Question 1 : circle the correct answer :

1. *[1 mark]*

What is the minimum number of nucleotides needed to code for a polypeptide composed of 210 amino acids?

A. 70

B. 210

C. 420

D. 630

2. *[1 mark]*

What are linked by hydrogen bonds?

A. Hydrogen and oxygen within a water molecule

B. Phosphate and sugar within a DNA molecule

C. Base and sugar between DNA nucleotides

D. Hydrogen and oxygen in different water molecules

3. *[1 mark]*

Which reaction occurs when a dipeptide is formed from amino acids?

A. Hydrolysis

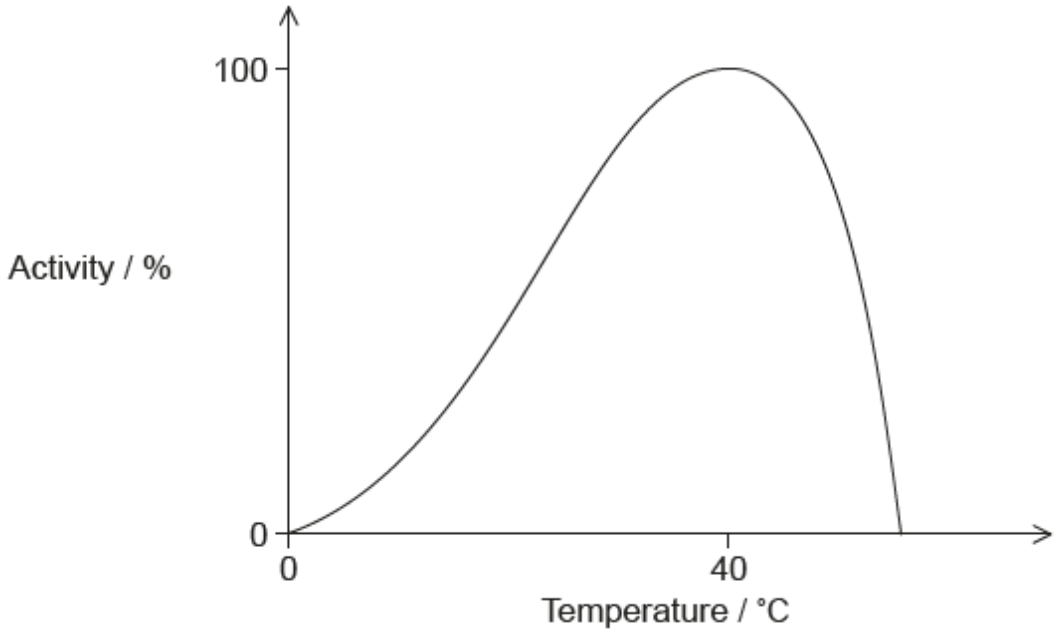
B. Condensation

C. Transcription

D. Oxidation

4. *[1 mark]*

The graph shows enzyme activity plotted against temperature.



What is the reason for the drop in enzyme activity above 40 °C?

A. A decrease in the enzyme concentration

B. Reaction is saturated because active sites are occupied

C. Insufficient activation energy for the reaction to proceed

D. Changes to the conformation of the enzyme

5. *[1 mark]*

Cell metabolism involves anabolic and catabolic reactions. Which process directly involves anabolism?

A. Active transport of ions

B. Release of energy from glucose

C. Production of intracellular enzymes

D. Breakdown of worn-out cell organelles by lysosomes

6. *[1 mark]*

What is a function of the enzyme helicase?

A. It coils DNA up into a double helical shape.

B. It links DNA nucleotides in a new DNA strand.

C. It breaks hydrogen bonds between the DNA strands.

D. It forms temporary hydrogen bonds to produce messenger RNA.

7. *[1 mark]*

Lipids are more efficient energy stores than carbohydrates. What is a reason for this?

A. Lipids are bigger molecules than carbohydrates.

B. Lipids release more energy per gram than carbohydrates.

C. Lipids can be more easily mobilized than carbohydrates when needed.

D. Lipids can be used in aerobic and anaerobic respiration when needed.

8. *[1 mark]*

What is the correct arrangement for the components of one strand in a DNA molecule?

A. — phosphate — deoxyribose — base — phosphate — deoxyribose — base —

B.
```
— base — deoxyribose — base — deoxyribose — base — deoxyribose —
                |                  |                  |
            phosphate          phosphate          phosphate
```

C.
```
— phosphate — deoxyribose — phosphate — deoxyribose — phosphate — deoxyribose —
                    |                      |                      |
                  base                   base                   base
```

D.
```
— phosphate — base — phosphate — base — phosphate — base —
                |                  |                  |
            deoxyribose        deoxyribose        deoxyribose
```

9. *[1 mark]*

What is the benefit to living organisms that water has a high specific heat capacity?

