CHAPTER 21 Space and Environment

Student's Learning Outcomes (SLOs)

After studying this chapter, students will be able to:

- explain the nature of the Sun [as a star of medium size, it consists mostly of hydrogen and helium, and that it radiates most of its energy in the infrared, visible and ultraviolet regions of the electromagnetic spectrum],
- interpret and compare given planetary data [about orbital distance, orbital period, density, surface temperature and uniform gravitational field strength at the planet's surface],
- use ideas of convection to explain how cyclones are formed.
- explain how global warming contributes to extreme weather events [specifically in the case of hurricanes, heat waves, flooding, rainfall, wildfires, droughts, winter storms],
- explain what is meant by background radiation.
- state the sources that make a significant contribution to background radiation [including:
  (a) radon gas (in the air)
  (b) rocks and buildings
  (c) food and drink
  (d) cosmic rays.

Subjective Type Questions

Long Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

Introduction

Q.1: What is the importance to understand space and environment?

Ans. Space and the environment are closely connected to each other. In order to understand and solve problems on the Earth, it is essential to explore the space. In the space, information regarding the environmental changes are collected by the satellites, orbiting around the Earth. This enables scientists to make efforts to protect the Earth using the data obtained from the satellites. New ideas have been created due to advancements in the space technology which help in obtaining renewable energy with better and efficient utilization of the materials. The study of space also enables us to understand the origin and evolution of the universe and to make the technological advancements.

Q.2: Describe the process of nuclear fusion in the sun. Explain how it generates energy?

Ans. Composition:

The Sun is the greatest source of light, heat and other forms of electromagnetic (E.M.) waves. The gravitational pull of the Sun keeps planets, including the Earth to orbit around it. The Sun is located at the centre of our solar system. The Sun contains 74 % of hydrogen and 24 % of helium along with few other elements.

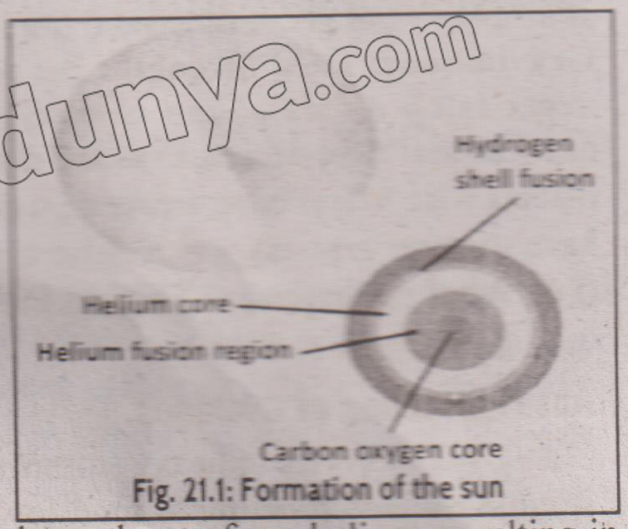

Fig. 21.1: Formation of the sun

Nuclear Fusion:

Nuclear fusion takes place at the core of the Sun (Fig. 21.1), in which hydrogen atoms are fused together to form helium, resulting in a tremendous increase in the temperature of the Sun (in millions of degree celsius). This releases a massive amount of energy which reaches the Earth in the form of light and heat. The energy released from the Sun travels through space in the form of various types of radiations such as infrared, heat, sunlight and ultraviolet radiations. These radiations have a considerable impact on the people living on the Earth and other form of lives. The energy obtained from the Sun plays an essential role in making weather patterns, changing the climate and supporting the ecosystems. For the study of planets, it is necessary to focus on different factors such as orbital distance, orbital period, density, surface temperature, gravitational field strength, etc. which makes each planet unique.

Q.3: How does planet's orbital distance affect its surface temperature and the amount of solar energy it receives?

Ans. Orbital Distance:

The solar system is shown in Fig. 21.2. Those planets that are closer to the Sun have smaller orbital distance and those located at a far away distance from the Sun have large orbital distances. Orbital distance plays a vital role in determining the amount of solar energy received by each planet.

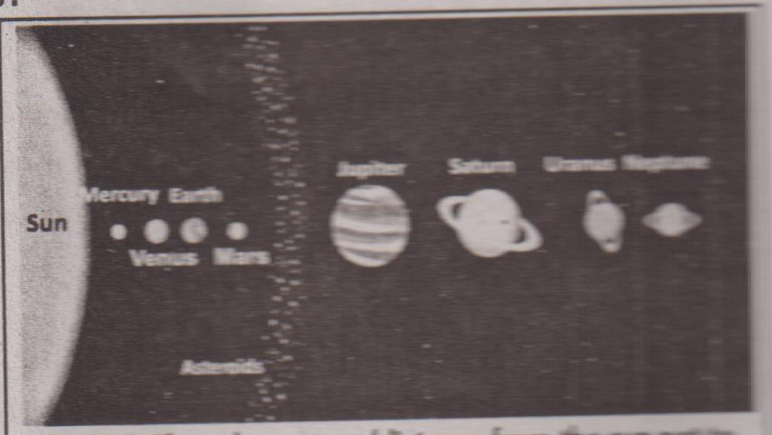

Fig. 21.2: The solar system (distance from the sun not to scale)

Orbital Period:

This is the time a planet takes to complete one orbit around the Sun. Planets closer to the Sun have shorter orbital periods.

