B

Scheme

TED (10) --2003
Revision –2010

SIXTH SEMESTER DIPLOMA EXAMINATION IN ENGINEERING / TECHNOLOGY ---

ENVIRONMENTAL SCIENCE AND DISASTER MANAGEMENT

PART – A

I.1) Water logging refers to the saturation of soil in water. Soil may be regarded as water logged when the ground water is too high. 2 marks.

I.2) Atmosphere, Hydrosphere, Lithosphere, Biosphere 2 marks

I.3) A common metric used to quantify food web trophic structure is food chain. Food chain is another way of describing food webs as a measure of the number of species encountered as energy or nutrients move from the plants to top predators. 2 marks

I.4)Water pollution is the deterioration in physical, chemical and biological properties of water brought about mainly by human activities and natural resources. 2 marks

I.5)Lightning is a massive electrostatic discharge caused by unbalanced electric charge in the atmospheric either in the clouds, cloud to cloud or cloud to ground, accompanied by the loud sound of thunder. 2 marks.

PART – B

II.1)Mineral resources and uses

A 'Mineral Resource' is a concentration of material of intrinsic economic interest in or on the earth's crust in such form, quality and quantity that there are reasonable prospects for eventual economic extraction. These are the natural resources which cannot be renewed. They can be classified into metallic mineral resources and non-metallic mineral resources. The major Mineral Resources that are commonly found in the vast lands of countries play a key role in enhancing the economy.
Uses: Minerals are important to our health. We need small amounts of a wide variety of minerals. Minerals found in Tennessee which people need include: calcium, phosphorus, sulfur, copper, fluoride, iron, and zinc. Coal, oil and natural gas provide us with almost all of the energy we use to light, heat and run our

world. Minerals are ingredients in almost all of the products we use from fertilizer to plastics. Minerals are common ingredients in pigments. Minerals also play an important role in the processing of materials. (6 marks)

II.2)Various factors affecting an Eco system

Ecosystems are controlled both by external and internal factors. External factors such as climate, the parent material which forms the soil and topography, control the overall structure of an ecosystem and the way things work within it, but are not themselves influenced by the ecosystem. Other external factors include time and potential biota. Ecosystems are dynamic entities—invariably, they are subject to periodic disturbances and are in the process of recovering from some past disturbance. Ecosystems in similar environments that are located in different parts of the world can end up doing things very differently simply because they have different pools of species present. The introduction of non-native species can cause substantial shifts in ecosystem function. Internal factors not only control ecosystem processes but are also controlled by them and are often subject to feedback loops. While the resource inputs are generally controlled by external processes like climate and parent material, the availability of these resources within the ecosystem is controlled by internal factors like decomposition, root competition or shading. Other internal factors include disturbance, succession and the types of species present. Although humans exist and operate within ecosystems, their cumulative effects are large enough to influence external factors like climate (6 marks)

II.3) Major biological components in terms of energy flow

- The sun is the ultimate source of energy for most ecosystems.
- Primary producers capture a fraction of energy in sunlight striking the earth and convert it into chemical energy (carbohydrate) that is stored in tissues of the primary.
- Energy in tissues of primary producers transferred to consumers as each consumes tissue of other organisms -- about 90% - 95% of energy present in one component is lost as heat at each transfer -- very inefficient process -- very little energy left when decomposers get to it. (6 marks)

II.4) SOURCES OF POLLUTION

<u>Natural sources</u>
- Dust from natural sources, usually large areas of land with little or no vegetation

- Methane, emitted by the digestion of food by animals, for example cattle
- Radon gas from radioactive decay within the Earth's crust. Radon is a colorless, odorless, naturally occurring, radioactive noble gas that is formed from the decay of radium. It is considered to be a health hazard. Radon gas from natural sources can accumulate in buildings, especially in confined areas such as the basement and it is the second most frequent cause of lung cancer, after cigarettesmoking
- Smoke and carbon monoxide from wildfires
- Vegetation, in some regions, emits environmentally significant amounts of VOCs on warmer days. These VOCs react with primary anthropogenic pollutants—specifically, NOx, SO2, and anthropogenic organic carbon compounds—to produce a seasonal haze of secondary pollutants
- Volcanic activity, which produce sulfur, chlorine, and ash particulates (6 marks)

II.5) Fire

Fires are nature's environmental managers. They create and maintain ecosystems such as prairies and pine forests. In fact, prairies evolved with the presence of fire. The health of the ecosystem is dependent on this disturbance. Fires remove a buildup of litter on the soil surface, allowing nutrients to be released into the environment. It also creates favorable conditions for seed germination. Suppression of fire allows litter to accumulate, setting the stage for catastrophic fires. Plants and trees have adapted to the presence of fire. However, the higher temperatures of crown fires can kill plants entirely. These fires are more difficult to control. Suppression of fires is expensive.