A. Heat can be lost from the skin when sweat evaporates.

B. Aquatic environments do not have a great fluctuation in their temperature.

C. The amount of heat stored by water is highly predictable.

D. It allows water to be a solvent for chemical reactions at body temperature.

10. *[1 mark]*

What is the term for the attraction of water molecules to other water molecules?

A. Surface tension

B. Capillary action

C. Cohesion

D. Adhesion

11. *[1 mark]*

Which statement applies to enzymes?

A. Enzyme function depends on collisions between substrate and active sites.

B. One active site typically binds to a broad range of substrates.

C. The active site on the substrate is specific to one enzyme.

D. When enzymes are immobilized they stop working.

12. *[1 mark]*

Which process is an example of catabolism?

A. Translation of mRNA

B. Replication of DNA

C. Hydrolysis of protein

D. Synthesis of a disaccharide

13. *[1 mark]*

What property of water accounts for its usefulness as a coolant in sweat?

A. High specific heat capacity

B. High latent heat of vaporization

C. High boiling point

D. High melting point

14. *[1 mark]*

Which feature is common to both mRNA and DNA?

A. Covalent bonds between adjacent nucleotides

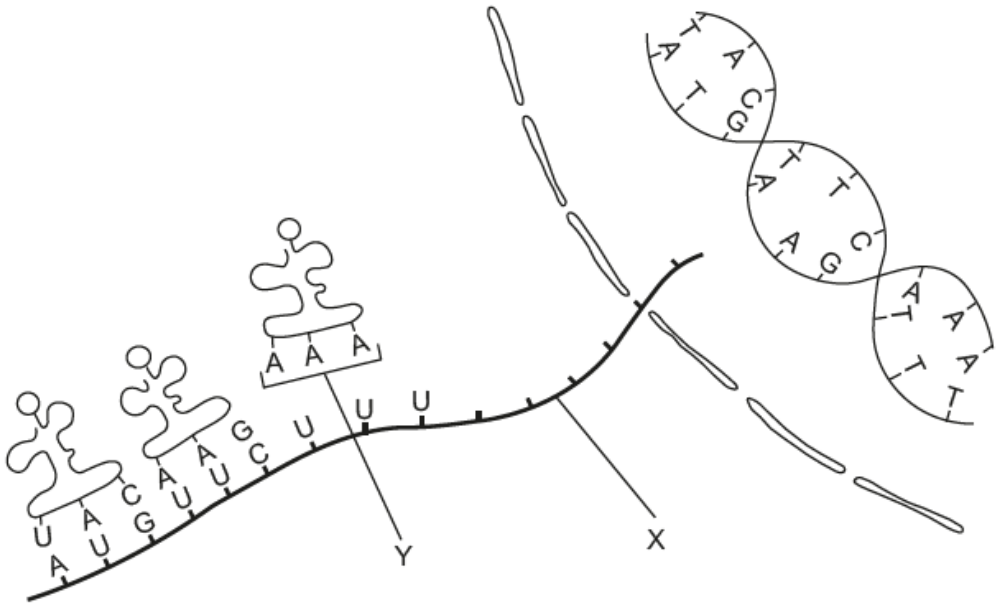
B. Hydrogen bonds between guanine and cytosine

C. Ribose sugar attached to phosphate

D. Antiparallel arrangement of polynucleotide strands

15. *[1 mark]*

The diagram represents transcription and translation.



[Source: © International Baccalaureate Organization 2020.]

What structures do the letters X and Y represent?

	X	Y
A.	DNA	anticodon
B.	mRNA	anticodon
C.	DNA	codon
D.	mRNA	codon

16. *[1 mark]*

What is a property of water?

A. Water has a low specific heat capacity so large increases in heat energy cause a small temperature change.

B. Water is an excellent solvent for non-polar substances.

C. Covalent bonds between adjacent water molecules are responsible for its unique properties.

D. Water molecules are highly cohesive which is important for transport in xylem.

17. *[1 mark]*

The gene that codes for a particular polypeptide includes the base sequence shown.

GAGTACCCT

What is the base sequence of the mRNA molecule which is complementary to this sequence?

A. GAGTACCCT

B. CTCATGGGA

C. GUGTUCCCT

D. CUCAUGGGA

18. *[1 mark]*

The diagram shows two polysaccharides, formed from condensation of many glucose molecules.

X Y

[Source: © International Baccalaureate Organization 2019]

What are the names of X and Y?

