

Question 1

The table below shows number of employees and sales revenue for some multinational companies for fiscal year 2024. Which of the following statements is or are correct?

Company	Sales revenue	Employees
Volkswagen	325	683,000
NVIDIA	130	29,600
Amazon	638	1,556,000
	(billion US\$)	(heads)

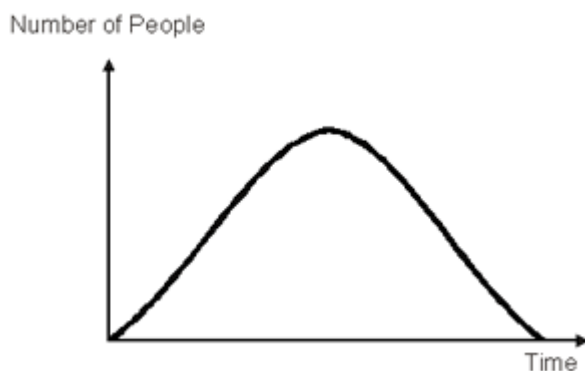
Statement I: in 2024 NVIDIA had a higher sales revenue than Volkswagen.

Statement II: in 2024, Amazon had a higher sales revenue per employee than NVIDIA.

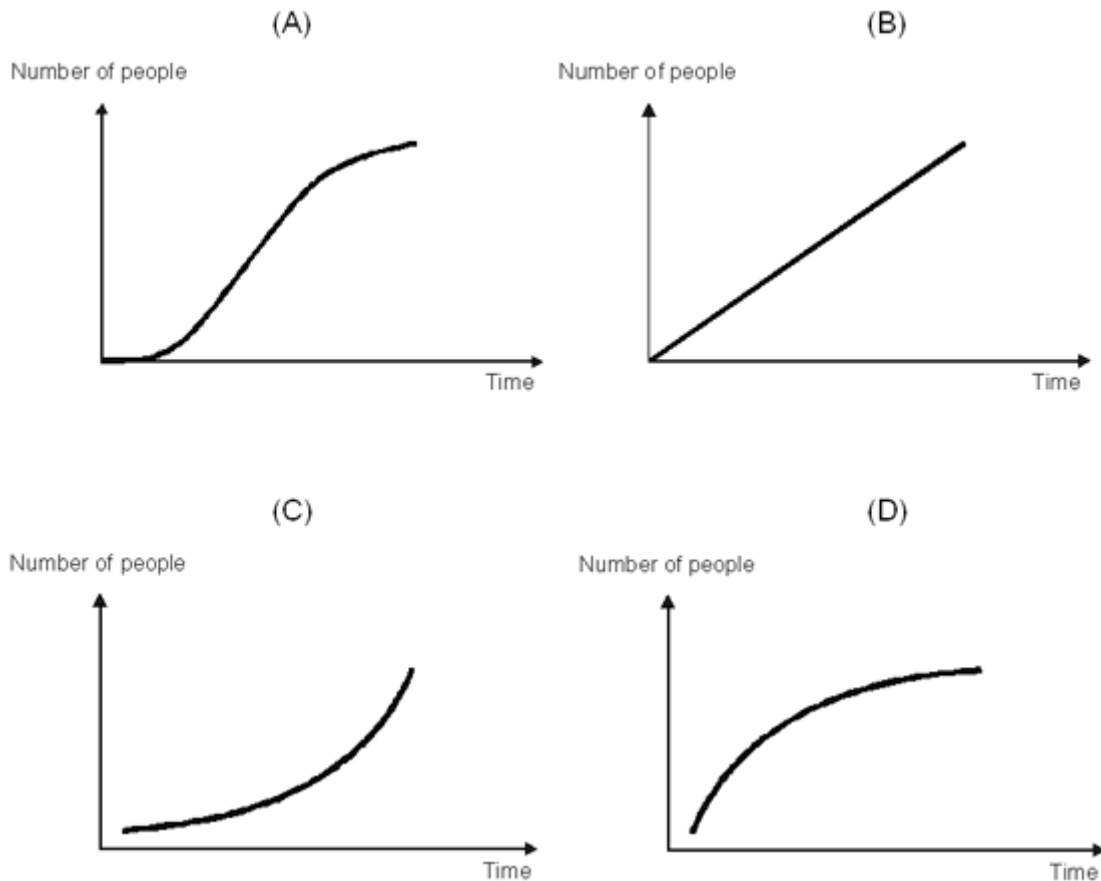
1. Only statement I is correct.
2. Only statement II is correct.
3. Both statements are correct.
4. Neither of the two statements is correct.