<u>Causes</u>:

Lack of guidelines

In buildings, damaging of installation due to earthquake etc.,

<u>Prevention</u>:

Heat, fuel and oxygen are the 3 elements required for fire. The removal of one element will extinguish the fire. (6 marks)

II.6) Biological effects of Radioactive substance

The biological effects of internally deposited radionuclides depend greatly on the activity and the bio-distribution and removal rates of the radionuclide, which in turn depends on its chemical form. The biological effects may also depend on the chemical toxicity of the deposited material, independent of its radioactivity. Some radionuclides may be generally distributed throughout the body and rapidly removed, as is the case with tritiated water. Some radionuclides may target specific organs and have much lower removal rates. For instance, the thyroid gland takes up a large percentage of any iodinethat enters the body. If large quantities of radioactive iodine are inhaled or ingested, the thyroid may be impaired or destroyed, while other tissues are affected to a lesser extent. Radioactive iodine is a common fission product; it was a major component of the radiation released from the Chernobyl disaster, leading to many cases of pediatric thyroid cancer and hypothyroidism. On the other hand, radioactive iodine is used in the diagnosis and treatment of many diseases of the thyroid precisely because of the thyroid's selective uptake of iodine

6 marks.

II.7) Uses of wood

Fuel: Wood has a long history of being used as fuel, in rural areas of the world. Hardwood is preferred over softwood because it creates less smoke and burns longer.
Construction: Wood has been an important construction material since humans began building shelters, houses and boats. New domestic housing in many parts of the world today is commonly made from timber-framed construction.
Furniture and utensils: Wood is used extensively for furniture and also for tool handles and cutlery, such as chopsticks, toothpicks, and other utensils, like the wooden spoon.
Engineered wood: Wood can be cut into straight planks and made into wood-flooring. Engineered wood products, glued building products "engineered" for application-specific performance requirements, are often used in construction and industrial applications.
In the arts: Wood has long been used as an artistic medium. It has been used to make sculptures and carvings Sports and recreational equipment: Many types of sports equipment are made of wood. eg: cricket bats, baseball bats.

$3 \times 2 =$ (6 marks)

any 3 points with explanation.

PART - C

III.a) Water resources and its uses

Rain water: Rain water is a major component of the water cycle and is responsible for depositing most of the fresh water on the Earth.

Surface water: Surface water is water collecting on the ground or in a stream, river, lake, wetland or ocean; it is related to water collecting as groundwater or atmospheric water. It is naturally replenished by precipitation and naturally lost through discharge to evaporation and sub-surface seepage into the ground. Depletion of surface and ground water sources for public consumption (including industrial, commercial, and residential) is caused by over-pumping.

Groundwater: Groundwater is water located beneath the earth's surface in soil pore spaces and in the fractures of rock formations. Groundwater is also often withdrawn for agricultural, municipal and industrial use by constructing and operating extraction wells. is a highly useful and often abundant resource. Overuse of Groundwater or overdraft, can cause major problems to human users and to the environment. The most evident problem (as far as human groundwater use is concerned) is a lowering of the water table beyond the reach of existing wells. Wells must consequently be deepened to reach the groundwater. Groundwater is also ecologically important as it sustains rivers, wetlands and lakes. (8 marks)

III.b)Land resources

Land is the source of many materials essential to man and other organisms. Land is used for various ways like food and energy production, waste disposal, commercial and residential , industrial purposes.