	X	Y
A.	glycogen	amylose
B.	amylopectin	amylase
C.	amylase	glycogen
D.	amylose	amylopectin

19. *[1 mark]*

The base sequences of a short section of DNA are shown, together with mRNA that has been transcribed from it and one of the tRNA anticodons that could be used to translate the mRNA.

DNA strand 1 A-C-G-G-C-A-T-T-A-G-C-T-A **tRNA anticodon** U-U-A

DNA strand 2 T-G-C-C-G-T-A-A-T-C-G-A-T **mRNA** U-G-C-C-G-U-A-A-U-C-G-A-U

Which strand of DNA is transcribed and to which codon in the mRNA would the tRNA anticodon bind during translation?

	DNA strand transcribed	mRNA codon that tRNA anticodon binds to
A.	DNA strand 1	second
B.	DNA strand 2	second
C.	DNA strand 1	third
D.	DNA strand 2	third

20. *[1 mark]*

Where are amino acids joined together to make polypeptides?

A. Nucleus

B. Nucleolus

C. Golgi apparatus

D. Ribosomes

21. *[1 mark]*

Nucleic acids are polymers of nucleotides. What parts of nucleotides are joined together in both DNA and RNA to make these polymers?

A. Large nitrogenous bases with small nitrogenous bases

B. Nitrogenous bases with hexose sugars

C. Nitrogenous bases with phosphates

D. Pentose sugars with phosphates

22. *[1 mark]*

What do DNA replication, transcription and translation have in common?

A. Take place in cell nucleus

B. Require free nucleotides

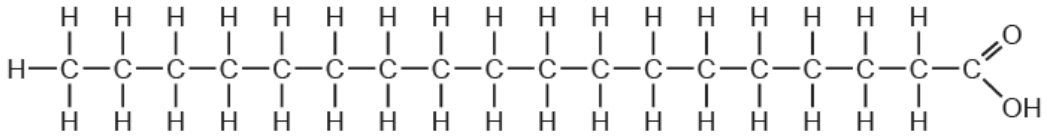
C. Catalysed by polymerase

D. Complementary base pairing

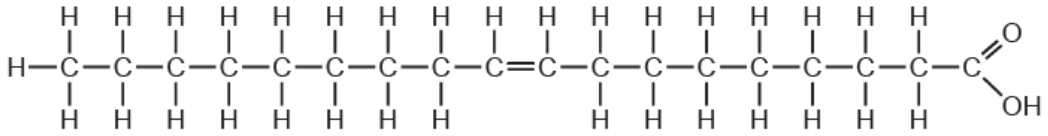
23. *[1 mark]*

Which fatty acid would occur in a trans fat?

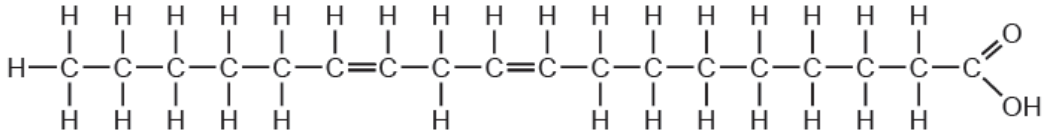
A.



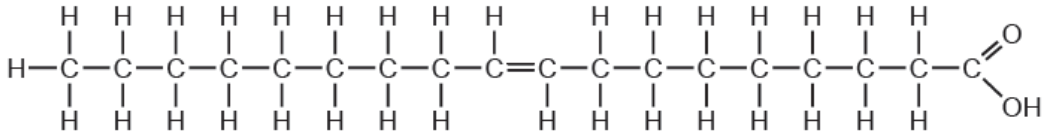
B.



C.



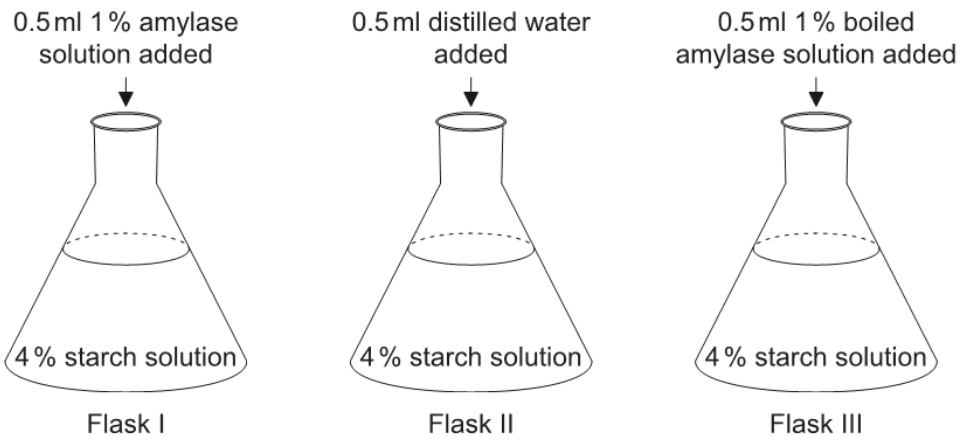
D.



