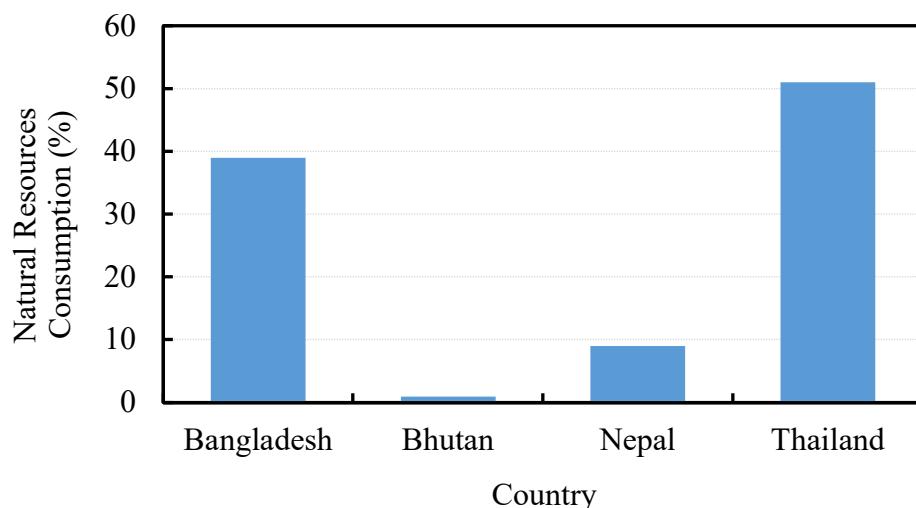


**SECTION A (40 MARKS)**  
**ANSWER ALL QUESTIONS**

a) For each question, there are four alternatives A, B, C and D. Choose the correct alternative and circle it. Do not circle more than ONE alternative. If there are more than one choice circled, NO score will be awarded. [25]

- i. The species with less population in a community but plays a vital role in an ecosystem's functioning is called
  - A flagship species.
  - B indicator species.
  - C keystone species.
  - D dominant species.
- ii. What is ecological resilience?
  - A level of balance within an ecosystem
  - B level of disturbance caused to an ecosystem
  - C ability of an ecosystem to change over time
  - D ability of an ecosystem to recover after a certain disturbance
- iii. Study the graph.



(Source: Global Footprint Network, 2021)

Which country has the largest ecological footprint?

- A Nepal
- B Bhutan
- C Thailand
- D Bangladesh

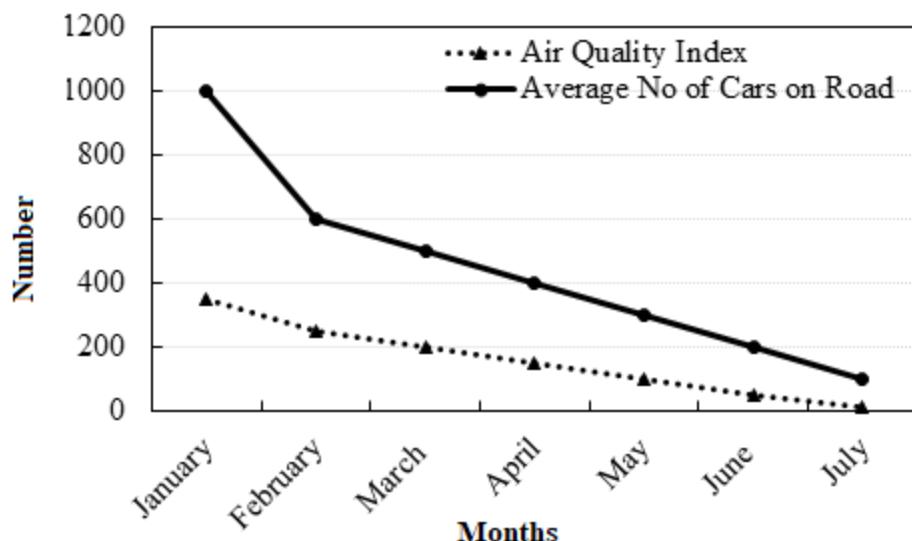
iv. "In Bhutan, the house crows are normally distributed along the southern region in urban areas bordering India. However, in the recent past they have started inhabiting the areas northward, where they were never found before..."

