# Biology

## Standard level

## Paper 2

1 hour 30 minutes

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**Instructions to candidates**

- Write your session number in the boxes above.
- Do not open the examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer one question.
- Answers must be written in the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[50 marks]**.

## Section A

1. ADCP helps immune cells destroy cancer cells marked by antibodies. Study Figure 1 (stages of ADCP) and Table 1 (monoclonal antibody therapies), then answer the questions.

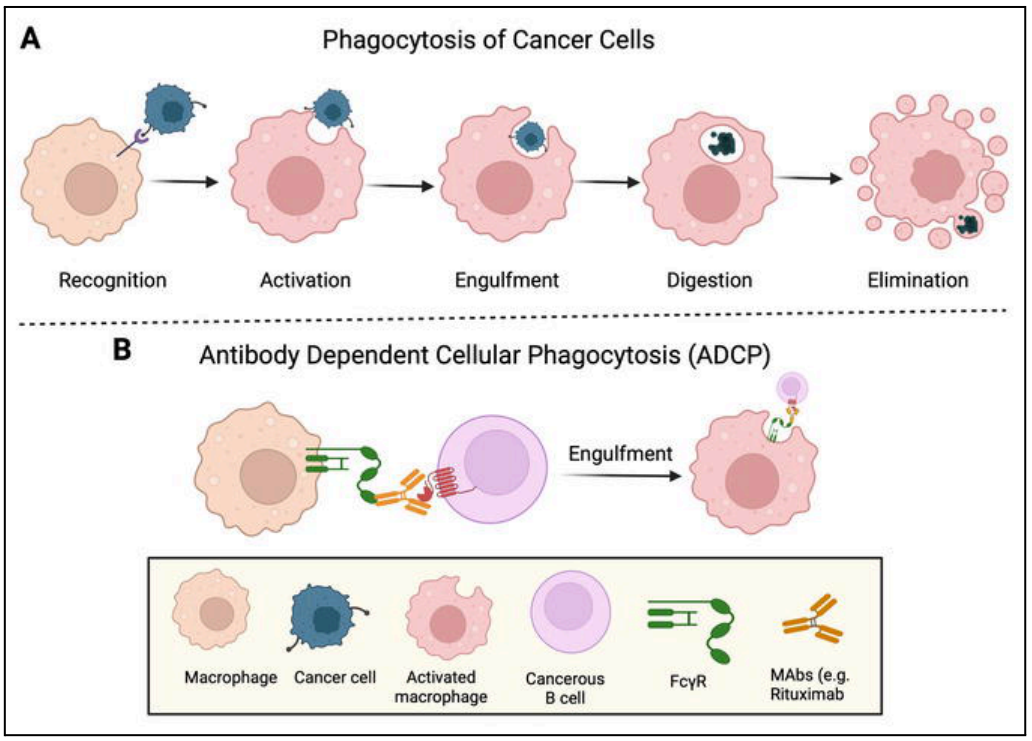


Figure 1.

a) Using Figure 1, identify the immune cell responsible for ADCP. [1]

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b) Describe how Rituximab (Table 1) marks cancer cells for destruction. [2]

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c) Explain why ADCP is more targeted than chemotherapy. [2]

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d) Outline the role of the **Fcγ receptor** in Figure 1. [2]

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e) A patient's cancer cells lose CD20 expression. Predict the effect on Rituximab treatment. [2]

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f) Discuss why ADCP is considered a "bridge" between innate and adaptive immunity. [2]

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g) Suggest how macrophages recognize digested cancer cell fragments after ADCP. [2]

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h) Explain the process of recognition in phagocytosis. [2]

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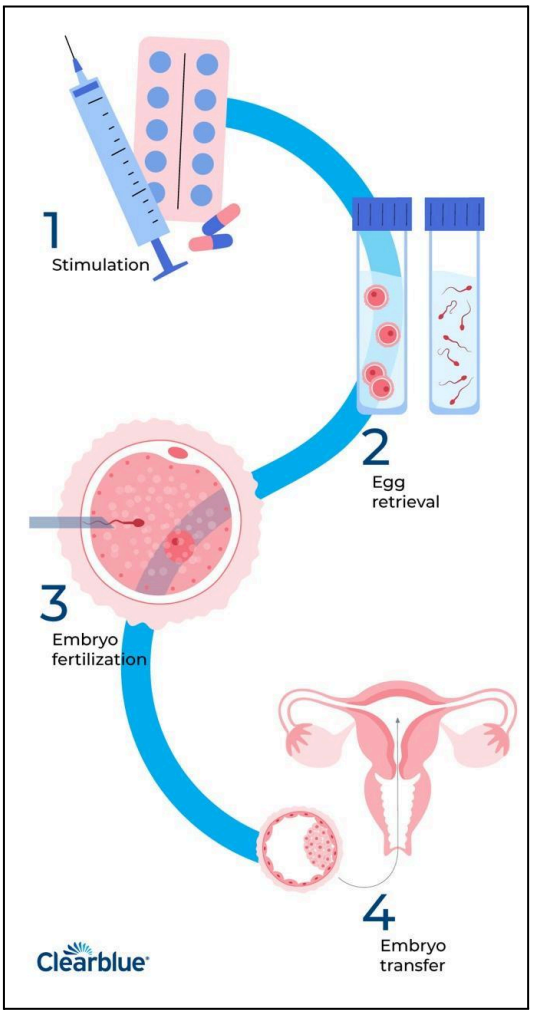
2. The image shows the process of In-vitro fertilization.