[Source: © International Baccalaureate Organization 2018]

24. *[1 mark]*

Three flasks were prepared for an analysis of the activity of amylase. At time zero, each of the substances indicated in the diagrams was added.



Which flask(s) could provide support for the hypothesis that heat denatures enzymes?

A. Flasks I and II after 15 minutes

B. Flasks II and III after 15 minutes

C. Flasks I and III after 15 minutes

D. Flask III at time zero and again after 15 minutes

25. *[1 mark]*

For which discovery about DNA do Watson and Crick receive credit?

A. DNA is the molecule that genes are made of.

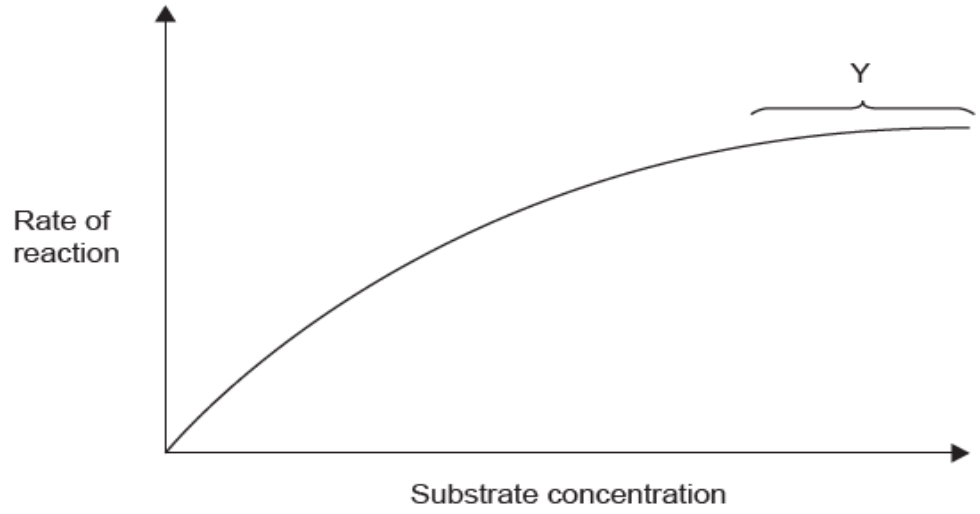
B. The amount of adenine equals the amount of thymine in an organism.

C. Phosphate–pentose bonding along the nucleotide backbone is covalent.

D. The shape of DNA is a double helix.

26. *[1 mark]*

The graph shows the effect of increasing the substrate concentration on the rate of an enzyme-catalysed reaction. What is occurring during the phase indicated by section Y of the graph?



A. The active site of the enzyme is saturated.

B. The enzyme becomes denatured.

C. The substrate concentration has risen too high.

D. The optimum rate is reached.

27. *[1 mark]*

More than 90 % of cellular cholesterol is located in the cell's plasma membrane. What is the main role of cholesterol in the plasma membranes of mammalian cells?

A. To regulate membrane fluidity

B. To increase membrane solubility

C. To increase membrane permeability

D. To regulate membrane temperature

28. *[1 mark]*

What is/are required for facilitated diffusion?

I. A concentration gradient

II. ATP

III. A channel protein

A. I only

B. I and III only

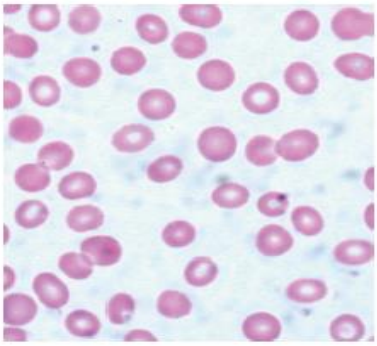
C. II and III only

D. I, II and III

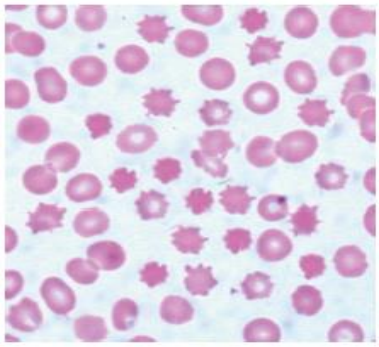
29. *[1 mark]*

In an experiment on osmosis, red blood cells were immersed in a salt solution for two hours. The micrographs show the appearance of these cells before and after immersion in the salt solution.

before immersion



after immersion



What explains the observed changes?

