exit from neare

4) exit in orderly form.
Assemble at the designated point outside buildin

Don'ts in case of fire emergency

1) Do not dishonour the instructions.

2) Do not panic and create chaos during evacuation

3) Do not overcrowd during evacuation

4) Do not take refuge in toilets / pantry.

2(a) What are fire extinguishers ? Name different types of fire extinguishers and their use during fire.

A fire extinguisher is an active fire protection device used to extinguish or control a fire, often in emergency situations. Typically a fire extinguisher consists of a handled cylindrical pressure vessel containing an agent which can be discharged to extinguish a fire.

Types of extinguishing agents

Dry chemical

1) Ammonium phosphate

Used on class A, B and C fires. It receives its class A rating from the agent's ability to melt and flow at 350° to smother the fire. More corrosive then other dry chemical agents.

2) Sodium bicarbonate

Used on class B and C fires. Interrupts the fire's chemical reaction.

3) Potassium bicarbonate

Used on class B and C fires. About two times as effective on class B fires as sodium bicarbonate

Foams

1) Aqueous Film Forming Foam (AFFF)

Used on A and B fires and for vapor suppression

2) Alcohol Resistant Aqueous Film Forming Foam (AR-AFFF)

used on fuel fires containing alcohol. Forms a membrane between the fuel and the foam preventing the alcohol from breaking down the foam blanket.

3) Film Forming Fluoroprotein (FFFP)

Contains naturally occurring protcins to create a foam blanket that is more heat resistant than the Synthetic AFFF foams.

4) Compressed Air Foam System (CAFS)

Any APW style extinguisher that is charged with a foam solution and pressurized with compressed air. Generally used to extend a water supply in Wildland operations. Used on class A fires and with very dry foam on class B for vapor suppression.

5) Arctic Fire

Is a liquid fire extinguishing agent that emulsifies and cools heated materials quicker than water or ordinary foam. It is used extensively in the steel industry. Effective on classes A, B and D.

6) Fire Ade

A foaming agent that emulsifies burning liquids and renders them non-flammable. It is able to cool heated materi and surfaces similar to CAFS. Used on A and B (said to be effective on some class D hazards).

7) Wet Chemical (Potassium acetate)

Extinguishes the fire by forming a crust over the burning oil. Generally class A and K only.

Water

1) Air pressurized water (APW) cools burning material by absorbing heat from burning material.

2) Water mist uses a misting nozzle to break up a stream of distilled water to the point of not conducting electricity back to the operator. class A and C rated.

Clean agents

1) Halon, a gaseous agent that smothers the fire. Classes A, B and C. (Banned from new production; replaced by Halotron).

2) CO_2, a gaseous agent that smothers the fire. Classes B and C.

Class D Fire extinguishers.

1) Sodium chloride and copper forms a crust over the burning metal and performs like a heat sink to draw heat away from the burning material, also smothers to a degree.

3(a) Briefly discuss the precautions to be taken at the time of fire at homes

The best way to reduce fires is to prevent their occurrence One means of reducing a fire hazard is the isolation of the three triangle elements: fuel, oxygen and heat.

1) use a fireplace screen to prevent sparks from flying.

2) Do not store any flammable materials near the fire place

3) Check your chimney ~~check~~ before it is put to use.

4) Install a chimney spark arrestor to prevent roof fires.

5) When lighting a gas fireplace, strike your match first, then turn on the gas.

6) Smoke is the leading cause of home fire, it is responsible for 3 out of 4 deaths hence it is necessary to install smoke detectors on every level of house and outside of sleeping areas.

7) Test every detector atleast once a month.

8) Keep smoke detectors dust free.

9) Wise to have a fire extinguisher near the kitchen.

10) Do not overload kitchen electrical outlets.

11) Clean the exhaust wood and duct over the stove regularly.

12) Operate microwave only when there is food in it.

3(b) Discuss briefly the causes and prevention of industrial fires.