a) i) Identify the first hormone administered to suppress the menstrual cycle. [1]

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ii) Explain why the suppression of this hormone is necessary for IVF success. [1]

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b) Superovulation is induced after downregulation. Name the hormone used to stimulate multiple follicle development. [1]

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c) Before egg retrieval, a final hormone injection is given. Identify this hormone. [1]

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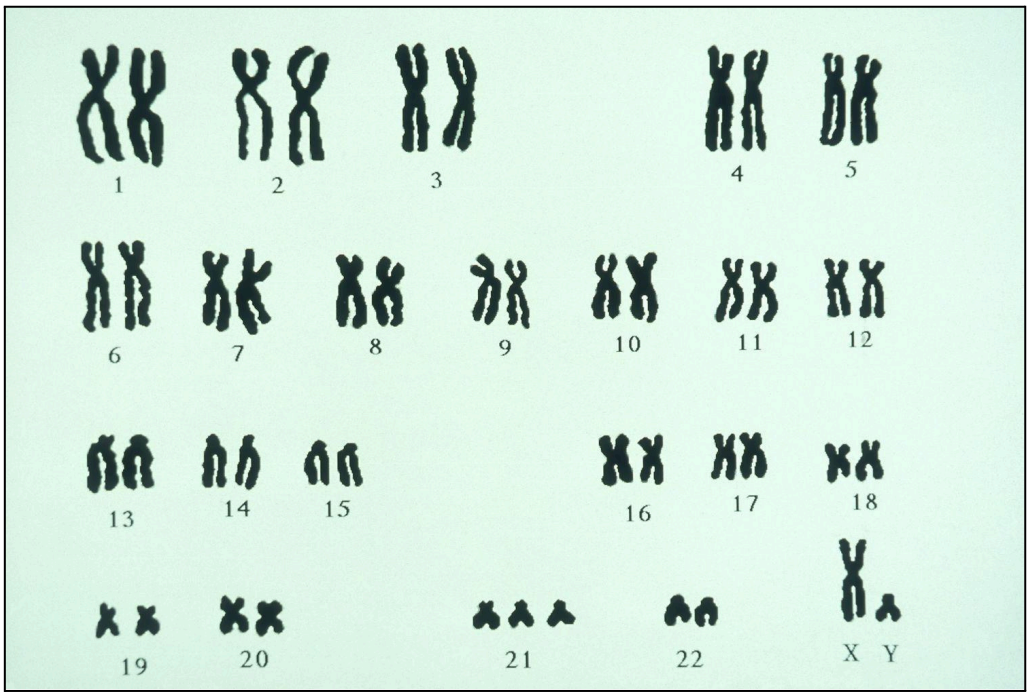
3. The karyogram below shows chromosomes from an individual.




a) i) State the total chromosome number in this individual. [1]

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ii) Identify which meiotic division error most likely caused this condition. [1]

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iii) What genetic disorder does the individual have? [1]

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b) State one method for prenatal detection of chromosomal abnormalities [1]

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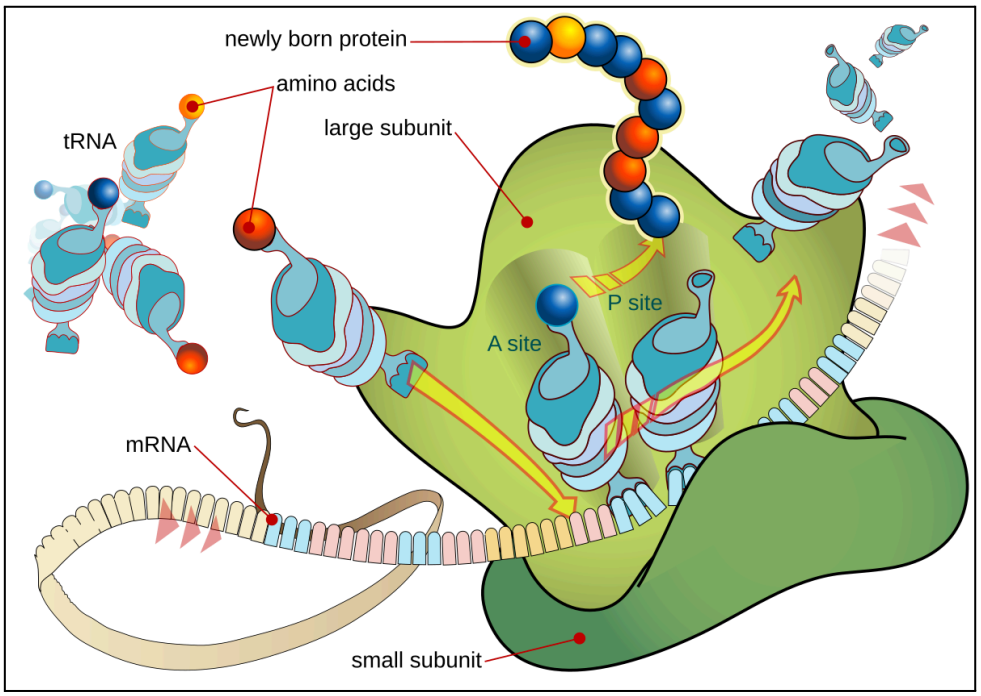
4. The image below shows the process of translation.




