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Level: HL IB in Biology

Subject: Biology

Topic: IB HL Biology

Type: Mark Scheme

2002

XVIII

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All International Baccalaureate IB Topic Questions HL Biology

BIOLOGY

HL - IB

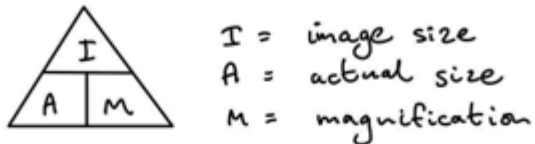
Key skills



Answer 1

The correct answer is D because:

Step ①: Recall formula triangle



Step ②: Calculate image size

$$\begin{aligned} I &= A \times M \\ I &= 1 \mu\text{m} \times 50,000 \\ I &= 50,000 \mu\text{m} \end{aligned}$$

Step ③: Convert units from μm to mm

$$50,000 \div 1,000 = 50 \text{ mm}$$

There are 1,000 micrometres in a millimetre

Step ④: Convert 50 mm into standard form

$$50 \text{ mm} = \underline{\underline{5 \times 10^1 \text{ mm}}}$$

A is incorrect because $10^0 = 1$, so $5 \times 10^0 \text{ mm} = 5 \text{ mm}$.

B is incorrect because $10^{-1} = 0.1$, so $5 \times 10^{-1} \text{ mm} = 0.5 \text{ mm}$.

C is incorrect because $10^2 = 100$, so $5 \times 10^2 \text{ mm} = 500 \text{ mm}$.



Answer 2

The correct answer is C because:

Step ①: Recall formula triangle



I = image size
A = actual size
M = magnification

Step ②: Ensure units for I and A are the same

Convert all values to smallest unit given

$$1.5 \times \underline{10,000} = 15,000 \mu\text{m}$$

There are 10,000 micrometres in a centimetre

Step ③: Calculate magnification

$$M = I \div A$$

$$M = 15,000 \mu\text{m} \div 5 \mu\text{m}$$

$$M = \underline{\underline{3,000}}$$



Answer 3

The correct answer is B because:

Step ①: Recall formula triangle



I = image size
A = actual size
M = magnification

Step ②: Calculate actual size

$$\begin{aligned} A &= I \div M \\ A &= 10 \text{ mm} \div 200 \\ A &= 0.05 \text{ mm} \end{aligned}$$

Step ③: Convert units from mm to μm

$$0.05 \times 1,000 = \underline{\underline{50 \mu\text{m}}}$$

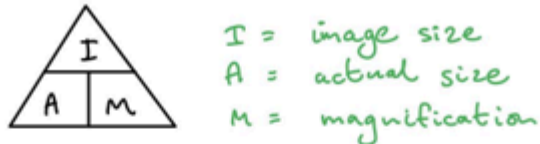
There are
1,000 micrometres
in a millimetre



Answer 4

The correct answer is B because:

Step ①: Recall formula triangle



Step ②: Ensure units for I and A are the same

Convert all values to smallest unit given

$$2 \times 10,000 = 20,000 \mu\text{m}$$

There are 10,000 micrometres in a centimetre

Step ③: Calculate magnification

$$M = I \div A$$

$$M = 20,000 \mu\text{m} \div 5 \mu\text{m}$$

$$M = 4,000$$

Step ④: Convert 4,000 into standard form

$$4,000 = \underline{\underline{4 \times 10^3}}$$



Answer 5

The correct answer is A because:

Step ①: Convert all units to μm

$$7,000 \text{ nm} = 7 \mu\text{m}$$

There are
1,000 nanometres
in a micrometre

Step ②: Compare the sizes
of the cells

$$35 \div 7 = \underline{\underline{5}}$$

Pancreatic
cell

Erythrocyte

So erythrocytes are x5
smaller than pancreatic cells

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Answer 6

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The correct answer is C because cell theory contains three basic ideas, which are:

- Cells are the building blocks of structure in living things.
- Cells are the smallest unit of life.
- Cells are derived from other cells (pre-existing cells) by division.

Although statement II is true, it is not one of the fundamental principles of cell theory.

Answer 7

The correct answer is C 'lysosomes' because their role is in digesting unwanted substances *inside* the cell; this is a separate process to the production and secretion of enzymes for use outside the cell.

A is incorrect because the rough endoplasmic reticulum has ribosomes which carry out protein synthesis of the; this is the production of the digestive enzymes.

B is incorrect because the Golgi body processes the enzymes and packages them into vesicles to be secreted into the pancreatic duct.

D is incorrect because mitochondria releases the energy needed for protein synthesis of the digestive enzymes.

Answer 8

The correct answer is C because an electron microscope does not have a resolution as small as 0.05 nm.

All the other statements are correct descriptions of either a light microscope or an electron microscope.