(Source: MoAF, 2021)

What is the most probable cause of expansion of habitat range by the house crows?

- A effect of climate change
- B exploration of new habitats
- C increase in their population
- D predation by other animals

v. The graph shows a hypothetical correlation between the number of cars on the road and air quality index (micrograms per cubic meter) data of various months in Thimphu.



What conclusion can be drawn from the trends shown in the graph?

- A increase in number of cars on the road decreases the air quality index
- B decrease in number of cars on the road increases the air quality index
- C decrease in number of cars on the road decreases the air quality index
- D increase in number of cars on the road fluctuates the air quality index

vi. Plants help in creating and maintaining a healthy environmental condition by removing pollutants from the air and releasing oxygen. Such type of ecosystem services provided by the plants in an ecosystem is categorized as

- A cultural services.
- B supporting services.
- C regulating services.
- D provisional services.

vii. It emphasizes on its ability to function well under stress, adapt to new challenges, achieve self-reliance and work with social cohesion and kinship network.

The above statement describes the characteristics of a

- A resilient community.
- B vulnerable community.
- C disaster management system.
- D department of disaster management.

viii. Study the figure.



What would be the negative impact of this activity on the natural resources?

- A nourishes soil
- B improves crop yield
- C damages soil biomass
- D causes respiratory disorders in humans

ix. One of the benefits of biodiversity conservation is agriculture and food security of the country. A rich biodiversity ensures favorable conditions for

- A producing varieties of crops.
- B carrying out recreational activities.
- C enhancing human-wildlife conflicts.
- D preventing and mitigating natural hazards.

x. Which one of the following is responsible for biodiversity management measures that integrate all stages of planning and operation of an organization or project?

- A National Biodiversity Centre
- B Biodiversity Management System
- C Convention on Biological Diversity
- D National Biodiversity Strategies and Action Plans

xi. Benthic macroinvertebrates are used as indicator for water quality test because they are

- A easy to capture for test.
- B resistant to water pollution.
- C sensitive to water pollution.
- D the only organisms found at the bottom of the water.

xii. Research has been carried out in using hydrogen fuel cells to power cars. The hydrogen fuel cell uses hydrogen and oxygen gases to release energy and water as by-products.

Why are hydrogen fuel cells suitable as an alternative source of energy?

- A uses gaseous materials as fuels
- B safe to use as an energy source
- C water is produced as by-product
- D both hydrogen and oxygen gases are readily available

xiii. Study the information given below.

- I. Efficient resource usage.
- II. Reducing carbon emission.
- III. Achieving unsustainable economic growth.
- IV. Clean technologies replacing lesser efficient ones.

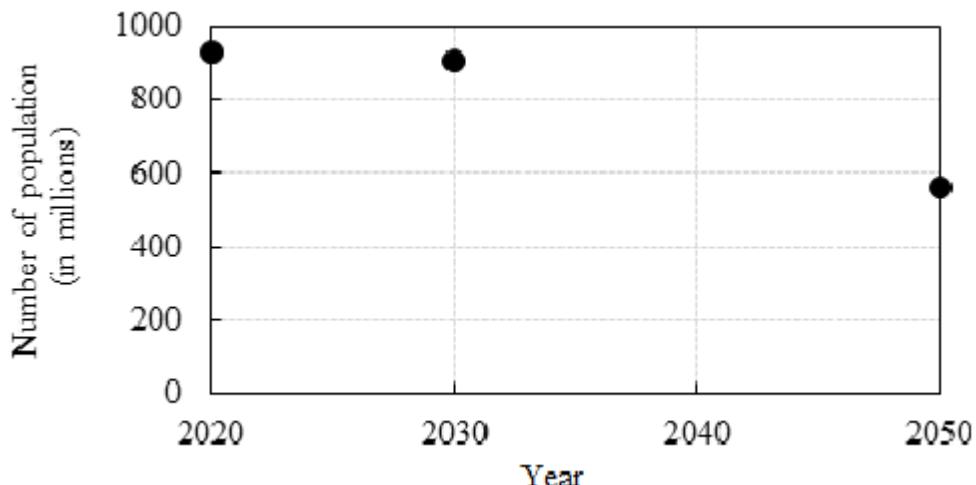
Which combinations best describes a green economy?