A. The salt solution was hypertonic and entered the red blood cells.

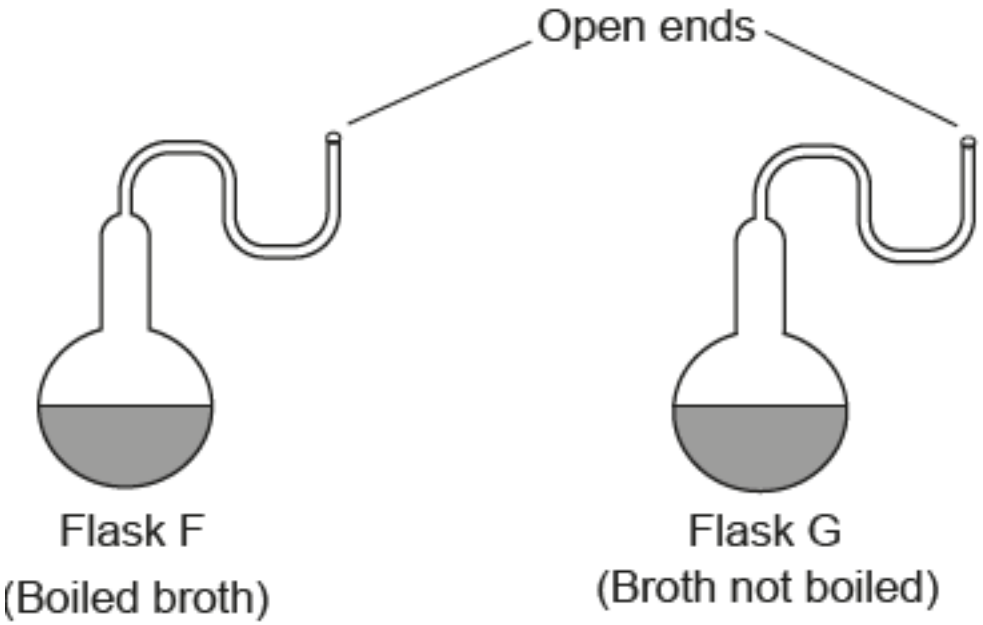
B. The salt solution was hypotonic and disrupted the membranes of the red blood cells.

C. The salt solution was hypertonic and water moved into it from the red blood cells.

D. The salt solution was hypotonic and mineral salts were lost from the red blood cells.

30. *[1 mark]*

Pasteur used swan-necked flasks and a nutrient broth to demonstrate that spontaneous generation of organisms does not occur on Earth. Some students performed a similar experiment using two swan-necked flasks, one containing broth which had been previously boiled and another containing broth which had not been boiled.



The flasks were left in the school laboratory and observed after one week. What is the evidence against the spontaneous generation theory?

A. Microorganisms died in flask F due to high temperatures.

B. No microorganisms grew in either flask.

C. Microorganisms grew in flask G.

D. No microorganisms grew in flask F but many grew in flask G.

31. *[1 mark]*

Two cells have the following characteristics.

	Cell I	Cell II
Ribosomes	✓	✓
Nucleus	X	✓
Cell wall	✓	✓
Cytoplasm	✓	✓
Cell respiration	✓	✓
Ability to photosynthesize	✓	X

Which deduction is supported by this information?

A. Both cells are from plants.

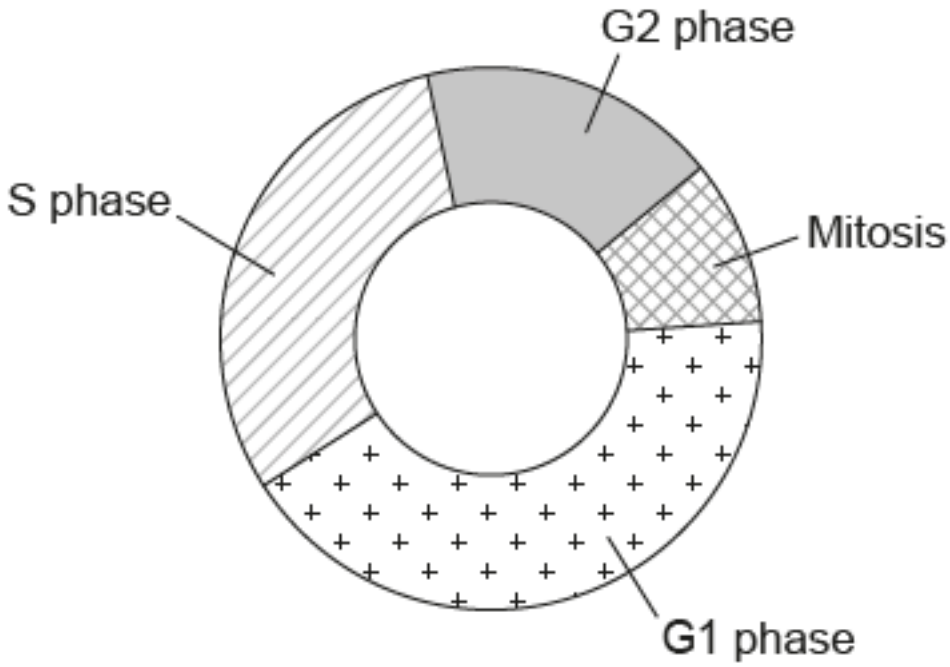
B. Cell I is more complex than cell II.