Impacts:

Emission of water pollutants and air pollutants
Soil degradation
Pollute the ground and surface water
Agricultural land used as urban area
Disturbiing ecological cycle etc.,

Land degradation: Intensive farming often leads to a vicious cycle of exhaustion of soil fertility and decline of agricultural yields. Approximately 40% of the world's agricultural land is seriously degraded. Our fertile soils are being exploited faster than they could recuperate. **Land deals/ real estate:** Corporations are buying up the rights to millions of hectares of agricultural land in developing countries in an effort to secure their own long-term food supplies as well as real estate; ultimately resulting in decline of agricultural lands (7 marks)

IV.a) Mining

Coal is mined either by surface or underground methods requires a lot of land area. For surface or open cast mining the ground is cleared of vegetation and the soil is removed resulting in disfiguring

Impacts of mining and quarrying for construction materials: The soil, stones and sand required for the construction of dams and canals are often mined and quarried from around the dam or canal site. Such extraction can also have ..adverse environmental impacts, especially by aggravating dust pollution, disturbing wildlife and destroying vegetation. The scars and pits that such mining and quarrying leave (sometimes called borrow pits) remain as ecological sores and can also have an adverse impact on the dam and the canals. (7 marks)

IV.b) Soil erosion

There is no particular soil erosion cause which can be singled out and assumed as the main cause of soil erosion. The process has many underlying factors, some induced by nature and some by humans.Human Induced Causes of

Soil Erosion Human exploitation of nature is perhaps the most hazardous cause of soil erosion, which has increased over the last decade. Human activities, such as faulty farming systems, deforestation caused by overgrazing, clearance of land for agricultural purposes and construction, dam construction and diversion of the natural course of river, and mining activities are just a few among the various human activities which have either directly or indirectly weakened the topmost layer of the planet, thus making it vulnerable to excessive wearing away by the various agents of erosion. For instance, tree roots help in holding the soil together, and therefore depletion of vegetation cover is bound to make soil vulnerable to erosion by running water

Desertification:

Desertification is a type of land degradation in which a relatively dry land region becomes increasingly arid, typically losing its bodies of water as well as vegetation and wildlife. It is caused by a variety of factors, such as climate change and human activities. Desertification is a significant global

The most common cause of desertification is the over cultivation of desert lands. Over-cultivation causes the nutrients in the soil to be depleted faster than they are restored. Improper irrigation practices result in salinated soils, and depletion of aquifers.

Vegetation plays a major role in determining the biological composition of the soil. Studies have shown that, in many environments, the rate of erosion and runoff decreases exponentially with increased vegetation cover.Overgrazing removes this vegetation causing erosion and loss of top-soil.

(4+4=8 marks)

V.a) Forest Eco system

A forest ecosystem is one major ecologic unit that exists as "home" for a community of either native orintroduced classified organisms. The forest ecosystem is just one of a number of unique ecosystems including prairies, deserts, polar regions and great oceans, smaller lakes and rivers. A forest ecosystem typically is associated with land masses covered in trees and those trees are often classified by foresters into forest cover types.

A forest ecosystem community is directly related to species diversity. Generally, you can assume that the more complex the structure, the greater is its species diversity. You should remember that a forest community is much more than just the sum of its trees. A forest is a system that supports interacting units including trees, soil, insects, animals, and man. Complex forest ecosystems are extremely diverse, ranging from dry desert shrub land to large temperate rain forests. These natural resource professionals have categorized forest ecosystems in North America by placing them into forest biomes. Forest biomes are broad categories of natural tree/plant communities

Forest ecosystems tend to always be moving toward maturity or into what foresters call a climax forest. This maturing, also called forest succession, of the ecosystem increases diversity up to the point of old age where the system slowly collapses. One forestry example of this is growth of trees and the entire system toward an old growth forest. When the ecosystem is exploited and exploitation is maintained or when components of the forest begins to naturally die, then the maturity of the forest ecosystem declines.

Management of forests for sustainability is desirable when forest diversity is threatened by overuse, resource exploitation, old age and poor management. Forest ecosystems can be disrupted and harmed when not properly sustained. A sustained forest that is certified by a qualified certification program gives some assurance that the forest is managed to allow maximum diversity while satisfying the manager's environmental and economic demands. (8 marks)

V.b) Biomes

A biome is a large ecosystem. It is an area on the earth's surface that has similar climate, plants and animals.There are 8 main biomes: Tundra ,Taiga, Temperate forest, Tropical rainforest, Desert, Mediterranean , Savanna Temperate grassland.