Density:

Density reflects a planet's composition. Rocky planets like Earth and Mars have higher densities due to their solid, metallic cores, while gas giants like Jupiter and Saturn have lower densities because they are composed mostly of hydrogen and helium.

Surface Temperature:

This depends on factors like distance from the Sun, atmospheric composition, and greenhouse effects. For example, Venus has an extremely high surface temperature due to its thick, heat-trapping atmosphere, while Mars is much colder due to its thin atmosphere and greater distance from the Sun.

Gravitational Field Strength: For a planet, the gravitational field strength at its surface depends on its mass, and is nearly uniform across its surface. The strength of the gravitational field decreases as the distance from the planet increases. Smaller planets (like Mars) have weaker gravitational force, while larger planets (such as Jupiter) have stronger gravitational relative to the Earth.

Q.4: What is cyclones? Explain the role of convection formation and strengthening of cyclone.

Ans. Formation of Cyclones:

Cyclones refer to heavy storms containing fast and spinning winds forming around low air pressure area (Fig. 21.3). The phenomenon of convection is responsible to develop these cyclones. The convection takes place due to rise of the warm air (being lighter) as compared to the (heavier) cool air that moves down. Due to rise in the warm air, more air rushes in to take its place, which creates the spinning effect. The cyclone grows stronger and bigger due to the movement of air (Fig. 21.4).The convection contributes to cyclone formation in the following ways:

Fig. 21.3: Cyclone

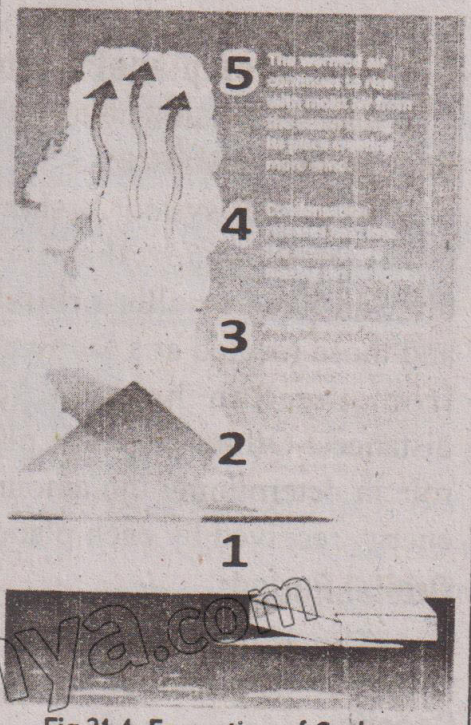

Fig.21.4: Formation of Cyclone

1. Warm Ocean Waters:

Formation of cyclones occurs (over warm oceans) where temperature of the sea surface is very high (27 °C or 300 K). The air above the warm water is heated, becomes less dense and rises rapidly. This movement of the warm air in the upward direction creates an area of low pressure at the surface.

2. Rising Air and Condensation:

The rising warm air moves to low air pressure areas, causing the air to expand. The clouds are formed due to the moisture in the air and as a result, heat is released into the surrounding air. Due to this heat, the air becomes even warmer and it rises even faster. As this process continues, the warm air further rises, forms more clouds and increases the release of more heat in the surroundings. This cycle keeps going, making the cyclone stronger and helping it grow bigger.

3. Formation of a Low-pressure Centre:

As the warm air keeps rising, it leaves behind empty space near the surface, like a small vacuum. To fill this space, warmer, moist air from the surrounding areas rushes in. Because the Earth is spinning, this moving air does not go in a straight line. Instead, it starts to spin around the low-pressure area. This effect is called the Coriolis effect. In the northern hemisphere, the air spins anticlockwise, while in the southern hemisphere, it spins clockwise. This spinning motion helps shape the cyclone and keeps it growing stronger

4. Development of a Cyclonic System:

As more warm air keeps getting pulled into the storm, the rising and spinning of the air becomes even stronger. The cyclone keeps growing as long as it has warm, moist air from the ocean. In the middle of the cyclone, a special area called the eye forms, where the air moves downward, making it calm and clear. However, just outside this calm centre is the eye wall, which is the most dangerous part of the cyclone. Here, the winds are extremely strong, and heavy rain falls, making this the most powerful part of the storm.

5. Energy Dissipation:

Cyclones start to weaken when they move over land or colder water because they can no longer get warm, moist air, which acts like fuel for the storm. Over the ocean, this warm air keeps the cyclone strong by helping the air rise and spin. But when the cyclone moves away from the warm ocean, the air stops rising as much, and the spinning slows down. Without this energy, the storm loses its strength, the winds become weaker, and the cyclone slowly fades away.

21.2 Global Warming and Geothermal Activity

Q.5: Why understanding of Global warming and geothermal activities are important?

Ans. Global warming: Global warming is a long term increase in the average surface temperature of the Earth due to burning of fossil fuels, release of gases like methane, carbon dioxide, nitrous oxide, cutting down forests, and using certain industrial and farming methods. The gases trap the heat coming from the Sun and causes an increase in the temperature. The global warming has a great impact on the weather, sea level and disruptions to ecosystems.