Question 2

The first diagram shows the development in the number of people testing a new product for the first time.



Which diagram shows the development in the number of people who have already tested the product at least once?



1. Diagram A is correct.
2. Diagram B is correct.
3. Diagram C is correct.
4. Diagram D is correct.

Question 3

In the current setup of the production process, 80 workers can produce a wind turbine in 6 working days. If 40 extra workers would be added, how many days would it take to finish a wind turbine?

1. 3.0 days
2. 3.5 days
3. 4.0 days
4. 4.5 days

Question 4

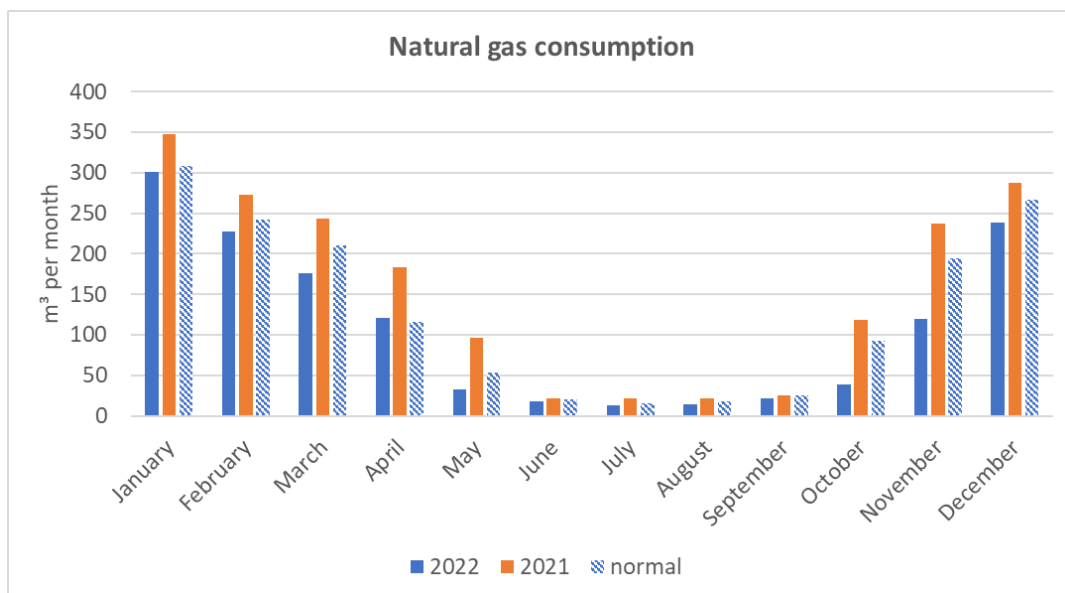
Bronze is an alloy of the metals copper and tin. An archaeologist excavates a bronze pin dating from the 4th century BC near the city of Berlin in 2023. Analysis of the object tells the archaeologist that the tin in the pin comes from what we now call Britain and the

copper is from Cyprus. What can you conclude with certainty from this? Indicate one or more correct answers.

1. The people living in the area we now call Berlin were in contact with people in Cyprus and Britain.
2. The owner of the pin went to Cyprus and Britain.
3. In the fourth century BC, there was overseas trade.
4. The technology to make bronze was known in the area we now call Berlin in the 4th century BC.

Question 5

The graph below shows the natural gas household consumption in Belgium per month, for the years 2021 and 2022 and for normal values. Normal values are the averages over the period 2010-2020. These are used to compare new years with 'normal' conditions.



Which statement is correct?

1. In 2022, total natural gas consumption over the entire year was lower than normal
2. In 2021, total natural gas consumption over the entire year was higher than normal
3. Natural gas consumption is almost equally distributed over the months of the year
4. In 2022, natural gas consumption was lower every month than in 2021.

Question 6

What is the natural (pre-industrial) content of CO₂ in the atmosphere?

