# SIR ARTHUR LEWIS COMMUNITY COLLEGE

# ACADEMIC YEAR (2024/2025) – SEMESTER TWO

# END OF SEMESTER EXAMINATION

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| *COURSE CODE* | : | **ENV113** |
| *COURSE TITLE* | : | **Climate and Climate Change** |
| *LECTURER(S)* | : | **B. Robinson-Charlery** |
| *DATE* | : | **May 8, 2025** |
| *TIME* | : | **9:00 – 11:00** |
| *DURATION* | : | **2 Hours** |
| *STUDENT ID #* | : | _____ |

## GENERAL INFORMATION AND INSTRUCTIONS

- Students must sign **IN** and **OUT** on the examination class list.
- Write your ID number on the question paper.
- This paper has two Sections (Section A - 30 multiple Choice questions and Section B - three structured questions and one essay)
- Section A - Circle the correct answer on the answer sheet provided.
- Section B – Write your answers on paper provided.

**Instructions:**

1. Answer **ALL** questions in all sections.
2. Write your answers clearly and concisely.
3. Use diagrams where appropriate to support your answers.
4. Allocate your time wisely. Suggested time allocations are provided for each section.
5. Calculators may be used where necessary.

**DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO**

**SECTION A: MULTIPLE CHOICE QUESTIONS (MCQS)**

**Time: 40 minutes** **Total Marks: 30**

**Instructions: This section has 30 questions. Answer** ALL **questions by shading the letter next to the most correct response. Each question is worth** 1 mark**.**

1. What is the layer of the atmosphere where weather phenomena occur?
   A) Mesosphere
   B) Troposphere
   C) Stratosphere
   D) Thermosphere

2. Which of the following best describes the Coriolis effect?
   A) The force that drives convection currents.
   B) The deflection of winds due to Earth's rotation.
   C) The friction between air and the Earth's surface.
   D) The force that causes winds to blow from high to low pressure.

3. What is the role of the ozone layer in the stratosphere?
   A) To generate weather patterns.
   B) To absorb ultraviolet radiation.
   C) To trap heat and warm the Earth.
   D) To reflect solar energy back into space.

4. If a parcel of air experiences lifting starts with a temperature of 20$^{o}$C, and the temperature drops at the dry adiabatic rate 10$^{o}$C/km. What would be the temperature at 200m?
   A) 25$^{o}$C
   B) 20$^{o}$C
   C) 18$^{o}$C
   D) 10$^{o}$C

5. Which of the following would most likely occur in a STABLE atmosphere?
   A) Thunderstorms
   B) Light persistent rainfall
   C) Clear skies and fair weather
   D) Rapid vertical air movement

6. How does a lower sun angle affect surface insolation?
   A. No effect
   B. Increases it
   C. Decreases it
   D. Causes seasonal wind changes

7. Which of the following best explains why the equator receives more solar radiation than the poles?
   A. The Poles have higher albedo
   B. The Earth's rotation is faster at the equator
   C. The equator has more cloud cover and therefore reflects more insolation back into Earth's atmosphere
   D. Sunlight hits the equator directly, covering a smaller area, while at the poles, it strikes at an oblique angle

8. What is the reason for the formation of subtropical high-pressure belts?
   A. Rising warm air at the equator
   B. The Coriolis effect deflecting winds.
   C. Descending cool air from the Hadley cell.
   D. Friction between air and the Earth's surface.

9. Which of the following is a key difference between mid-latitude cyclones and tropical cyclones?
   A. Tropical cyclones occur only in the Northern Hemisphere
   B. Mid-Latitude cyclones are smaller in size than tropical cyclones
   C. Mid-Latitude cyclones form over warm ocean waters, while tropical cyclones form over land
   D. Mid-Latitude cyclones are driven by frontal systems while tropical cyclones are driven by warm ocean temperatures

10. Which of the following is the strongest evidence of human-induced climate change?
   A) Natural variations in solar radiation.
   B) Historical climate data from ice cores.
   C) Volcanic eruptions releasing greenhouse gases.
   D) The correlation between rising $CO_2$ levels and industrial activities.

11. Warm dry winds blowing down the east slopes of the Rockies are known as:
   A. Foehn
   B. Chinook
   C. Valley winds
   D. Mountain winds

12. Which of the following is most powerful in determining the movement of wind including its velocity?
   A. Frictional force
   B. Centrifugal force
   C. Gravitational force
   D. Pressure gradient force

13. Earth's atmosphere is warmed from
   A. The sun
   B. The earth
   C. The moon
   D. Greenhouse gases

14. What is the term used to describe the cooling of an air mass as it rises due to adiabatic lifting and the decrease in pressure?
   A. Advection
   B. Convection
   C. Expansion cooling
   D. Compression cooling

15. What phenomenon marks the height at which a rising parcel of moist air becomes fully saturated, leading to the onset of condensation and a relative humidity of 100%?
   A. Dew point
   B. Saturation point
   C. Adiabatic cooling point
   D. Lifting condensation level

16. What type of rainfall occurs when warm and cold air masses meet, causing the warmer, lighter air to rise above the colder air, leading to heavy rainfall?
   A. Frontal rainfall
   B. Monsoonal rainfall
   C. Orographic rainfall
   D. Convectional rainfall