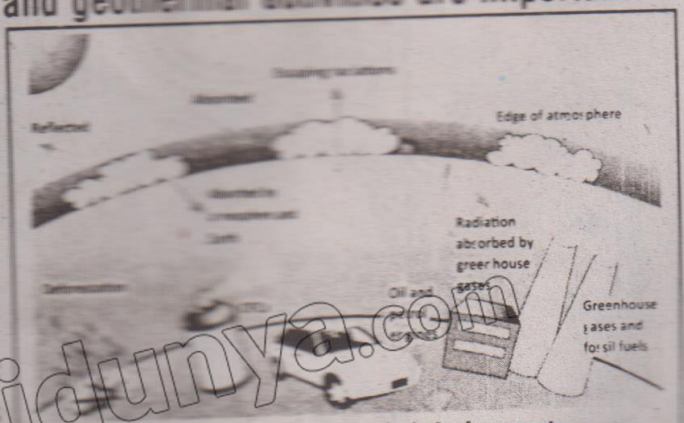

Fig. 21.5: Illustration of global warming

Geothermal activity: Similar to global warming, the inner heat of the Earth (Geothermal Activity) causes volcanic eruptions, geysers, hot springs, and the movement of tectonic plates. Geothermal energy is considered as renewable resource of energy due to its sustainability as long as the Earth's internal heat remains active. Global warming has been illustrated in Fig. 21.5.

Q.6: Write few effects of Global warming and geothermal activities on environment.

Ans. Hurricanes:

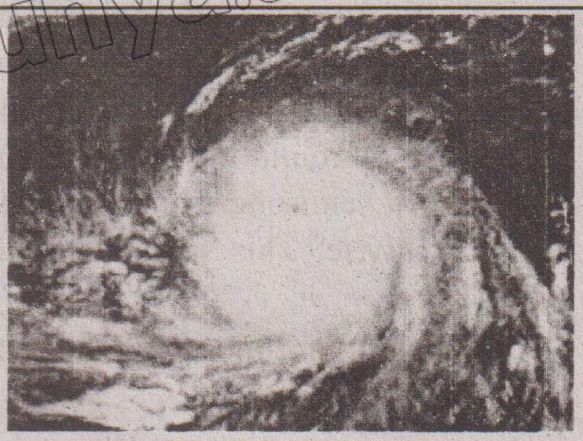

Fig. 21.6: Hurricane

Due to rise in the temperature, more heat is absorbed by the ocean which fuels hurricanes, making them stronger and more destructive. Intensity of hurricanes is increased by the warmer ocean waters, with higher wind speeds and heavier rainfall, causing greater damage (Fig. 21.6). Furthermore, ice begins to melt and seawater expands due to rise in the temperatures. This results in higher sea levels. Consequently, stronger storm surges and more frequent flooding in coastal areas take place, increasing the damage to homes and communities

Heat waves:

The rise in the global temperatures produces heatwaves. The heat is trapped by the gases in the atmosphere, leading to extended periods of extreme heat. Buildings and roads absorb heat and retain it. Cities are particularly affected, as buildings and roads absorb and retain heat, causing those areas to be much hotter compared to the others (Fig. 21.7).

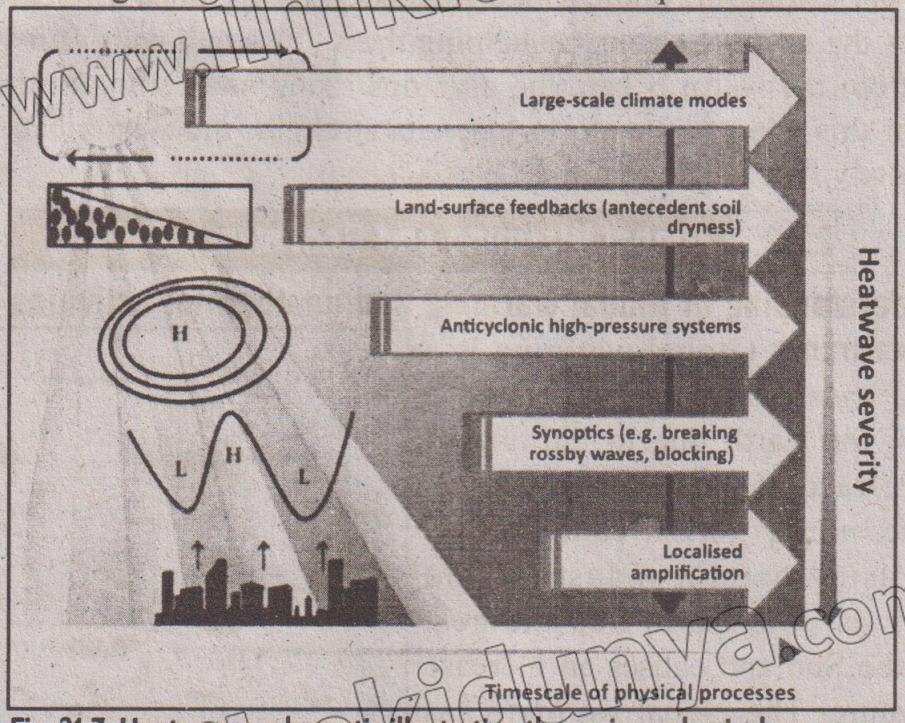

Fig. 21.7: Heatwaves schematic illustrating the various physical processes

Flooding:

Heavier rainfall comes to a warmer atmosphere because it can hold more moisture, resulting in intense flooding in those areas. As global warming changes weather patterns, storms become stronger, increasing the risk of both inland and coastal floods. In addition sea levels to rise due to melting glaciers and ice sheets, resulting in more flood in the coastal regions.