1. 10%
2. 3%
3. 0.3%
4. 0.03%

Question 7

Electromagnetic radiation is a central term in physics and is also important in sustainable sciences. For example, the main cause of global warming is the enhancement of greenhouse gases in the atmosphere, as these gases absorb and re-emit long-wave electromagnetic radiation emitted from Earth. Electromagnetic radiation consists of photons. The energy of a photon can be calculated as Planck constant multiplied by:

1. the frequency of the photon;
2. the speed of light and divided by the wavelength of the radiation;
3. the wavelength of the radiation;
4. the speed of light and divided by the mass of the photon

Question 8

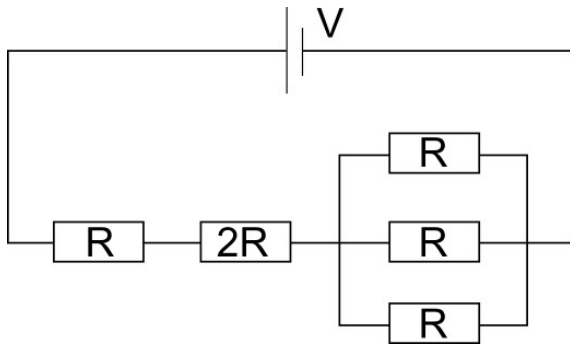
Rely on source material: The green chemistry principles are a modern framework that is designed to guide chemists and process engineers in the implementation of more sustainable strategies in chemical value chains. Which of the following statements correctly complement the sentence "Green chemistry attempts to ...":

1. reduce the hazard inherent in a chemical process;
2. minimize the use of all chemicals;
3. invent technologies that will clean up toxic sites;
4. develop biodegradable products.

Question 9

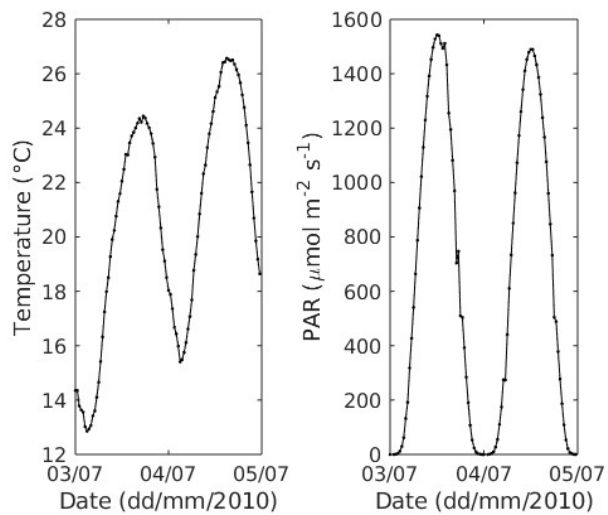
What is the total resistance in the electric circuit shown below?

1. $6R$;
2. $7R/3$;
3. $10R/3$;
4. $4R$



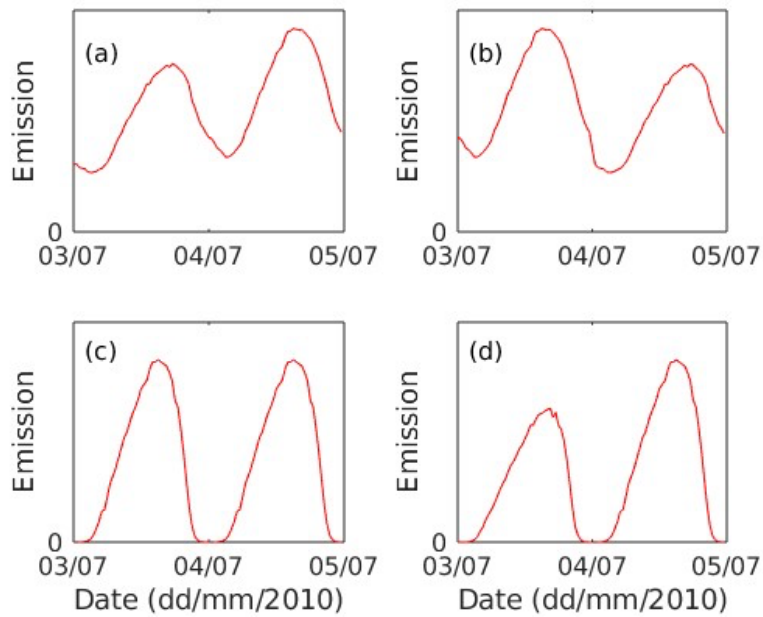
Question 10

Rely on source material: Field observations of ambient temperature and photosynthetically active radiation (PAR) during two days in 2010 from the SMEAR II station in Hyytiälä, Finland are provided in the figure below.