Almost everything in an industrial environment will burn. Metal furniture, machines, plaster, and conc block walls are usually painted. Most paints and lacquers will easily catch fire.

Causes of Industrial fires

Although many industries have specific problems of fire prevention and control because of the type of work performed or the materials used, the most frequent causes of industrial fires are common to all industries. Most of these causes can be controlled or eliminated. The success or failure of any plant safety and fire prevention progra depends on the first-line supervisors.

Below is a list of somethings that can be done to help prevent a serious fire, which could destroy an entire plant; the percentage identify the extent to which a specific cause has contributed to industrial fires

Electrical causes - 22%. Guard against electrical defe mainly the kind that develop from lax maintenance in wiring, motors, switches, lamps & heating element.

Matches and smoking - 18%. Don't relax the rules in "no smoking" areas just because a fire hasn't happened yet. Be especially careful where flammable liquids

are present, near stored combustibles, or in working areas where combustibles are used. If an area is restricted for smoking, then there can be no exceptions.

Friction - 11% : Watch for hot bearings, misaligned or broken machine parts, choking or jamming material, poor adjustmen of moving parts.

Hot Surfaces - 9%. Guard against exposure of combustibles to furnaces, hot ducts or flues, electric lamps or heating elements, and hot metal in process.

Overheated Materials - 7%. Watch out for abnormal process temperatures, overheating of materials in driers, and overheating of flammable liquids.

Open flames - 6%. Gasoline or other torches, trouble with gas or oil burners.

Foreign Substances - 5%. Foreign materials in stock, Tramp metal produces sparks when struck by rapidly revolving tools. Oils pans used near cutting machines are a constant hazard.

Spontaneous Heating - 4%. Deposits in ducts and flues, low grade storage, Scrap waste, oily waste, and rubbish.

Cutting and Welding - 4%. Dangerous operations in areas where sparks can ignite combustibles.

Combustion sparks - 4%. Burning of rubbish, Foundary cupolas, furnaces & fireboxes.

Miscellaneous -10%. This includes incendiary cases (3%); fires spreading from adjoining buildings (2½%); mo metal or glass (2%); static electricity near flammable liq as at spreading or coating rolls or where liquid flows f pipes (1½%); chemical action (½%); and lightning (½%

The following factors should be considered in implem a fire prevention program.

Gas: Gases of all types represent a hazard. All equipme (piping, regulators and ignitors) should receive periodic and careful inspection by a qualified person. Employees must receive thorough instruction before using these typ of equipment. matches should not be used for lighting - fired equipment.

Housekeeping: Rubbish, waste, and other debris must be cle up and removed daily and disposed of in suitable contain outside of the plant.

Electrical equipment: Inspection and maintenance of mot and other electrical devices should be done by a qualified Person. All electrical equipment should be included in a Periodic inspection.

Matches & smoking: Smoking and the use of matches sh be permitted in designated areas only. Dust, lint, and collecting in ducts and flues can also ignite spontaneou

Safety containers should be provided for rags and waste. and they should be emptied daily. Employees must be instructed carefully and supervised closely to prevent fires of these types.

Open Flames. Open flames are involved in welding, forging, forming, and other heating operations. Fireproof materials around the work area and suitable clothing will aid in the prevention of most fires. However the use of portable equipment involves high fire danger and all precautions should be taken, including having an extinguisher of the proper type immediately available.

Heated Surfaces: Heated surfaces on furnaces, flues, heating devices, and light bulbs can be the cause of fires. care should be taken to ensure that all devices are properly installed, especially with respect to clearance & barrier materials.

Molten metals: precautions should be taken to provide a flameproof environment in foundary areas and also to Provide flameproof clothing.

Volatile liquids: paints, varnishes, lacquers, petroleum Products, solvents, and similar volatile materials are frequent sources of fire & explosion.

Tight metal containers, flameproof cabinets, color coding, and strict storage and handling procedures are necessary.