Wildfires:

Wildfires often result from high temperatures and long periods of dryness. With reduced moisture in the air and soil, forests and grasslands become more susceptible to ignition. The wildfire season is also lasting longer due to earlier snowmelt and extended dry periods. As a result, wildfires are becoming more common, more severe, and more damaging, threatening ecosystems and communities alike

California wildfire fury

Droughts:

Due to increase in the temperature, more water evaporates from the land, drying out the soil. This reduces the water available for plants, animals, and people which causes droughts to last longer and become more intense, particularly in areas already facing water shortages. Changes in rainfall patterns also lead to extended dry periods, making it harder to grow crops and provide enough drinking water for communities.

Winter Storms:

Global warming can also make winter storms stronger. Warmer air holds more moisture, which means heavier snowfalls when temperatures are cold enough. This leads to extreme winter storms, including heavy snow, ice storms, and longer periods of freezing weather in unexpected places.

Florida winter storm chaos

21.3 Radiation Exposure

Q.7: How radiation exposure can be harmful and how to minimize its risk?

Ans. Radiation exposure: Radiation exposure happens when someone comes into contact with radiation, which is a type of energy (Fig. 21.8). This energy can come from natural sources like the Sun and the ground or from man-made sources like X-ray machines and nuclear power plants.

Fig. 21.8: Radiation exposure warning

Safety measures: A small amount of radiation is usually safe, but too much exposure can harm our bodies by damaging cells. That is why we use safety measures, like protective wear and limited exposure, to stay safe while using radiation for useful purposes.

Q.8: Define background radiation and write Majore Sources of background radiation.

Ans. Background Radiation:

"The radiation that exists around us all the time is known as background radiation."

Explanation: It is the constant, low-level ionizing radiation present in the environment from both natural and human-made sources. It includes cosmic rays from space, radioactive materials in the Earth's crust (like uranium and radon), and even tiny amounts of radiation in our food and bodies. Human activities, such as medical procedures (X-rays, CT scans), nuclear power plants, and past nuclear testing, also contribute to it. Background radiation is usually harmless at normal levels, but it is an ever-present part of our world, reminding us of the natural and human influences that shape our environment (Fig. 21.9).

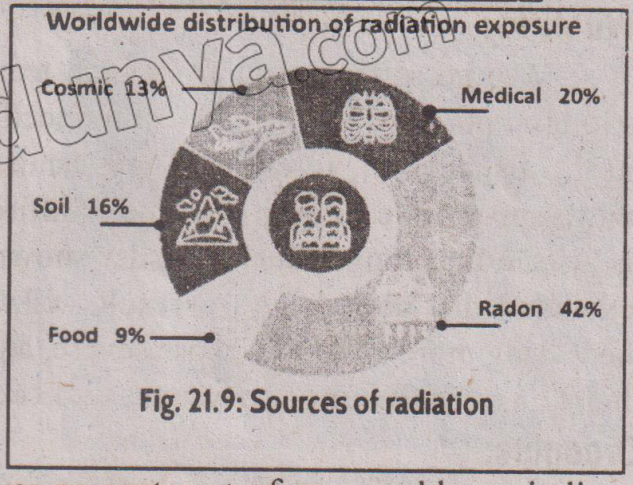

Fig. 21.9: Sources of radiation

Sources of Radiation:

(a) Radon gas (in the air):

1. Radon gas is an alpha emitter.
2. Radon gas is particularly dangerous if it is inhaled into the lungs in large quantities.
3. The gas is tasteless, colourless and odourless, but it is not generally a health issue unless levels are significantly high.

(b) Rocks and buildings:

1. Natural radioactivity can be found in building materials, including decorative rocks, stones and bricks.
2. Heavy radioactive elements, such as uranium and thorium, occur naturally in rocks in the ground.
3. Uranium decays into radon gas.

(c) Food and Drink:

1. Food and water contain small amounts of naturally occurring radioactive isotopes, such as potassium-40 and carbon-14.
2. These isotopes are absorbed by plants and animals and enter the human body through consumption.
3. The contribution from food and drink is generally small but consistent.

(d) Cosmic rays from space:

1. The Sun and other stars emit an enormous number of cosmic rays including protons every second.
2. Some of these enter the Earth's atmosphere at high speeds.
3. When they collide with molecules in the air, they lead to the production of gamma radiation.
4. High exposure to radiation in a short time can cause radiation sickness, with symptoms like nausea, vomiting, fatigue, and organ damage.
5. Long-term exposure to low levels of radiation increases the risk of cancer, especially in organs like the lungs, thyroid, and bones.