The total amount of living matter, and the remains of dead organisms, in an area is the area's biomass. When living things die, decomposers break down the material in the biomass, and the biomass decays. The decay of biomass produces matter in the form of small molecules. This chemical breakdown also releases the energy stored in the chemical compounds in the biomass

<u>Major Biomes</u>

• Tundra

i. Locate on northernmost

ii. Low-growing vegetation withstand to cold weather

iii. Short growing season

• Evergreen coniferous forest / Boreal forest

i. Locate on south of tundra

ii. Coniferous trees are dominant e.g. black and white spruce

iii. Occur in Russia ...

• Temperate coniferous forests / Taigas

i. Plants with tough narrow leaves, needles

ii. spruces, pines are dominated plants

iii. acidic and poor soil, because of slow decay of fallen leaves

Temperate communities

1. Deciduous forest

i. broad-leaved trees

ii. lose their leaves seasonally
iii. soil is well differentiated

(7 marks)

VI.a) Grass Land Eco System

A biological community that contains few trees or shrubs, is characterized by mixed herbaceous (non-woody) vegetation cover, and is dominated by grasses or grass like plants. Mixtures of trees and grasslands occur as savannas at transition zones with forests or where rainfall is marginal for trees. Grasslands occur in regions that are too dry for forests but that have sufficient soil water to support a closed herbaceous plant canopy that is lacking in deserts. Thus, temperate grasslands usually develop in areas with 10–40 in. (25–100 cm) of annual precipitation, although tropical grasslands may receive up to 60 in. (150 cm). Grasslands are found primarily on plains or rolling topography in the interiors of great land masses, and from sea level to elevations of nearly 16,400 ft (5000 m) in the Andes. Because of their continental location they experience large differences in seasonal climate and wide ranges in diurnal conditions. In general, there is at least one dry season during the year, and drought conditions occur periodically. There are many more invertebrate species than any other taxonomic group in the grassland ecosystem. Invertebrates play several roles in the ecosystem. Most of the reptiles and amphibians in grassland ecosystems are predators. Relatively few bird species inhabit the grassland ecosystem, although many more species are found in the flooding pampas of Argentina than in the dry grasslands of the western United States. Their role in the grassland ecosystem involve within the grassland ecosystem are enormous numbers of very small organisms, including bacteria, fungi, algae, and viruses. From a systems perspective, the hundreds of species of bacteria and fungi are particularly important because they decompose organic material, releasing carbon dioxide and other gases into the atmosphere and making nutrients available for recycling. Bacteria and some algae also capture nitrogen from the atmosphere and fix it into forms available to plants. Much of the grassland ecosystem has been burned naturally, probably from fires sparked by lightning. Human inhabitants have also routinely started fires intentionally to remove predators and undesirable insects, to improve the condition of the rangeland, and to reduce cover for predators and enemies; or unintentionally. Thus, grasslands have evolved under the influences of grazing and periodic burning, and the species have adapted to withstand these conditions. If burning or grazing is coupled with drought, however, the grassland will sustain damage that may require long periods of time for recovery by successional processes. Structure and Function The different components of a grassland ecosystem are: Abiotic Component These are the nutrients present in the soil and other components present in the air. The basic elements are supplied by carbon dioxide, water, nitrogen, sulphates etc. All these are present in atmosphere and soil of that

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location. Biotic components In grasslands the producers are mainly grasses, herbs and shrubs. All these contribute to production of biomass. Common species of grass are sp. Condon etc. As regards the consumers the basic three types are Primary, Secondary and Tertiary.Primary consumers feed directly on grass. All the grazing animals as well as the termites and insects come under thiscategory. The secondary consumers feed on these primary consumers and include snakes, lizards etc. The tertiaryconsumers feed on secondary consumers. Examples are eagles and vultures. Fungi, bacteria etc. are the decomposers. (7 marks)

VI.b) ECOLOGICAL SUCCESSION

Succession is a sequential change in the relative abundances of the dominant species in a community following a disturbance. There are 2 kinds of succession:

- Primary succession - the community develops from an essentially abiotic situation following a cataclysmic disturbance
- Secondary succession - the community develops in a habitat that has been disturbed, but not so severely as to destroy all life.

Sere - the entire sequence of stages in succession Climax - the final stage of community change. Secondary succession is faster than primary succession, because soil and some organisms remain and the abiotic conditions are not as inhospitable. There are 3 fundamental types of successional change:

- Facilitation: The organisms at a given successional stage make the environment more suitable for later successional stages. Examples: lichens breaking down rock into soil, nitrogen-fixing plants improve fertility of soil
- Tolerance: The organisms of a given successional stage have little impact on later successional stages. Example: Oldfield succession (possibly)- species of all stages get started at the same time, but are dominant at different times because of different life histories.
- Inhibition: The organisms at a given stage resist invasion by organisms of later stages. Succession proceeds when the individuals of a given stage die.