- A I, II and III
- B I, II and IV
- C I, III and IV
- D II, III and IV

xiv. Bhutan Agriculture and Food Regulatory Authority (BAFRA) is mainly responsible for preventing the entry of

- A air pollutants.
- B land pollutants.
- C water pollutants.
- D biological pollutants.

xv. The graph below shows the projected number of people in extreme poverty in 2020, 2030 and 2050 under a ‘COVID-19 baseline’ scenario.



(Source: UNDP, 2020)

Which Sustainable Development Goal is directly affected by the onset of the COVID-19 pandemic?

- A no poverty
- B gender equality
- C quality education
- D good health and well-being

xvi. After calculating your ecological footprint by attempting an online survey questionnaire, the result read, “If Everyone Live Like You, We Would Need 3 Earths.” What can you deduce from this finding?

- A Average bio-productive area of Earth can support all your needs and wants.
- B Your lifestyle is exceeding the average per capita bio-productive area of Earth.
- C No matter what kind of lifestyles people adopt, at least 3 Earths are required for living.
- D Earth’s bio-productive area can support exponential growth of the human population.

xvii. One of the key adaptation strategies to climate change adopted by the tourism sector in Bhutan is

- A decreasing tourism taxes.
- B diversifying eco-tourism.
- C increasing the number of regional tourists.
- D increasing the tourism related agents and operators.

xviii. Mock drills are practiced by schools and other organizations.

This activity is an example of

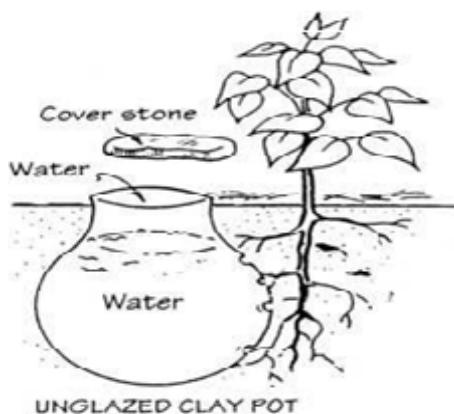
- A recovery phase.
- B response phase.
- C preparatory phase.
- D preventive mitigation.

xix. Rhododendron Bhutanese is a species of Rhododendron found only in Bhutan.

This kind of species is called

- A exotic species.
- B extinct species.
- C invasive species.
- D endemic species.

xx. Observe the given diagram carefully.



(Source: Vukasin et al. 1995)

Which of the following irrigation method is illustrated in the diagram?

- A drip irrigation
- B pitcher irrigation
- C surface irrigation
- D sprinkle irrigation

xxi. To prevent the overlapping of grazing area of livestocks with wild animals, farmers are provided with highbred livestock.

The above statement best describes

- A over grazing.
- B incentive program.
- C insurance program.
- D compensation system.

xxii. Benefit transfer method is preferred over the rest of the ecosystem service valuations for upgradation of a recreational park because it

- A requires data collection.
- B aids in ecosystem restoration.
- C helps in ecosystem conservation.
- D saves resources, time and money.

xxiii. Which of the following best explains the importance of ecological succession?

- A prevents further disturbance to the ecosystem
- B re-establishes the ecosystem within a brief period
- C provides information on the type of climax community
- D used for management and restoration of disturbed ecosystem

xxiv. Land degradation has long lasting impacts on the environment, economy and the society.