6. Radiation can damage DNA, leading to genetic mutations that may affect future generations.
7. Radioactive materials can contaminate air, water, soil, and food, spreading radiation to the environment.
8. Inhaling radioactive dust or drinking contaminated water can cause internal exposure, where radioactive particles stay in the body and keep emitting radiation.
9. Accidents, such as leaks, spills, or explosions, can occur if radioactive materials are not stored or handled safely.
10. Nuclear power plant accidents or improper waste management can lead to large-scale disasters, harming communities and ecosystems.
11. Radioactive materials can be misused in nuclear bombs, which spread radiation using conventional explosives, causing panic and long-term contamination.

FOR YOUR INFORMATION

Thanks to water's high specific heat capacity, oceans absorb and release heat slowly, helping to regulate global climate and reduce the intensity of heat waves until global warming messes with the balance.

Exposure pathways to humans from environmental release of radioactive materials.

DO YOU KNOW?

Planets have different orbital periods. While Earth takes 365.25 days to orbit the Sun, Mercury takes just 88 days, and Neptune takes 165 Earth years!

Some cosmic rays that hit the Earth have travelled for millions of years from distant galaxies before colliding with atoms in our atmosphere to produce background radiation.

Tidbits

Even though it looks like a burning ball, the Sun does not burn like wood or coal. It fuses hydrogen into helium in its core, releasing immense energy through nuclear fusion, not combustion.

Even after 4.5 billion years, the Earth's core remains molten, partly due to radioactive decay and the heat leftover from planetary formation.

Earth-observing satellites can detect heat patterns, water vapour, and storm movement, helping scientists predict cyclones and track climate change with astonishing precision.

As temperatures rise, more water evaporates from land and water bodies. This leads to longer droughts, drying out the soil and stressing water supplies for agriculture, wildlife, and cities.

Global warming heats up the oceans, and warm ocean water acts like fuel for hurricanes. The hotter the water, the more energy the storm gets leading to stronger wind, heavier rainfall, and longer lasting storms.

Radon gas from the ground can seep into homes especially basements and contribute to natural background radiation. It is invisible, odourless, and radioactive.

Brain Teaser

1. **Which type of radiation comes from space and can affect airline pilots, but never passes through walls?**

Ans. Cosmic radiation.

Objective Type Questions

Additional MCQ's

Multiple Choice Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

21.1 Sun and Planetary Data

1. **Highest at percentage gas present on Sun:**
   (a) Hydrogen (b) Oxygen (c) Nitrogen (d) Argon
2. **Sun contain helium:**
   (a) 20% (b) 24% (c) 30% (d) 74%
3. **Which relation take place at the core of the sun?**
   (a) Addition (b) Substitution (c) Nuclear fusion (d) Nuclear fission
4. **Which orbit has smallest orbital distance?**
   (a) Earth (b) Venus (c) Mercury (d) Neptune
5. **Orbital period of earth is:**
   (a) 365 days (b) 365.25 day (c) 360 days (d) 336 days
6. **Which planet has higher density?**
   (a) Mars (b) Jupiter (c) Saturn (d) None of these
7. **Which planet has highest temperature?**
   (a) Jupiter (b) Earth (c) Mars (d) Saturn
8. **In the northern hemisphere, it spins:**
   (a) anticlockwise (b) clockwise (c) downward (d) upward
9. **Most dangerous part of cyclone is:**
   (a) Eye forms (b) Eye wall (c) Eye (d) Eye basine

21.2 Global Warming and Geothermal Activity

10. **Causes of global warming are:**
    (a) Fossil fuel burning (b) Release of gases
    (c) Cutting of forest (d) All of these

21.3 Radiation Exposure

11. **Which gas from the ground can seep into the homes?**
    (a) Hydrogen (b) Neon (c) Argon (d) Radon

12. Radioactive element uranium decay produces which gas?
(a) Radon (b) Neon (c) Argon (d) Hydrogen

13. Which radiative elements are present in food and water?
(a) Potassium–40 (b) Carbon–14 (c) Both a & b (d) None of these

14. While colliding the cosmic rays with molecules produces.
(a) Alpha-radiations (b) Beta - radiation (c) Gamma radiation (d) theta radiation

ANSWERS:

1.	(a)	2.	(b)	3.	(c)	4.	(c)	5.	(b)	6.	(a)	7.	(c)
8.	(a)	9.	(b)	10.	(d)	11.	(d)	12.	(a)	13.	(c)	14.	(c)

Additional Short Questions

Short Answer Questions prepared in the light of new Examination Techniques (Knowledge, Understanding, Application, Analytical & Conceptual)

21.1 Sun and Planetary Data

1. What is the role of Sun in our solar system?

Ans. The sun is located at the center of our solar system. The gravitational pull of the Sun keeps planets, including the earth to orbit around it. Sun is also the greatest source of light, heat and electromagnetic waves.

2. Why Sun looks like a burning ball?

Ans. The Sun does not burn like wood or coal. It fuse hydrogen into helium in its core, releasing immense energy through nuclear fusion, not combustion.

3. What is role of energy coming from sun?

Ans. The energy coming from Sun have considerable impact on the people living on Earth and other form of lives. The energy obtained from the Sun play essential role in making weather patterns, changing the climate and supporting the ecosystem.