C. Cell II is an animal cell.

D. Cell I is prokaryotic.

32. *[1 mark]*

In which stage of the cell cycle are chromosomes duplicated?



A. G1 phase

B. G2 phase

C. S phase

D. Mitosis

33. *[1 mark]*

Which features of phospholipids give them their amphipathic properties?

A. Basic phosphate groups and acidic lipids

B. Acidic phosphate groups and basic lipids

C. Hydrophobic phosphate groups and hydrophilic fatty acids

D. Hydrophilic phosphate groups and hydrophobic fatty acids

34. *[1 mark]*

How do both mitochondria and chloroplasts provide evidence for the endosymbiotic theory?

A. They have double membranes.

B. They have 80S ribosomes similar to prokaryotes.

C. They contain the same DNA as the nucleus of the cell.

D. They exist together in eukaryote cells for their mutual benefit.

35.*[1 mark]*

Which statement applies to cholesterol?

A. It is hydrophobic and found on the outside of the phospholipid bilayer.

B. It is hydrophilic and found inside the phospholipid bilayer.

C. It impacts membrane fluidity.

D. It is transported in association with glucose in the blood.

36. *[1 mark]*

A tissue sample was examined under the microscope in order to determine a mitotic index. The number of cells in each stage of the cell cycle was determined and the data were entered into a table.

Stage of life cycle	Interphase	Prophase	Metaphase	Anaphase	Telophase	Total
Number of cells	120	20	10	8	2	160

What is the mitotic index?

A. 0.125

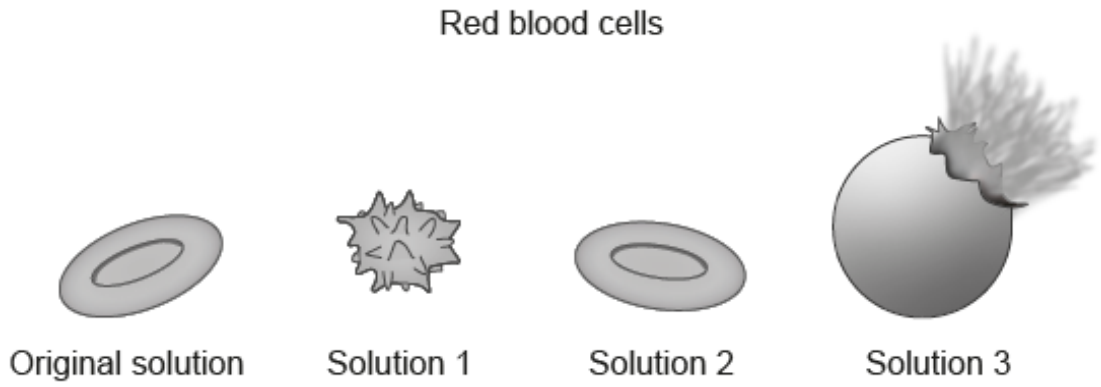
B. 0.25

C. 0.75

D. 1.00

37. *[1 mark]*

The images show samples of red blood cells that were placed in different concentrations of salt solutions.



Which process explains the observations shown in the images?

A. Active transport

B. Exocytosis

C. Facilitated diffusion

D. Osmosis

38. *[1 mark]*

Which solution has the highest salt concentration?

A. The original solution

B. Solution 1

C. Solution 2

D. Solution 3

39. *[1 mark]*

When does DNA replication occur?