Since, the initial stage of succession depends upon the intensity and extent of the disturbance. The final stage of succession just determines by climax and topography (8 marks)

VII.a) Air pollution

Air pollution is the introduction into the atmosphere of chemicals, particulates, or biological materials that cause discomfort, disease, or death to humans, damage other living organisms such as food crops, or damage the natural environment or built environment.

The atmosphere is a complex dynamic natural gaseous system that is essential to support life on planet Earth. Stratospheric ozone depletion due to air pollution has long been recognized as a threat to human health as well as to the Earth's ecosystems.

A substance in the air that can be harmful to humans and the environment is known as an air pollutant. Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made. Pollutants can be classified as primary or secondary. Usually, primary pollutants are directly emitted from a process, such as ash from a volcanic eruption, the carbon monoxide gas from a motor vehicle exhaust or sulphur dioxide released from factories.

Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact. An important example of a secondary pollutant is ground level ozone— one of the many secondary pollutants that make up photochemical smog.

1. Proper planning of Towns, Cities and Industries
2. Vegetation
3. Pollution control equipments

(8 marks)

VII.b) Noise Pollution

Noise pollution is excessive, displeasing human, animal, or machine-created environmental noise that disrupts the activity or balance of human or animal life. The word noise may be from the Latin word nauseas, which means disgust or discomfort. The source of most outdoor noise worldwide is mainly construction and transportation systems, including motor vehicle noise, aircraft noise, and rail noise. Poor urban planning may give rise to noise pollution, since side-by-side industrial and residential buildings can result in noise pollution in the residential areas. High noise levels can contribute to cardiovascular effects in humans, a rise in blood pressure, and an increase in stress and vasoconstriction, and an increased incidence of coronary artery disease. In animals, noise can increase the risk of death by altering predator or prey detection and avoidance, interfere with reproduction and navigation, and contribute to permanent hearing loss.

(7 marks)

VIII.a) Soil Pollution

Soil pollution is caused by the presence of xenobiotic (human-made) chemicals or other alteration in the natural soil environment. It is typically caused by industrial activity, agricultural chemicals, or improper disposal of waste. The most common chemicals involved are petroleum hydrocarbons, poly-nuclear aromatic hydrocarbons (such as naphthalene and benzo(a)pyrene), solvents,

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pesticides, lead, and other heavy metals. Contamination is correlated with the degree of industrialization and intensity of chemical usage.

Not unexpectedly, soil contaminants can have significant deleterious consequences for ecosystems. There are radical soil chemistry changes which can arise from the presence of many hazardous chemicals even at low concentration of the contaminant species. These changes can manifest in the alteration of metabolism of endemic micro organisms and arthropods resident in a given soil environment. The result can be virtual eradication of some of the primary food chain, which in turn could have major consequences for predator or consumer species. Even if the chemical effect on lower life forms is small, the lower pyramid levels of the food chain may ingest alien chemicals, which normally become more concentrated for each consuming rung of the food chain. Many of these effects are now well known, such as the concentration of persistent DDT materials for avian consumers, leading to weakening of egg shells, increased chick mortality and potential extinction of species

Effects occur to agricultural lands which have certain types of soil contamination. Contaminants typically alter plant metabolism, often causing a reduction in crop yields. This has a secondary effect upon soil conservation, since the languishing crops cannot shield the Earth's soil from erosion. Some of these chemical contaminants have long half-lives and in other cases derivative chemicals are formed from decay of primary soil contaminants. (7 marks)

VIII.b)Waste Management

Waste management is the collection, transport, processing or disposal, managing and monitoring of waste materials. The term usually relates to materials produced by human activity, and the process is generally undertaken to reduce their effect on health, the environment or aesthetics. Waste management is a distinct practice from resource recovery which focuses on delaying the rate of consumption of natural resources. All wastes materials, whether they are solid, liquid, gaseous or radioactive fall within the remit of waste management
Waste management practices can differ for developed and developing nations, for urban and rural areas, and for residential and industrial producers. Management for non-hazardous waste residential and institutional waste in metropolitan areas is usually the responsibility of local government authorities, while management for non-hazardous commercial and industrial waste is usually the responsibility of the generator subject to local, national or international controls. (8 marks)

IX.a) Land slides

The causes of landslides are usually related to instabilities in slopes. It is usually possible to identify one or more land slide causes and one landslide trigger.

