Exercise walk-through

Origins of Life on Earth ▪ 7.12

eXercise

You must be able to

- outline the main hypothesis (simple molecules $\rightarrow$ polymers $\rightarrow$ protocells)
- describe the evidence (Miller-Urey, RNA world)
- put the key steps in order

Method — The proposed sequence

A leading hypothesis for life's origin:

1. **Simple organic molecules** (amino acids, nucleotides) formed from inorganic ones on early Earth.
2. These joined into **polymers**.
3. Polymers became enclosed in membrane droplets (**protocells**).
4. Molecules that could **self-replicate** allowed heredity and evolution to begin.

Method — Miller-Urey evidence

The **Miller-Urey experiment** showed that amino acids can form from simple gases and energy (simulating early Earth), supporting step 1.

Method — The RNA world

RNA can both store information **and** act as a catalyst, so it may have been the first self-replicating molecule — the "**RNA world**" idea.

Method — A worked ordering

Order: inorganic molecules → organic monomers → polymers → protocells → self-replicating systems → early cells.

Practice 2.1 ▪ 1 mark

What did the Miller-Urey experiment produce?

Solution 2.1

Method: Miller-Urey evidence

Worked steps

Amino acids (organic molecules) from simple gases and energy B1.

Practice 2.2 ▪ 1 mark

Why is RNA proposed as the first self-replicating molecule?

Solution 2.2

Method: The RNA world

Worked steps

RNA can both store information and act as a catalyst (enzyme) B1.

Practice 2.3 ▪ 1 mark

What is a protocell?

Solution 2.3

Worked steps

A membrane-enclosed droplet containing molecules — a precursor to a cell B1.

Exam-style 3.1 ▪ 1 mark

The Miller-Urey experiment supported the idea that

A cells arose fully formed

B organic molecules can form from inorganic ones

C DNA came before RNA

D life came from space only

Solution 3.1

Method: Miller-Urey evidence

A cells arose fully formed

B organic molecules can form from inorganic ones ✓

C DNA came before RNA

D life came from space only

Worked steps

B — organic molecules can form from inorganic ones.

Exam-style 3.2 ▪ 2 marks

Put these steps of life's origin in order: polymers, protocells, simple organic monomers, self-replicating molecules.

Solution 3.2

Method: The proposed sequence

Worked steps

Simple organic monomers $\rightarrow$ polymers $\rightarrow$ protocells $\rightarrow$ self-replicating molecules M1 A1.

Exam-style 3.3 ▪ 2 marks

Explain why the ability to self-replicate was a key step for evolution to begin.

Solution 3.3

Method: The proposed sequence

Worked steps

Self-replication allowed information to be copied and passed on (heredity); variation in the copies could then be selected, so evolution could begin M1 A1.