A. S phase of interphase

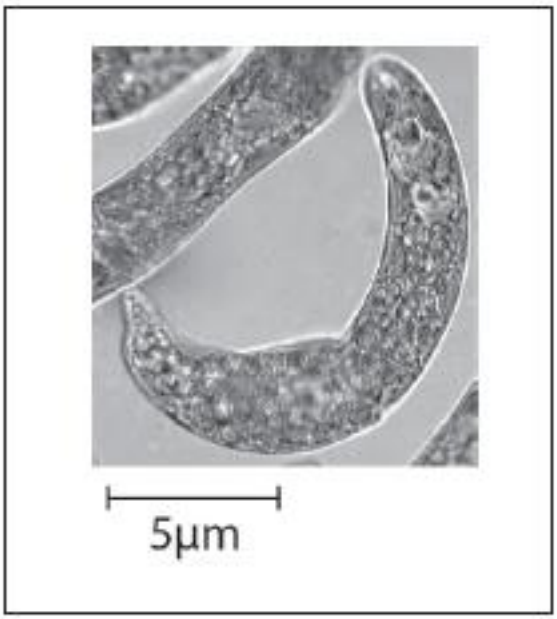
B. prophase

C. G phase of interphase

D. metaphase

40. *[1 mark]*

The electron micrograph shows a thin section through a plant mesophyll cell.



What is the magnification of the image?

A. × 75

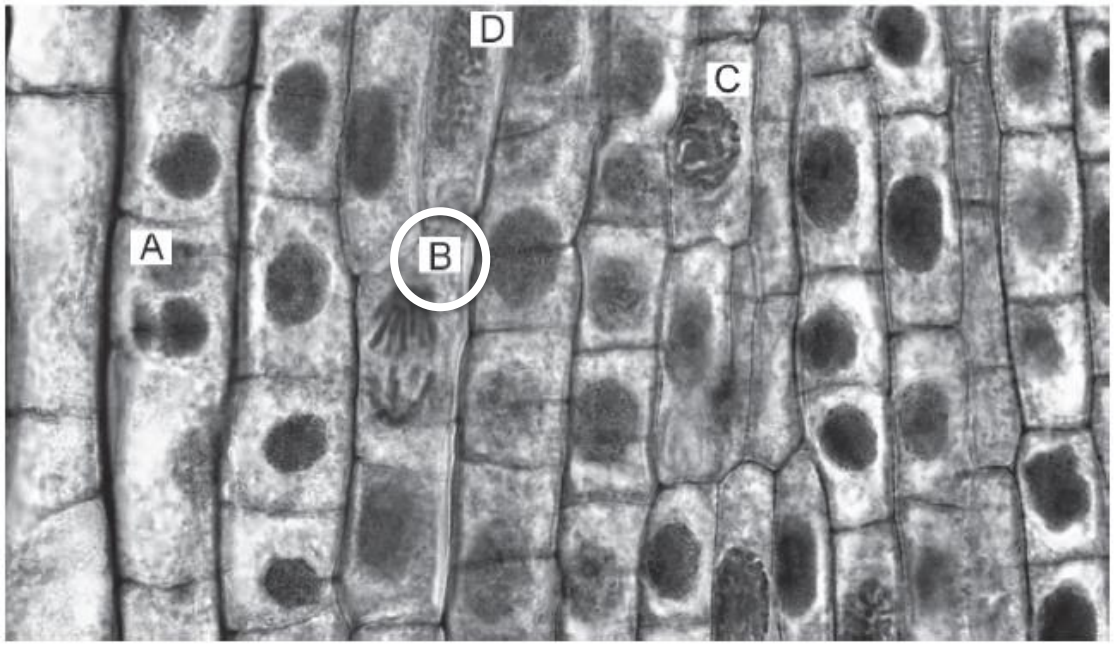
B. × 300

C. × 3000

D. × 7500

41. *[1 mark]*

In the micrograph, which letter points to a cell in anaphase?



42. *[1 mark]*

Students examined micrographs and counted cells in the different stages of mitosis as well as those cells with no visible chromosomes. The table shows their results.

Stage	Prophase	Metaphase	Anaphase	Telophase	Interphase
Number of cells	10	3	2	5	30

What is the mitotic index?

A. 0.2

B. 0.4

C. 0.6

D. 0.7

43. *[1 mark]*

Which structures are found only in prokaryotic cells?

A. Ribosomes

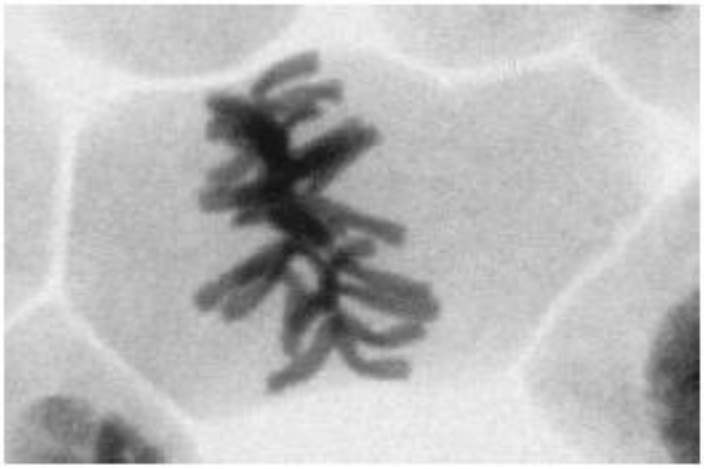
B. Pili

C. Cell walls

D. Flagella

44. *[1 mark]*

The image shows a micrograph of a cell.