Which of the figures below shows the modelled emission of a BVOC emitted from trembling aspen in Hyytiälä?

- a
- b
- c
- d



Source material for the exam:

Biogenic Volatile Organic Compounds (BVOCs) are important precursor molecules for atmospheric aerosols. Atmospheric aerosol particles interact with solar radiation by absorbing, reflecting and scattering light and by affecting cloud properties, and aerosols thereby impact Earth's climate. BVOCs are emitted from vegetation, and in fact, almost all vegetation emits BVOCs.

The emission of BVOCs from vegetation can be modelled using the following equation:

$$E = \varepsilon \times \gamma_t \times \gamma_L$$

where:

- E is the emission of BVOCs at prevailing temperature and light conditions,
- ε is the emission rate of a BVOC at standard conditions (i.e., temperature of 30°C and photosynthetically active radiation of $1000 \mu\text{mol m}^{-2} \text{s}^{-1}$),
- γ_t and γ_L are emission activity factors to account for instantaneous temperature and light conditions, respectively.

The emission of BVOCs from vegetation without storage structures (e.g., such as resin ducts) is controlled by the production of BVOCs inside the plant. Grasses, aspens and birches are examples of such vegetation.

For BVOC emissions controlled by BVOC production, the light response factor γ_L is given by:

$$\gamma_L = (\alpha \times C_{L1} \times PAR) / \sqrt{1 + \alpha^2 \times PAR^2}$$

where:

- α and C_{L1} are constants,
- PAR is photosynthetically active radiation.

The temperature response factor γ_t behaves as a function of temperature as shown in Figure 1.

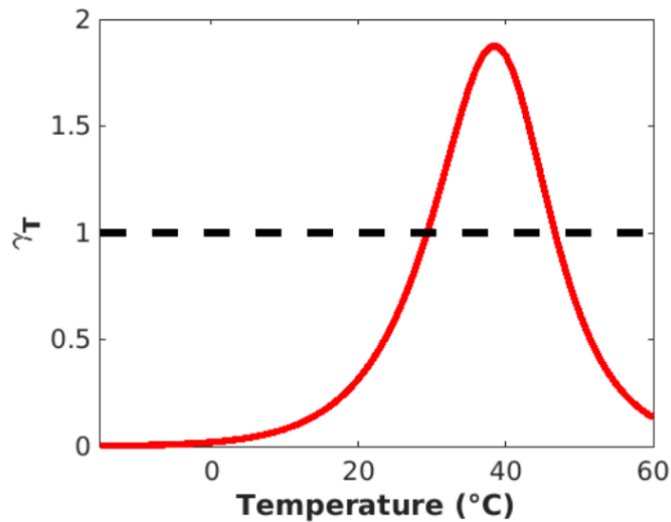


Figure 1: $\gamma_t(T)$ for BVOC emissions controlled by BVOC production

The emission of BVOCs with rather low vapor pressures, such as monoterpenes (i.e., organic molecules containing 10 carbon atoms and which make up a large part of resin), from vegetation with storage structures is not controlled by the production of BVOCs, but instead by the volatilization of stored BVOCs.

Hence, for such vegetation:

$$\gamma_t = \exp(\beta \times (T - T_s))$$

$$\gamma_L = 1$$

where:

- β is a constant,
- T_s is the standard temperature (30°C),
- T is the prevailing temperature.

Pines and spruces are examples of vegetation with storage structures.

Question 11

Read the following excerpt from the *World Development Report 2024* and respond to the subsequent questions.