17. Which one of the following processes releases heat into the environment?
   A. Melting
   B. Freezing
   C. Evaporation
   D. Sublimation

18. Which of the following indicates that an atmosphere is UNSTABLE based on the temperature of rising air parcel?
    A. The temperature of the rising parcel matches the surrounding air
    B. The temperature of the rising parcel is cooler than the surrounding air
    C. The temperature of the rising parcel is warmer than the surrounding air
    D. The temperature of the rising parcel decreases faster than the temperature of the surrounding air

19. How are isobars represented on synoptic charts?
    A. Lines connecting regions of similar air pressure
    B. Lines connecting regions of different air pressure
    C. Lines connecting regions of similar air temperature
    D. Lines connecting regions of similar precipitation patterns

20. Which of the following must happen for an air parcel to form clouds as it cools?
    A. The air parcel must decrease in volume
    B. The air parcel must increase in pressure
    C. The air parcel must decrease in relative humidity
    D. The air parcel must cool until condensation is reached

21. What is the distinction between climate change and climate variability?
    A. Climate change and climate variability are interchangeable terms
    B. Climate change refers to short-term changes, while climate variability describes long-term patterns
    C. Climate change refers to permanent shifts in climate while climate variability refers to short-term variation
    D. Climate change is influenced solely by human activity while climate variability is caused exclusively by natural factors.

22. How do greenhouse gas concentrations help us understand climate change?
    A. They increase rainfall variability.
    B. They reduce the impact of climate intensification.
    C. They provide evidence of natural temperature fluctuations.
    D. They show the link between human activities and global warming.

23. How do prehistoric climate changes differ from contemporary climate changes?
    A. Prehistoric changes were entirely anthropogenic, while contemporary changes are natural.
    B. Prehistoric changes occurred over millennia, while contemporary changes occur at an accelerated pace.
    C. Prehistoric changes lacked impacts on ecosystems, while contemporary changes are ecosystem-driven.
    D. Prehistoric changes were unrelated to solar radiation, while contemporary changes are solely caused by the sun.

24. Why is sea level rise a direct consequence of global warming?
    A. It is unrelated to rising temperatures
    B. It results from more volcanic eruptions
    C. It is due to a reduction in water availability
    D. It is formed by melting glaciers and thermal expansion of seawater

25. How could governments mitigate the impacts of climate change on agriculture?
    A. Establish coral reef conservation programs
    B. Promote policies banning artificial fertilizers
    C. Encourage the adoption of drought-resistant crops
    D. Preventing rainfall variability through geoengineering

26. What immediate action can reduce the impact of deforestation on climate change?
    A. Restoring global coral reef
    B. Establishing new solar farms
    C. Promote policies against illegal logging
    D. Increasing the use of gas ovens in tropical regions

27. How could climate mitigation strategies target emissions from rice farming?
    A. Establishing industrial hubs next to farms
    B. Reducing rainfall variability by using geoengineering
    C. Increasing reafforestation activity to stabilize emissions
    D. Reducing methane emissions by changing farming techniques

28. What evidence suggests the claim that climate intensification is occurring globally?
    A. Decreased temperature variability
    B. Stabilization of coral reef worldwide
    C. Increased frequency of droughts and cyclones
    D. Reduced coastal flooding in equatorial regions

29. What challenges complicate global efforts to reduce greenhouse gas emissions?
    A. Uniform policies across all regions
    B. Unequal distribution of solar energy
    C. Economic disparities across nations
    D. Absence of natural climate intensification

30. Which of the following best explains why droughts are being more severe due to climate intensification?
    A. Rising sea levels reduce the impact of heatwaves
    B. Increased solar radiation leads to warmer temperatures
    C. Increasing deforestation for logging resulting in groundwater recharge
    D. Changes in environmental circulation patterns disrupt rainfall distribution

## SECTION B: STRUCTURED QUESTIONS AND ESSAY

**Time: 1 hr. 20 minutes** **Total Marks: 60**

**Instructions: There are FOUR questions in this section. Answer ALL questions on the sheets provided.**

**1.** (a) Explain how the Earth's energy budget is maintained, including the roles of:
- Reflection and albedo.
- Absorption and re-radiation. (6 marks)

(b) Account for temperature changes with elevation through the different layers of Earth's atmosphere (troposphere, stratosphere, mesosphere, thermosphere). (8 marks)

**Total 14 marks**

**2.** (a) Describe the three-cell model of global atmospheric circulation. Include the name, direction of air movement within in each cell and the pressure belts associated with each cell in your answer. Use a well-labelled diagram to help you. (9 marks)

(b) Explain how land and sea breezes influence weather patterns. (5 marks)

**Total 14 marks**

**3.** (a) (i) Define the term relative humidity (2 marks)

(ii) Explain how temperature affects the relative humidity of the air. (2 marks)

(b) Differentiate between the following types of lapse rates:
   (i) Environmental lapse rate.
   (ii) Dry adiabatic lapse rate. (4 marks)

(c) Using a well labelled diagram, explain the relationship between lapse rates and atmospheric stability. (6 marks)

**Total 14 marks**

**4.** Using your knowledge of climate change, write an essay to evaluate the statement: 'Human activities are the primary driver of contemporary climate change, and without immediate action, the consequences will be irreversible.'

[Word count 250 – 300 words]

**Total 18 marks**

**END OF EXAMINATION**