a) State where the mRNA binds within the ribosome. [1]

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b) Translation requires the interaction of mRNA, tRNA, and ribosomes.

i) Explain how mRNA determines the sequence of amino acids in a polypeptide. [1]

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ii) Describe the role of tRNA in translation, including the significance of its anticodon. [2]

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c) Two tRNA molecules can bind simultaneously to the ribosome. Explain why this is necessary for the elongation of a polypeptide chain. [1]

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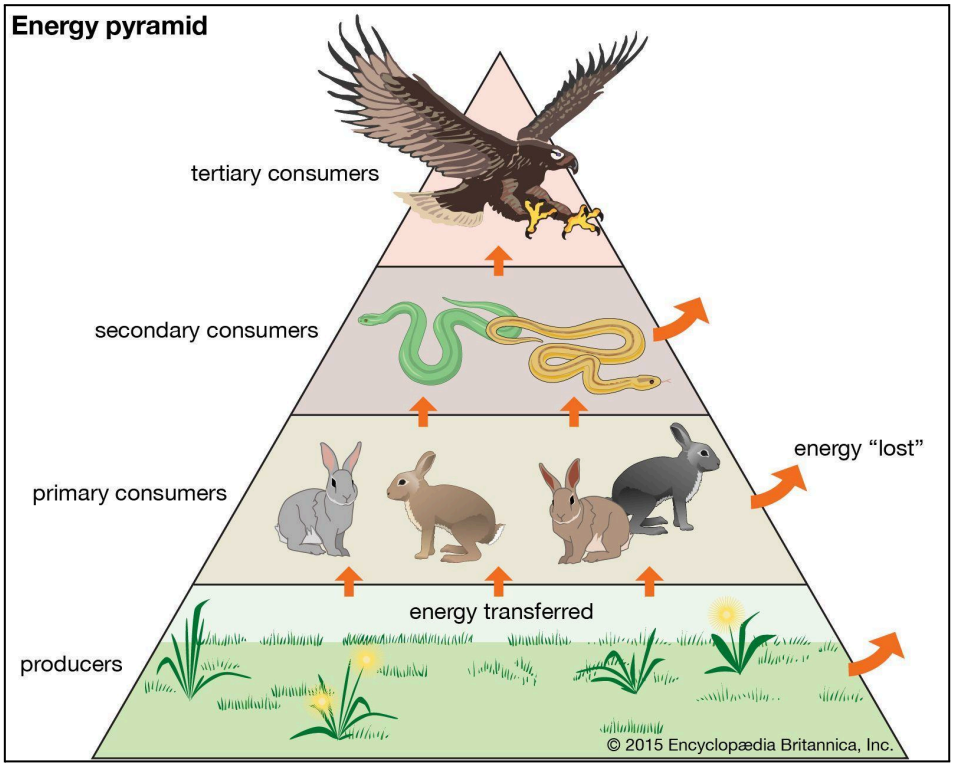
5. A pyramid of energy flow in an ecosystem, showing decreasing energy at each trophic level, from producers to tertiary consumers.




a) Explain why the energy available at each successive trophic level decreases. [1]

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b) The number of trophic levels in an ecosystem is limited. Based on the diagram, predict what would happen if a new top predator was introduced. [1]

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c) Explain why organisms at higher trophic levels have less biomass but higher energy content per unit mass. [1]

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6. Competition and cooperation is observed in intraspecific relationships.

a) Explain how limited resources (e.g., light, water, nutrients) drive intraspecific competition in plants. [1]

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b) Describe a real-world example of plant cooperation in response to environmental stress. [1]

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c) Explain how mycorrhizal fungi contribute to cooperative relationships in plant populations. [1]

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## Section B

**Answer one question. One additional mark is available for the construction of your answer. Answers must be written within the answer boxes provided.**

7. Cell signaling is essential for communication within and between organisms.

a) Explain how receptors function in cell signaling, including the role of ligands. [3]

b) Describe one example of cell signaling in bacteria, including its significance. [2]

c) Compare and contrast hormones and neurotransmitters in animal signaling systems. Write on each. [4]

d) List 3 examples of the chemical substances used as signaling molecules. Discuss why a wide range of chemical substances are used as signaling molecules in organisms. Give three reasons. [6]

8. a) Outline the role of skin and mucous membranes as primary defences against pathogens. [2]

b) Describe how phagocytes recognize and destroy pathogens. [4]

c) Compare and contrast the innate and adaptive immune systems, including the role of memory cells. List one similarity and 2 differences. [6]

d) Discuss how herd immunity helps prevent epidemics, using vaccination as an example. [3]