4. How Gravitational field strength vary on planets?

Ans. Gravitational field strength depends on its mass and is nearly uniform across its surface Gravitational field decrease as a distance from the planet increases. Smalls planets like Mars have weaker a gravitational force, while larger planets such as Jupiter have stronger gravitational field.

5. What are cyclones?

Ans. Cyclones refer to heavy storms containing fast and spinning winds forming around low air pressure area. The phenomenon of convection is responsible to develop these cyclones.

6. How convection is responsible for cyclones formation?

Ans. Convection is the phenomenon take place due to rise of the warm air (being lighter) as compared to the (heavier) cool air that moves down. Due to rise in the warm air, more air rushes in to take its place, which creates the spinning effect.

7. **What is coriolis effect?**

Ans. As the warmer air keeps rising, it leaves behind empty space near the surface. To fill this space warmer, moist air from the Surrounding areas rushes in. Because earth is spinning, this moving air does not go in a straight line. Instead, it starts to spin around the low pressure area. This effect is called coriolis effect.

8. **What are the roles of Earth-observing satellites?**

Ans. Earth-observing satellites can detect heat patterns, water vapour, and storm movement, helping scientist predict cyclones and track climate change with astonishing.

21.2 Global Warming and Geothermal Activity

9. **What is global warming? Write few causes of it.**

Ans. Global warming is a long term increase in the average surface temperature of the Earth due to burning of fossil fuels, release of gases like methane, CO_2, NO, cutting forest, and using certain industrial and farming methods.

10. **Why geothermal energy considered as renewable source of energy?**

Ans. Geothermal energy is considered as renewable source of energy due to its sustainability as long as the Earth's internal heat remains active.

11. **How rise in temperature effect the Earth's environment?**

Ans. As temperature rise more Water evaporates from land and water bodies. This leads to longer droughts, drying out the soil and stressing water supplies for agriculture, wildlife, and cities.

21.3 Radiation Exposure

12. **Define background radiation.**

Ans. The radiation that exists around us all the time is known as background radiation. It includes cosmic rays, radioactive materials, X-rays etc.

13. **What are the safety measures during radiation exposure?**

Ans. Following are the safety measures during someone expose to radiations:

1. One should use protective wear.
2. Take limited exposure so that one should be safe.
3. Use radiations for useful purposes.

14. **Write names of sources of background radiations.**

Ans. 1. Radon gas(in air) 2. Rocks and buildings
3. Food and Drink 4. Cosmic rays from space

Exercise Questions (Solved)

A. Multiple Choice Questions

☆ **Tick (✓) the correct answer.**

21.1 What process generates energy in the Sun?

(a) Nuclear fission (b) Nuclear fusion
(c) Radioactive decay (d) Chemical reactions

21.2 The factor which primarily determines a planet's surface temperature:

(a) its density (b) its orbital distance from the Sun

(c) its gravitational field strength (d) the number of moons it has

21.3 What is the primary reason cyclones form over warm ocean waters?

(a) The presence of strong winds (b) The high atmospheric pressure

(c) The rising of warm, moist air creating low pressure

(d) The gravitational pull of the moon

21.4 Which of the following gas contributes the most to global warming?

(a) Oxygen (b) Carbon dioxide (c) Nitrogen (d) Argon

21.5 How does the Coriolis effect influence cyclones?

(a) It causes cyclones to spin in opposite directions in different hemispheres

(b) It strengthens cyclones over land (c) It prevents warm air from rising

(d) It stops the formation of low-pressure areas

21.6 A major cause of rising sea levels is:

(a) increased volcanic activity (b) the Earth moving closer to the Sun

(c) melting glaciers and ice sheets (d) decreased solar radiation

21.7 A significant source of background radiation is:

(a) oxygen in the air (b) cosmic rays from space

(c) sound waves in the atmosphere (d) light from the Sun

Answers

21.1 (b) **21.2** (b) **21.3** (c) **21.4** (b) **21.5** (a) **21.6** (c) **21.7** (b)

B. Short Answer Questions

21.1 What are the two main elements that make up the Sun?

Ans. Hydrogen and helium are the two main elements present on Sun. The Sun contain 74% of hydrogen and 24% of helium.

21.2 What factors are used to compare planets in terms of their characteristics?

Ans. For the study of planets, it is necessary to focus on different factors such as size, mass, composition, distance from the Sun, orbital period, surface temperature, gravitational field strength, and moons.

21.3 Explain how global warming increases the intensity of hurricanes.

Ans. Global warming increases sea surface temperatures, providing more energy for hurricanes. Warmer temperatures also lead to higher evaporation rates, increasing humidity in the atmosphere, which fuels storm intensity.

21.4 What is background radiation, and what are its natural sources?

Ans. Background radiation is the constant, low-level radiation that is present everywhere. Natural sources include cosmic radiation from space, radioactive materials in the Earth's crust (such as uraium and thorium), and radon gas.

21.5 Name three safety measures used to handle radioactive materials safely.

Ans. Following are the safety measures during someone expose to radiations.

1. One should use protective wear.

2. Take limited exposure so that one should be safe.
3. Use radiations for useful purposes.

21.6 Why do cyclones weaken when they move over land?

Ans. Cyclones start to weaken when they move over land or colder water because they can no longer get warm, moist air, which acts like fuel for the storm.