All of the following describes the impact of land degradation on the environment **EXCEPT**

- A loss of biodiversity.
- B drying up of water resources.
- C food insecurity and adverse health issues.
- D loss of ecological services for the ecosystem.

xxv. After a landslide, the whole vegetation is completely wiped out.

Identify the correct order in which plants grow to repopulate the area?

- A lichens → shrubs → grasses → trees
- B grasses → lichens → shrubs → trees
- C lichens → grasses → shrubs → trees
- D shrubs → trees → grasses → lichen

**b) Write TRUE or FALSE for the following statements in the space provided.**

**[5]**

i. Search and rescue operation during a disaster falls under mitigation phase.		
ii. Phenology is the study of change in temperature for an extended period of time.		
iii. Smaller particulate matter ( $<10 \mu\text{m}$ ) is more of a health concern than larger ones ( $>10 \mu\text{m}$ ).		
iv. Biosecurity policy of the Kingdom of Bhutan 2010 ensures protection of biodiversity from harmful pests and diseases.		
v. Ecotourism is a measure to find a balance between biodiversity		

management and human-wildlife conflict.		
vi. Thermal oxidizer is a pollution reduction technique that absorbs excess heat from the atmosphere.		
vii. National Environment Commission (NEC) is the main agency that coordinates the mitigation measures for climate change in Bhutan.		
viii. The ability of the community to adapt and resist stress during a disaster is called community development.		
ix. The international treaties like CBD and CITES are concerned with protection of world heritage monuments.		
x. One of the measures to manage human-wildlife conflict is through proper waste management system.		

[5]

c) **Fill in the blanks with appropriate word/s.**

i. A management tool that helps countries to measure the achievement of SDGs is called _____.	
ii. Countries across the world adopt the concept of green economy to achieve _____.	
iii. A tool used to check the compliance of a project with the environmental laws and regulations is called _____.	
iv. Soil is classified as loam, sand, silt and clay on the basis of its _____.	
v. Indigenous practices like ladam, ridam and sokdam have greatly contributed to the _____ of biodiversity.	
vi. The procedures that protect the population against harmful biological or biochemical agents is termed as _____.	
vii. Clay and crystalline rocks do not make good aquifers because they have a low _____.	
viii. The main aim of disaster management cycle is to develop a community or individual who are _____ to disaster.	
ix. The rhythmic activity of an organism for food, shelter and reproduction during different times of the year is termed as _____.	
x. After a volcanic eruption, some lichens and mosses were the first organisms to inhabit the area after 20 years. Such organisms are referred to as _____ species.	

d) Match each item under column A with the most appropriate item in column B. [5]  
 Rewrite the correct pairs by writing the alphabet against the number in the space provided.

Column A	Column B
i. The sustainable goal to mitigate wildlife trafficking.	a. MAPS
ii. When the ecological footprint of a country is less than its biocapacity.	b. zero poverty
iii. The method of irrigation most suitable in green-houses.	c. sprinkle irrigation
iv. A hybrid engine uses mechanical energy to run vehicles and thermal energy produced is used for powering air conditioners.	d. drip irrigation
v. Amount of oxygen required to chemically oxidize compounds in water.	e. chemical oxygen demand
vi. Walking, cycling and using public transports and electric vehicles.	f. green transport
vii. Rural rehabilitation program.	g. land subsidence
viii. Common implementation strategy of sustainable developmental goal practiced by UN.	h. biological oxygen demand
ix. Prevention of warm air escaping via ceiling by installing insulation.	i. weatherization
x. Over utilization of ground water.	j. cogeneration
	k. sustainable use of resources
	l. life on land

Column A	Column B
i.	
ii.	
iii.	
iv.	
v.	
vi.	
vii.	
viii.	
ix.	
x.	