Answer 9

The correct answer is C because the nucleus, chloroplast and mitochondrion all have a double membrane.

- A nucleus is surrounded by a double membrane which connects directly with the *lumen* of the rough endoplasmic reticulum.
- A chloroplast has a double membrane consisting of an outer and inner membrane.
- A mitochondrion has a double membrane. The inner membrane is folded to form structures called the cristae, which contains many of the structures needed to synthesise ATP.

A, B and D are incorrect because endoplasmic reticulum and lysosomes have single membranes.

Answer 10

The correct answer is C because:

- Eukaryotic cells contain two types of endoplasmic reticulum in their cytoplasm: the rough endoplasmic reticulum (RER) and the smooth endoplasmic reticulum (SER).
- The DNA in eukaryotic cells is wound around proteins called histones to make chromatin that forms the chromosomes.
- No eukaryotic cells are smaller than 1 μm in diameter. They usually range between 10-100 μm in diameter, whilst prokaryotic cells usually range between 0.1-5 μm in diameter.

Answer 11

The correct answer is D because products of metabolism, such as enzymes, can function intracellularly (inside the cell) or extracellularly (outside the cell).

A is incorrect because lysosomes contain hydrolytic enzymes that are responsible for breaking down waste material inside cells. This means that while some of the products of the ER might be *stored* inside lysosomes, they will be released from the lysosome in order to function. This will be one of *many* functions of the products of the ER.

B is incorrect because many products of the ER function inside the cell.

C is incorrect because many products will function outside the cell.

Answer 12

The correct answer is B because this provides evidence that mitochondria evolved from free-living prokaryotic organisms with their own genetic material. These prokaryotes had developed the process of aerobic respiration and larger prokaryotes must have, at some point, taken them in by endocytosis, allowing them to live inside their cytoplasm. This is the basis of the endosymbiotic theory.

A, C and D are all scientifically correct statements but do not provide evidence for the endosymbiotic theory.

Answer 13

The correct answer is A because this is an exocrine gland cell from the pancreas. Organelles that are visible in the image that should help you to reach this conclusion include:

- Lysosomes/vesicles; these organelles allow the cell to store digestive enzymes and/or move these protein products around the cell in order to secrete them at the cell surface membrane. Note that the small, dark circles inside the cell are the lysosomes/vesicles
- Rough endoplasmic reticulum; this organelle contains ribosomes which are essential for the production of digestive enzymes. Note that the ribosomes are not visible in this image, so you would perhaps identify this structure by its proximity to the nucleus.

B is incorrect because this image does not show a leaf palisade cell. If this were a photosynthesising plant cell you would be able to identify a cell wall and chloroplasts.

C is incorrect because this image does not show a red blood cell. Red blood cells have a very distinctive biconcave shape and lack many of the organelles shown in the image, such as a nucleus or mitochondria.

D is incorrect because this image does not show an epithelial cell of the small intestine. If it did it would have microvilli to increase the surface area for absorption.

Answer 14

The correct answer is B as statements I and II best describe ribosomes. They are found in all living cells and are composed primarily of ribosomal RNA and about a dozen proteins.

C and D are incorrect, as statements III and IV do not accurately describe ribosomes. It is the proteins that provide structure to the ribosome, ribosomal RNA is the catalytic site of translation and facilitates the binding of mRNA and tRNA. Ribosomes consist of two subunits of non-equal size known as the small subunit and the large subunit.

Answer 15

The correct answer is C: the lack of a nucleus is a defining cellular feature of prokaryotes, this allows transcription and translation to take place in the same cellular compartment (and at the same time) because there is no nuclear membrane separating the DNA from the ribosomes.

- A is incorrect, as the circular nature of the chromosome is not a defining reason why transcription and translation can be coupled; plasmid DNA can also be expressed in the same manner
- B is incorrect, as although free ribosomes can start translating a mRNA molecule whilst it is still being transcribed, they are also present in eukaryotic cells so it is not a defining reason
- D is incorrect, as introns are not present in prokaryotic DNA. The lack of introns means that prokaryotic mRNA can be made immediately available for translation processing

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Answer 16

The correct answer is B; Cairns was able to see this by viewing his results under an electron microscope.

We now know A to be true, but this particular study only involved *E. coli*, so this conclusion cannot be drawn from its results.

Autoradiography is the name of the technique that Cairns used in this study, and it revealed a single, circular chromosome; C is therefore incorrect.

Cairns did later go on to discover D, but did not see it in this particular study.

Answer 17

The correct answer is A.

DNA wraps around histone proteins to form chromatin. Chromatids are the two strands of DNA (known as sister chromatids) that make up the chromosome after DNA replication has occurred and before cell division. Note that because chromatids form the chromosome, they too are made of chromatin.



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