“Middle-income countries are in a race against time. Since the 1990s, many of them have done well enough to escape low-income levels and eradicate extreme poverty, leading to the general perception that the last three decades have been great for development. But this is because of abysmally low expectations—remnants from a period when more than two-thirds of the world lived on less than a dollar a day. The ambition of the 108 middle-income countries with incomes per capita of between US\$1,136 and US\$13,845 is to reach high-income status within the next two or three decades. When assessed against this goal, the record is dismal: the total population of the 34 middle-income economies that transitioned to high-income status since 1990 is less than 250 million, the population of Pakistan.

During the last decade their prospects have worsened. With rising debt and aging populations at home, growing protectionism in advanced economies, and escalating pressures to speed up the energy transition, today’s middle-income economies are growing into ever-tighter spaces. The odds that the 6 billion people in today’s middle-income countries will see their countries grow to high-income status within a generation or two were never that good. Now they are decidedly daunting.”

Based on the above description, we conclude that:

- A. Only a small number of countries have failed to transition to the high-income category.
- B. Since the 1990s, most middle-income countries have made it to the high-income category.
- C. While many middle-income countries performed well in escaping low-income levels in 1990s, they have failed so far to transition to the high-income category.
- D. Only few countries are trapped into the middle-income level, whose total population is no more than 250 million.

Question 12

Which of the following biomes has the highest biodiversity?

- A. Tundra
- B. Boreal forest
- C. Tropical rainforest
- D. Temperate grassland

Question 13

What is the primary greenhouse gas responsible for global warming?

- A. Methane (CH₄)
- B. Nitrous oxide (N₂O)
- C. Carbon dioxide (CO₂)
- D. Ozone (O₃)

Question 14

The solution(s) for the equation $(x + 4)^2 = 25$ is/are:

- A. $x = 1$
- B. $x = 5$
- C. $x = -2$
- D. $x = -9$

Question 15

Country A, with a population of 30 million people, has a poverty rate of 15 percent. Country B whose population is 40 million has a poverty rate of 10 percent. Which of the following statements is true?

- A. There is a larger number of people living in poverty in country A than in country B.
- B. There is a larger number of people living in poverty in country B than in country A.
- C. Both countries have equal number of the poor population.
- D. The two countries cannot be compared since they have different population sizes.

Question 16

[Fact-based, fictional] In 2014, in an effort to save money, the City of Flintstone in the state of Fictionland (United States of Examples) switched its water supply to water drawn from Flintstone River. According to Flintstone residents' March 31, 2016 complaint, engineering firms LAM and Eolia, both major professional companies with experience in water systems, advised the City about the switch to Flintstone River water. When Flintstone's citizens immediately complained about the new water's bad smell, color, and taste — and later, when the City suffered an outbreak of deadly Legionnaires' disease — it became apparent that the water pipes are corroding. In October 2015, the Governor of Fictionland, who previously authorized the switch despite concerns of local experts, finally acknowledged the problem. It turned out that Flintstone River water was eight times more corrosive than the City's previous water source. Over 30,000 of the City's housing units were affected because of corroded,

unsafe pipes and appliances and nearly 8,000 small children permanently harmed by lead poisoning caused by the corrosion.

The City of Flintstone wants to defend itself from allegations of wrongdoing. Which of the below strategies would be the best one?

- a. Act of nature – the damage was done by water, an element beyond the City’s control.
- b. Responsibility of LAM and Eolia – as professionals, they should have verified the safety of the Flintstone River water before recommending the switch.
- c. Responsibility of homeowners – the City has nothing to do with corrosive water pipes, which were the source of the problem.
- d. Weak causal link – health problems and damage of appliances were only remote consequences of the City’s decision to save money.

Question 17

Why was the Governor of Fictionland asked to authorize the City’s decision to switch to a new water source?

- a. Cities cannot be legal persons and they cannot make any legally binding decisions.
- b. Every legally binding decision requires at least two signatories.
- c. Local governments need to have all their decisions confirmed by higher levels in the governance structure.
- d. The division of competences between the City and the Governor must have necessitated the authorisation.

Question 18

The young children affected by lead poisoning would like to sue for compensation.

Would they be able to do so?

- a. Yes, even on their own.
- b. Yes, but they must be represented, as they have limited legal capacity.
- c. No, because it is difficult to pinpoint who has actually caused the harm.
- d. No, compensation can only be owed to adults.