The difference between these two concepts is subtle but important. The landslide causes are the reasons that a landslide occurred in that location and at that time.
Geological causes:

• Sheared materials, • Jointed or fissured materials ,• Adversely orientated discontinuities , • Permeability contrasts , • Material contrasts, • Rainfall and snow fall , • Earthquakes, • Working of machinery

Human causes:

• Excavation, • Loading, • Draw-down, • Land use change , • Water management, • Mining, • Quarrying, • Vibration , • Water leakage
• Deforestation

Physical causes:

• Intense rainfall, • Rapid snow melt, • Prolonged precipitation, • Rapid drawdown • Earthquake , • Volcanic eruption, • Thawing , • Freeze-thaw
• Ground water changes, • Soil pore water pressure , • Surface runoff
• Seismic activity , • Soil erosion

(6 marks)

IX.b) Approaches in Disaster management

Before the disaster (pre disaster) Activities taken up to reduce human and property losses caused by the hazard and to ensure that these losses are also minimized when the disaster strikes. Risk reduction activities are taken up during this stage and they are termed are prevention, mitigation and preparedness activities. . For example, earthquakes typically hit with no warning; whereas, hurricanes and floods typically arrive within hours to days of warning. When there is no warning, survivors may feel more vulnerable, unsafe, and fearful of future unpredicted tragedies. The perception that they had no control over protecting themselves or their loved ones can be deeply distressing. When people do not heed warnings and suffer losses as a result, they may experience guilt and self-blame. While they may have specific plans for how they might protect themselves in the future, they can be left with a sense of guilt or responsibility for what has occurred.

During the disaster (disaster occurrence) Activities taken to ensure that the needs and provisions of the victims are met and the sufferings are minimized. Activities taken up at this stage include emergency response activities. Depending on the characteristics of the incident, people's reactions range from constricted, stunned, shock-like responses to the less common overt expressions of panic or hysteria. Most typically, people respond initially with confusion and disbelief, and focus on the survival and physical well-being of themselves and their loved ones. When families are in different geographic locations during the impact of a disaster (e.g., children

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at school, adults at work), survivors will experience considerable anxiety until they are reunited.

After a disaster (post disaster) Activities taken to achieve early recovery and does not expose the earlier vulnerable conditions. Activities taken up at this stage are called as response and recovery activities. In the immediate aftermath of a disaster event, survival, rescuing others, and promoting safety are priorities. Evacuation to shelters, motels, or other homes may be necessary

(3+3+3 = 9 marks)

X.a) Tsunami

Tsunamis occur when there is a sudden large displacement of water.Three main causes of tsunamis are

Seismic Activity : It is the most common cause of tsunamis. Both tectonic and subduction earthquakes in and near the ocean may create tsunamis. During a tectonic earthquake, the sea floor becomes deformed, forcing a displacement of water. In a subduction earthquake, tectonic plates slip under each other, creating a massive disturbance, also resulting in a significant displacement of water.

Submarine Landslides: Submarine landslides can also cause tsunamis. Submarine landslides occur during earthquakes and the implosion of underwater volcanoes. The falling sediment and rock in these landslides can also trigger massive water movement, resulting in a tsunami.

Cosmic Impacts: Cosmic impacts in the ocean are the least frequent cause of tsunamis. This is similar to throwing a rock into a pond, except on a much larger scale. When the rock hits the water, it creates small ripples of water moving away from the point of impact.

(7 marks)

X.b) Protection Measures for buildings

1. to avoid residing on river banks and slopes on river sides and the sides of gorges. 2. to build at least 250 meters away from the sea coast/riverbanks
3. to build proper drainage system in all flood prone areas, so that the water can be drained off quickly to prevent accumulation.
4. to construct the building with a plinth level higher than the known high flood level.
5. to construct the whole village or settlement on a raised platform higher than the high flood level.
6. to construct buildings on stilts or columns with wall-free space at ground level permitting free-flow of water (inundation or flowing), provided that columns are circular and strong. In dry weather condition the ground area could be fenced and used for cattle, sheep poultry farming, or storage etc.

(8 marks)