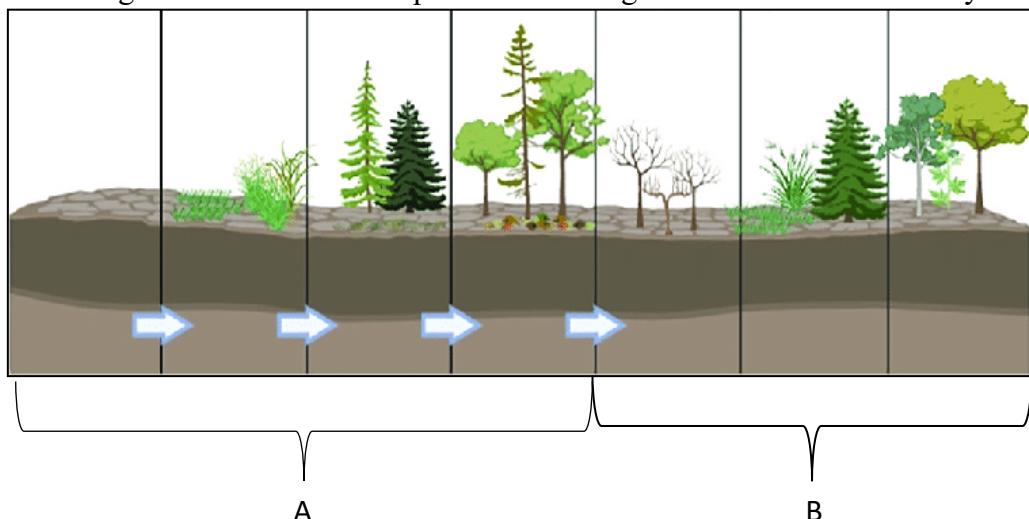
**SECTION B (60 MARKS)**  
**ANSWER ANY SIX QUESTIONS**

**Question 2**

a)i. How does increase in the vehicular traffic lead to air pollution? [1]


ii. Mention at least **TWO** health problems caused due to air pollution. [1]


b) The diagram below shows the process of ecological succession in an ecosystem.



*(Source: Khanolkar et al. 2020)*

i. Identify the type of ecological succession labelled as A and B based on the inhabitation of the places. [1]



ii. How do the two types of ecological succession differ with regard to their occurrence? [1]


iii. Give **ONE** example each for the two types of ecological succession. [1]


c) Why does ecotone contain more species diversity than the adjacent ecosystem? [2]


d) People living in urban and rural areas have the same ecological footprint. Do you agree? Justify with **THREE** points. [3]

### Question 3

a) What is meant by salinization? [1]


b) Explain sustainable development goals.

[2]


c) Summarize the roles of disaster risk reduction by mentioning **TWO** points.

[2]


d) “As the winter arrives the black mountain range is covered in snow. The Phobjekha valley in Wangduephodrang winter home to the Black-necked Crane is a primary habitat for them. This is the valley where the country’s conservation initiatives began. Black-necked Crane or *Grus nigricollis* (BNC) has moved one category closer to safety from vulnerable to near threatened.

(Source: Kuensel, 2021)

i. Which international convention is responsible for the conservation of wetlands such as the Phobjekha valley?

[1]


ii. How has the above mentioned convention contributed towards the conservation of Black-necked Cranes in Bhutan?

[1]


e) Despite extensive efforts by the government for biodiversity management, we are faced with many challenges among which human-wildlife conflict is the most common.

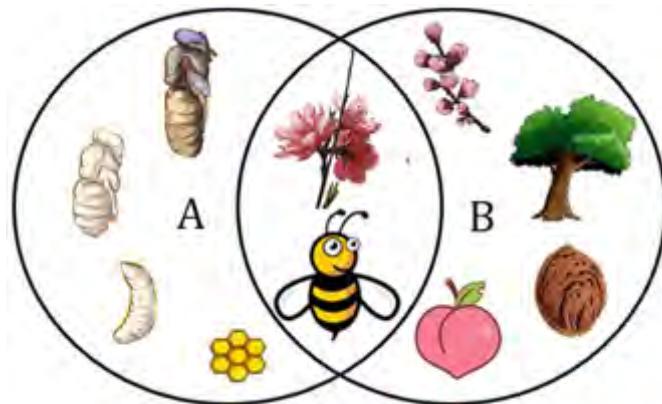
If you are appointed as one of the policy makers for biodiversity management, what measures would you adopt to overcome this problem? Mention **THREE** points.