Question 19

An expert who was in favour of the switch presents his own viewpoint. In his opinion, the economic benefits (savings made by the City) outweigh the harm done to people's health and the damage of property. According to his calculations, if the savings were invested into social programmes, within 10 years they would create more liveable households and provide healthcare to more people than the switch has ever affected.

Which counterargument is the best one?

- a. Public interest never outweighs private interest.
- b. 10 years is too long of a waiting time.
- c. Individuals cannot be forced to give up their health, it is a crucial right and cannot be compensated.
- d. There is no guarantee that people who would receive funding would be the same people who were affected in the first place.

Question 20

Corrosion and lead contamination have severely destroyed a production facility of a Swedish car manufacturer located in vicinity of Flintstone. The company is facing difficulties not only because no compensation has been awarded, but also because the local authorities refuse to issue the permits necessary for construction of a new production hall. The situation is in line with Flintstone's new deindustrialisation policies, but the manufacturer claims it violates international treaties protecting foreign investors. Which of the following is true?

- a. International law is hierarchically higher than local regulations.
- b. Local regulations would prevail over international law – they are more detailed and as such constitute *lex specialis*.
- c. There are no predetermined rules of hierarchy applicable to such circumstances – the court would need to establish them case-by-case.
- d. International law is irrelevant for the company – it is a car manufacturer, not a state.

Question 21

Preamble of the 2030 Agenda

This Agenda is a plan of action for people, planet and prosperity. It also seeks to strengthen universal peace in larger freedom. We recognise that eradicating poverty in all its forms and dimensions, including extreme poverty, is the greatest global challenge and an indispensable requirement for sustainable development. All countries and all stakeholders, acting in collaborative partnership, will implement this plan. We are

resolved to free the human race from the tyranny of poverty and want and to heal and secure our planet. We are determined to take the bold and transformative steps which are urgently needed to shift the world onto a sustainable and resilient path. As we embark on this collective journey, we pledge that no one will be left behind. The 17 Sustainable Development Goals and 169 targets which we are announcing today demonstrate the scale and ambition of this new universal Agenda. They seek to build on the Millennium Development Goals and complete what these did not achieve. They seek to realize the human rights of all and to achieve gender equality and the empowerment of all women and girls. They are integrated and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental.

The Goals and targets will stimulate action over the next fifteen years in areas of critical importance for humanity and the planet:

People. We are determined to end poverty and hunger, in all their forms and dimensions, and to ensure that all human beings can fulfil their potential in dignity and equality and in a healthy environment.

Planet. We are determined to protect the planet from degradation, including through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations.

Prosperity. We are determined to ensure that all human beings can enjoy prosperous and fulfilling lives and that economic, social and technological progress occurs in harmony with nature.

Peace. We are determined to foster peaceful, just and inclusive societies which are free from fear and violence. There can be no sustainable development without peace and no peace without sustainable development.

Partnership. We are determined to mobilize the means required to implement this Agenda through a revitalised Global Partnership for Sustainable Development, based on a spirit of strengthened global solidarity, focussed in particular on the needs of the poorest and most vulnerable and with the participation of all countries, all stakeholders and all people.

The interlinkages and integrated nature of the Sustainable Development Goals are of crucial importance in ensuring that the purpose of the new Agenda is realised. If we realize our ambitions across the full extent of the Agenda, the lives of all will be profoundly improved and our world will be transformed for the better.

According to the preamble of the 2030 Agenda, what is identified as the greatest global challenge and an indispensable requirement for sustainable development? (One correct answer)

- a) Ending global hunger and malnutrition
- b) Eradicating poverty in all its forms and dimensions
- c) Achieving equitable access to natural resources
- d) Mitigating the effects of climate change on vulnerable populations
- e) Promoting technological innovation in all sectors

Question 22

The preamble emphasizes the three dimensions of sustainable development.