21.7 How does the Coriolis Effect influence the movement of cyclones?

Ans. As the warmer air keeps rising, it leaves behind empty space near the surface. To fill this space warmer, moist air from the Surrounding areas rushes in. Because earth is spinning, this moving air does not go in a straight line. Instead, it starts to spin around the low pressure area. This effect is called coriolis effect.

21.8 What is the primary cause of rising sea levels due to global warming?

Ans. The primary cause of rising sea levels due to global warming is thermal expansion of water and the melting of glaciers and ice sheets.

C. Constructed Response Questions

21.1 Why do gas giants like Jupiter, despite their larger size, have lower densities than rocky planets such as Earth and Mars? What does this tell us about their internal structure?

Ans. Gas giants like Jupiter are mainly made of light gasses such as hydrogen and helium, while rocky planets like Earth and Mars are composed of heavy material like iron, nickel and silicate rocks. Because gasses are much less dense than rocks and metals, gas giants have lower average density even though they are much longer in size. This tell us that their internal structure is mostly gaseous, with possibly a small dense core surrounded by thick layer of gas.

21.2 If two planets receive the same amount of sunlight but have different atmospheric compositions, why might their surface temperatures still differ significantly?

Ans. Different atmospheric compositions, effect how much heat planet traps or releases some gases like carbon dioxide, methane, and water vapor cause a greenhouse effect, trapping heat and raising temperature. So, even if two planets receive equal sunlight, the one with more greenhouse gases will be warmer while the one with a thinner or different atmosphere will be cooler.

21.3 How does the coriolis effect play a role in creating the spiraling motion of cyclones, and what might happen to cyclone formation if the Earth stopped rotating?

Ans. The coriolis effect, caused by earth's rotation, deflects moving air, making winds curve instead of moving straight. This produces the spiraling motion of cyclones.
If earth stopped rotating, the coriolis effect would disappear and cyclones would not spiral, winds would flow directly low and low pressure centers, preventing cyclone formation.

21.4 Compare the ways radiation, conduction, and convection each contribute to geothermal activity. Why is convection considered the primary driver of tectonic plate motion?

Ans. Radiation: Transfer of heat as electromagnetic waves minor role inside Earth.

Conduction: Transfer heat through direct contact - slow process.

Convection: Transfer heat by movement of hot molten material in the mantle.

Convection is the primary driver of tectonic plate motion. Because hot magma rises and cooler magma sinks, creating convention currents that more Earth plates.

21.5 Explain why background radiation is always present in our environment and how cosmic and terrestrial sources balance each other despite fluctuations in human activity.

Ans. Back ground radiation is always present due to:

- Cosmic sources (radiation from space and the sun)
- Terrestrial Sources (radio active elements in rocks, soil, air, and water)

Even through human activities add some radiation, naturel sources dominate and both cosmic and terrestrial sources remain relatively balanced, keeping background radiation constantly present.

D. Comprehensive Questions

21.1 Describe the process of nuclear fusion in the Sun and explain how it generates energy.

Ans. For Answer See Q # 2

21.2 How does a planet's orbital distance affect its surface temperature and the amount of solar energy it receives?

Ans. For Answer See Q # 3

21.3 Explain the role of convection in the formation and strengthening of cyclones.

Ans. For Answer See Q # 4

21.4 What are the major sources of background radiation, and how does human activities contribute to it?

Ans. For Answer See Q # 8

21.5 Explain how radiation exposure can be harmful and describe three key safety measures used to minimize its risks.

Ans. For Answer See Q # 7

Pairing Scheme/ Instructions for Preparation of Examination Paper

The paper of Physics for class-10 will consist of 60 marks. Timing of the paper will be two (02) hours (Objective 15 minutes and Subjective 1: 45 hours). The paper will be made as per following details:

Objective	**Q-1:** 12 Multiple Choice Questions (MCQs) will be developed from the entire content of the textbook. One MCQ will be asked from each chapter.	(1×12) = 12
Subjective (Part-I)	This section will contain three short answer questions. Each short answer question will be asked from the content of the textbook. The detail is as follows: **Q-2:** 5 short answer questions have to be answered out of 8. The detail is as follows: • Two short answer questions should be asked from each chapter; 10, 11, 12 and 13.	(2 × 5) = 10
	Q-3: 5 short answer questions have to be answered out of 8. The detail is as follows: • Two short answer questions should be asked from each chapter; 14, 15, 16 and 17.	(2 × 5) = 10
	Q-4: 5 short answer questions have to be answered out of 8. The detail is as follows: • Two short answer questions should be asked from each chapter; 18, 19, 20 and 21.	(2 × 5) = 10
(Part-II)	This section will contain three detailed questions and students have to attempt any two (02) questions carrying 9 marks each. Each detailed question will be asked form the content of the textbook. The detail is as follows: **Q-5:** One detailed question will be asked from chapters; 10, 11, 12 and 13. **Q-6:** One detailed question will be asked from chapters; 14, 15, 16 and 17. **Q-7:** One detailed question will be asked from chapters; 18, 19, 20 and 21.	(2 × 9) = 18

Note: In this section, each question will consist of two parts. Part (a) may be asked from any chapter. Part (b) will be asked from any different chapter (not from the same chapter as Part (a). Part (a) will carry 4 marks, while Part (b) will carry 5 marks.