[3]

## Question 4

a) What are the significant measures taken by Bhutan to mitigate climate change? [2]  
Mention any **TWO** points.

b) The diagram below represents the phenophases of a peach tree and bee.



i. How is the phenophase of peach tree affected with delay in phenophase of bee? [2]


ii. What does the overlapping area of two circles A and B represent?

[1]


c) State at least **SIX** advantages of green buildings over traditional buildings.

[3]


d) “COVID-19 pandemic has brought us to a conclusion that we all are mere players in the hands of nature which we had been taking for granted for several decades together. It had been sending signals in one form or the other to mend our ways, but we have been ignoring it impertinently.”

(Source: GRIHA Council, 2021)

How has COVID-19 pandemic contributed towards reduction of environment pollution?

[2]


#### Question 5

a) Explain at least **TWO** causes of urbanization in Bhutan.

[2]


b) Describe any **ONE** method of rainwater harvesting practices in Bhutan.

[2]


c) How can you incorporate green economy initiatives in your school? Give any **THREE** points.

[3]


d) Clean water and sanitation is the sixth goal of Sustainable Development Goal which ensures access to water and sanitation for all.

List down **THREE** measures taken by our government to achieve the goal.

[3]

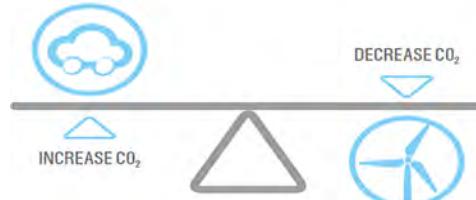
## Question 6

a) What do you understand by the term ecological niche of an organism?

[1]

--	--


b) The diagram given below is one of the technologies to reduce pollution.



(Source: bp, 2021) [0.5]

i. Identify the technology represented by the diagram.


ii. Explain the mechanism of the technology with **ONE** example.

[1.5]

c) Given the vital role that protected areas play in the preservation of biodiversity and reduction of extinction risk of threatened species, their effective management is of utmost importance to conservation.

(Source: Wangmo et al. 2021)

As an environmental science student, suggest **THREE** measures for effective management of protected areas in Bhutan.

[3]

d) Why do you think that assessment of land degradation plays an important role in the policy making process of a country?

[2]


e) The pictures A and B below are two methods which cause contamination of groundwater.



What is the difference in the way these methods contaminate the ground water?

[2]

Picture A	Picture B

### Question 7

a) State the importance of phenology in understanding climate change. Give **TWO** [2] points.


b) The picture shows wastes being thrown irresponsibly in the Pachhu river.



The mounting issue of wastes is a huge challenge for Bhutan too. Explain **TWO** [2] impacts to the aquatic ecosystem by this type of activity.


c) Study the figures given below.



A

B

i. Identify the kind of interaction shown in figures A and B.

[1]


ii. How is the ecological niche of the White-bellied Heron different from the bumble bees? Give **TWO** differences.

[2]

White-bellied Heron	Bumble Bees

d) Observe the figure given below.



(Source: Kuensel, 2020)

i. Name the phenomenon shown in the picture.