Which of the following are included as core dimensions? (Multiple correct answers)

- a) Social well-being and equity
- b) Economic growth, focused primarily on GDP expansion
- c) Environmental sustainability and resource management
- d) Political stability and governance
- e) Cultural preservation and diversity

Question 23

The Sustainable Development Goals (SDGs) mentioned in the preamble aim to build on the Millennium Development Goals. Which of the following are accurate descriptions of the SDGs, according to the preamble? (Multiple correct answers)

- a) They are designed to correct economic imbalances by prioritizing social welfare over economic growth
- b) They aim to complete what the Millennium Development Goals did not achieve
- c) They integrate human rights, gender equality, and the empowerment of women and girls
- d) They promote sustainable development across a set of goals that are indivisible and integrated
- e) They focus on technological solutions as the primary means to achieve sustainability

Question 24

The preamble asserts a strong connection between peace and sustainable development. Which of the following statements best reflects this relationship? (One correct answer)

- a) Sustainable development can only succeed when peace is achieved first in conflict-prone regions
- b) Sustainable development and peace are mutually reinforcing
- c) Peace is a secondary consideration in sustainable development, which focuses more on environmental issues
- d) Sustainable development is only relevant in regions where peace has already been established

- e) Sustainable development is necessary to prevent future conflicts, but does not directly impact current peace efforts

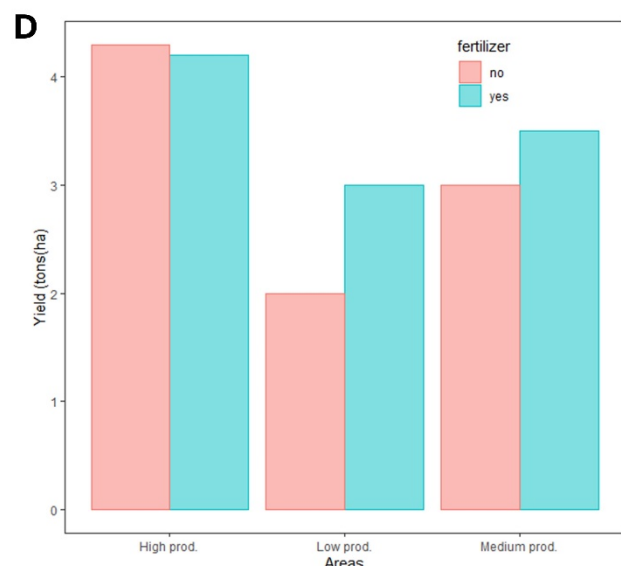
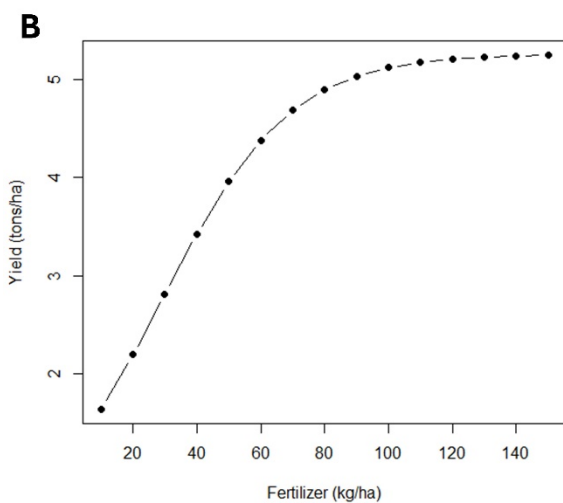
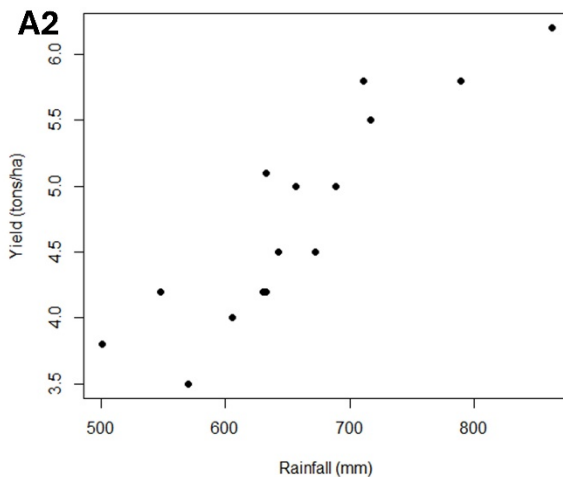
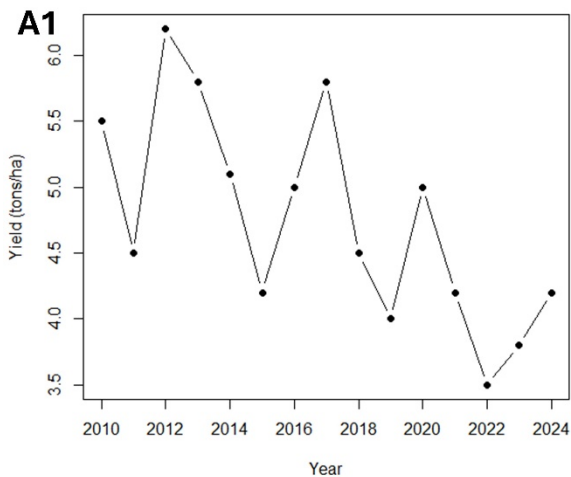
Question 25