Model Paper of Physics For Class-10

Objective Type

Time Allowed: 15 Min **Max. Marks: 12**

Note: Four possible answers A, B, C and D to each question are given. The choice which you think is correct, fill that circle in front of that question with marker or pen ink in the answer-book. Cutting or filling two or more circles will result in zero mark in that question.

1. Select the correct answer. **(1×12=12)**

(i) The latent heat of vaporization of water is:

(a) ✓ 2.26×10^6 J (b) 2.26×10^6 J kg^{-1} (c) 2.26×10^5 J (d) 2.26×10^5 J kg^{-1}

(ii) The natural phenomenon caused by convection currents is:

(a) Earthquakes (b) ✓ Land and sea breezes

(c) Magnetic fields (d) Solar eclipses

(iii) Which of the following wave type requires a medium to travel?

(a) X-rays (b) Light waves (c) Radiowaves (d) ✓ Sound waves

(iv) What is the approximate speed of sound in air?

(a) 150 ms^{-1} (b) ✓ 330-350 ms^{-1} (c) 500 ms^{-1} (d) 1,000 ms^{-1}

(v) A ray of light travelling from water to air bends:

(a) Towards the normal (b) ✓ Away from the normal

(c) At 90° to the normal (d) Parallel to the normal

(vi) What happens when two unlike charges are brought close to each other?

(a) ✓ They attract (b) They repel

(c) They neutralize each other (d) Nothing happens

(vii) The device used to measure electric current is:

(a) Voltmeter (b) ✓ Ammeter (c) Ohm meter (d) Watt meter

(viii) One tesla is equal to:

(a) ✓ 1T = 1 NA^{-1} m^{-1} (b) 1T = 1 N A m^{-1}

(c) 1T=1A^{-1}m^{-1} (d) 1T = 1NA^{-1}m

(ix) The sky appears blue during the day due to:

(a) Reflection of light (b) ✓ Scattering of shorter wavelengths

(c) Absorption of blue light (d) Refraction of light

(x) The output of NOR gate is:

(a) $X = \overline{A-B}$ (b) $X = A+B$ (c) $X = \overline{A}$ (d) ✓ $X = \overline{A + B}$

(xi) Which one of the following isotope is used in medical treatment and as a radioactive tracer?

(a) Strontium –90 (b) polonium –210 (c) ✓ Cobalt –60 (d) Radon –222

(xii) Which of the following gas contributes most to global warming?

(a) Oxygen (b) ✓ Carbon dioxide (c) Nitrogen (d) Argon

Time Allowed: 1:45 Hours | **Subjective Type (Part I)** | Max. Marks: 48

2. Write short answers to any five (05) questions: (2×5=10)

(i) What is latent heat of fusion?
(ii) How does evaporation contribute to cooling processes in everyday life?
(iii) How is heat transferred through radiation?
(iv) How does the greenhouse effect help regulate Earth's temperature?
(v) What is meant by wavelength and frequency?
(vi) What are electromagnetic waves? Give examples.
(vii) A person hears his echo when shouting near a tall building. Why must the building be at least 17 metres away for the echo to be heard clearly?
(viii) Define reflection and diffraction of sound waves.

3. Write short answers to any five (05) questions: (2×5=10)

(i) How does the power of a lens relate to its focal length?
(ii) Define linear magnification and write its formula.
(iii) A conductor and an insulator are both placed in an electric field. How will their behaviour differ, and why?
(iv) Define electrostatic induction. (v) State Ohm's law and define resistivity.
(vi) How does temperature affect the resistance of a conductor?
(vii) What role does commutator play In a D.C motor?
(viii) State right-hand grip rule.

4. Write short answers to any five (05) questions: (2×5=10)

(i) Why Is an Iron core used In transformers Instead of wood or plastic? Explain briefly.
(ii) If we stop moving a magnet near a coil, what happens to the Induced current?
(iii) What is the role of an AND gate In digital circuits?
(iv) What is NAND gate? Write Its truth table.
(v) Define nuclear fission with an example.
(vi) Imagine a new radioactive element Is discovered. How could scientists estimate its half-life without waiting thousands of years?
(vii) What is the primary cause of rising sea levels due to global warming?
(viii) How are cyclones formed? Describe briefly.

Subjective Type (Part II)

Write detailed answers of any two (02) questions. (2×9=18)

5. (a) What are infrasound and ultrasound, and how are they used in different applications? (4)

(b) A wave takes 5 seconds to complete 10 cycles. If the wavelength of the wave is 1.2 metres, calculate: (a) frequency of the wave (b) speed of the wave (5)

6. (a) What is meant by resistivity of a material? How does; it depend on the material, and what role does temperature play in changing the resistivity of conductors and semiconductors? (4)

(b) A ray of light travels from air into an unknown liquid. The angle of incidence in air is 45°, and the angle of refraction in the liquid is 30°. Calculate the refractive Index of the liquid. (5)

7. (a) What are logic gates? Describe the working of NAND and OR gates with the help of truth tables and circuit symbols. (4)

(b) In 420 days, one-eighth of polonium (Po) remains un-decayed. Calculate the half-life of polonium. (5)