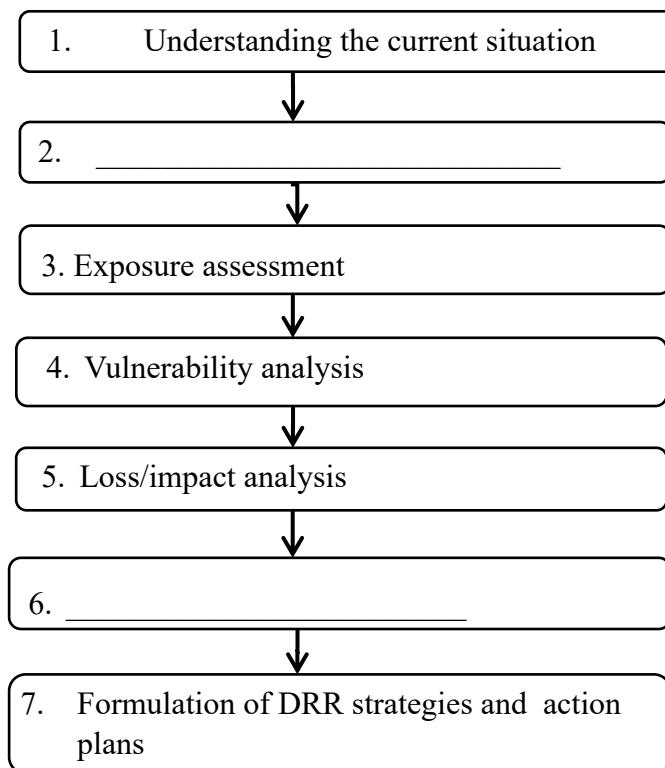
[1]


ii. Suggest **TWO** recommendations to prevent such a phenomenon from occurring.

[2]


### Question 8

a) Study the disaster risk reduction chart and fill in the missing components to complete the steps of Disaster Risk Reduction (DRR). [2]



b) The table shows land use and land cover change in Bhutan for 2000–2013.

Class Name	%Area 2000	%Area 2006	Change 2000-2006	%Area 2013	Change 2006-2013	Change 2000-2013
Snow	4	6	2	9	3	5
Lake	1	1	0	1	0	0
River	2	2	0	3	1	1
Barren	20	6	-14	7	1	-13
Vegetation	54	64	10	58	-6	4
Agriculture	14	15	1	8	-7	-6
Build-up	5	6	1	14	8	9
Total	100	100	0	100	0	0

(Source: Yangchen et al. 2015)

i. The built-up area shows a change of 5% in 2000 to 14% in 2013. What are some of the reasons that have caused such changes? Mention **TWO** reasons. [1]

--


ii. Vegetation land use cover shows the maximum increase from 2000 to 2006. Mention [2] **TWO** reasons that accounts for the change.


c) The renewable energy landscape in Bhutan is dominated by hydropower. Other renewable energy technologies such as solar, wind and bioenergy are often limited to pilot projects and small applications.

*(Source: Camera, 2019)*

As a responsible citizen, what strategies would you suggest to the government to enhance the use of alternative energy sources? Give **THREE** points. [3]


d) As mandated by the Convention on Biological Diversity (CBD), Bhutan has adopted the National Biodiversity Strategies and Action Plan (NBSAP).

How does the adoption of NBSAP help Bhutan in biodiversity management?

**Question 9**

a) Explain biodiversity management at the community level. Provide any **TWO** points. [1]


b) Mention the four pillars of Gross National Happiness. [2]


c) The table shows a hypothetical water quality standard parameters.

Sl. No	Parameters	Water Samples		
		A	B	C
1	pH	6.5–8.5	6–9	6–9
2	Conductivity (µs/cm)	800	1000	2000
3	Dissolved Oxygen (mg/L)	6	4	–
4	Biological Oxygen Demand (Mg/L)	2	45	50
5	Total Coliform (MPN/100ml)	50	5000	1000

Which sample is suitable for drinking purposes? Why? Support with **TWO** reasons.

[2]

d) Excessive use of forest resources cause land degradation in Bhutan.

Is it so? Justify with **THREE** reasons.

[3]




- e) “Life Cycle Assessment” and “International Organization for Standardization Certification” are two common tools used for environmental management and environmental performance improvement.

Which of the two tools is most suitable for environmental management and performance improvement? Support your answer with **TWO** reasons.

[2]