The 2030 Agenda emphasizes partnerships as crucial to achieving its goals. Which of the following elements are described as essential to mobilizing the means to implement the Agenda? (Multiple correct answers)

- a) Stronger financial commitments from developed countries, particularly high-income countries
- b) Strengthened global solidarity and collaboration, particularly addressing the needs of the poorest and most vulnerable
- c) Prioritizing private sector leadership in driving sustainable development initiatives
- d) Participation of all countries, all stakeholders, and all people in a revitalized Global Partnership for Sustainable Development
- e) Increased focus on technology transfer from developed to developing nations

Question 26

A cooperative of farmers has noticed a decline in production over the past few years. Concerned about the situation, they consulted a technology-based company to conduct a detailed study of the issue. This study includes analysing production trends over the years and conducting small experimental trials to establish a series of corrective measures. The results of these trials are presented in the following panel. First, the company examined production variability and its relationship to climatic variables (panel A1 and A2). Secondly, they studied the effect of adding different amounts of fertilizer on production (panel B). Third, they analysed the spatial variability of production in the cultivated area, identifying three zones with different production potentials where they evaluated the effect of fertilizer addition (yes/no) (panel D).



Based on the analysis of productivity trends over the past 15 years, we can deduce the following:

- There is no clear trend toward lower production in the analysed series
- Production showed a high interannual variability
- There is a trend toward lower production
- The production trend remains constant, but it fluctuates significantly from year to year

Question 27

[In reference to the above panels] The analysis of the relationship between production and annual precipitation shows:

- An inversely proportional or negative relationship between both variables
- A positive relationship between the two variables, suggesting that drier years result in lower production
- A positive relationship between the two variables, suggesting that wetter years result in higher production
- No relationship between studied variables

Question 28

[In reference to the above panels] The results of the fertilization experiment showed that:

- a) There is a linear increase in production with the addition of fertilizer
- b) There is no relationship between fertilizer application and production
- c) The positive effect of increased fertilizer is greater when applied at a high dose compared to a small dose
- d) There is a positive effect of fertilizer on production up to a certain level, beyond which additional fertilizer does not further improve production

Question 29

[In reference to the above panels] In the fertilization experiment of the panel B:

- a) Yield is the independent variable and fertilizer the dependent one
- b) Yield is the explicative variable and fertilizer the response one
- c) Yield is the dependent variable and fertilizer the independent one
- d) Both, yield and fertilizer are continuous variables

Question 30

[In reference to the above panels] Based on the results of the fertilization experiment in the different zones identified by their productivity, what recommendation would you make to the landowners to improve their production without significantly increasing fertilization costs?

- a) Fertilize all areas, as it increases production and could offset the costs
- b) Do not fertilize, as there is no increase in production associated with fertilizer
- c) Fertilize in the low- and medium-production areas, as this is where production increases
- d) Fertilize in the most productive areas to maximize production in these zones

Answer key

Question 1 – 4
Question 2 – 1
Question 3 – 3
Question 4 – 3
Question 5 – 4
Question 6 – 4
Question 7 – 1 & 2
Question 8 – 1 & 4
Question 9 – 3
Question 10 – d
Question 11 – c
Question 12 – c
Question 13 – c
Question 14 – a & d
Question 15 – a
Question 16 – b
Question 17 – d
Question 18 – b
Question 19 – c
Question 20 – a
Question 21 – b
Question 22 – a & c
Question 23 – b, c & d
Question 24 – b
Question 25 – b & d
Question 26 – b & c
Question 27 – b & c
Question 28 – d
Question 29 – c & d
Question 30 – c