What explains the appearance of the cell in the micrograph?

A. The cell is dying.

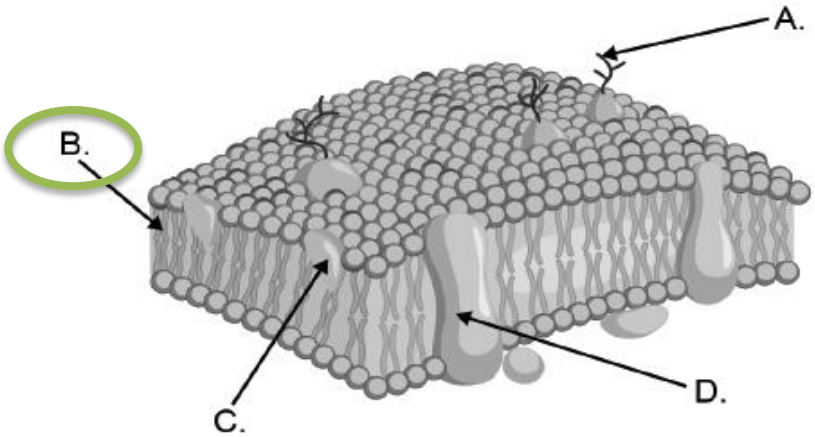
B. The DNA is replicating.

C. The cell is in metaphase.

D. The cell is in telophase.

45. *[1 mark]*

What part of the plasma membrane is fluid, allowing the movement of proteins in accordance with the fluid mosaic model?



[Source: Vecton/Vector images/Shutterstock]

46. *[1 mark]*

Where could genes be located in a prokaryotic cell?

	Nucleoid	Plasmids	Ribosomes
A.		✓	✓
B.	✓	✓	
C.	✓		✓
D.	✓	✓	✓

49. Which of the following is the correct sequence of the four phases of mitosis?

A. Prophase, anaphase, metaphase, telophase

B. Anaphase, prophase, metaphase, telophase

C. Prophase, metaphase, anaphase, telophase

D. Prophase, metaphase, telophase, anaphase

47. How did Pasteur's experiment with sterile broth in open flasks demonstrate the principle

that cells only come from pre-existing cells?

A. By demonstrating that sterile broth would not ferment in contact with air alone.

B. By demonstrating that the air contained microbes

C. By demonstrating that broth would not ferment if sterile

D. By demonstrating that sterile broth fermented in contact with air

Question 2:

1. Outline how the mitotic index can be used in the diagnosis of cancer?

One mark for any of the point below

Mitotic index is a measure for how fast the cells are dividing (also known as proliferation) A high mitotic index means that the cells might be cancerous;

Mitotic Index is defined as the ratio between the number of cells actively dividing (in mitosis) and the total number of cells / a low mitotic index means that the cells are dividing slowly.

Mitotic index has been shown to be a strong predictor of / to correlate to survival / prognosis / treatment success in (some) cancers.

2. List two sources of stem cells that can be used in therapeutic treatment.

- The foetal umbilical cord (blood);
- Early-stage embryos (specially created);

3. Outline two similarities between the structure of prokaryote cells and eukaryote cells.

Both cells have;

- plasma membrane
- ribosomes (although they are 70s in prokaryotes and 80s in eukaryotes)
- both cells contain DNA

4. Define the term "cell differentiation".

Cell differentiation is the process by which a cell changes from one cell type (an undifferentiated cell / a stem cell) to another cell type / specialised cell (by expressing some of its genes and not others)

5. Explain the evidence which supports the endosymbiotic theory of the evolution of the eukaryotic cell.

- Mitochondria **and** chloroplasts are believed to have been free living (they are endosymbionts);
- Mitochondira and Chrloroplasts have double membrane **which is evidence for** endocytosis of the organelle;
- they have 70s ribosomes **which** are found in Prokaryotes;
- they have a DNA loop/naked DNA **as found** in Prokaryotes;
- they are self replicating **which is evidence** for them having been free living origin;

6. Eukaryote cells contain organelles which each have specific functions. Complete the table below, to identify the missing organelle names and the missing functions.

Organelle	Structure	Function
Nucleus	Large structure surrounded by a double membrane with DNA and proteins inside.	Contains the cell's DNAand is the site of DNA replication
Golgi apparatus	A stack of four or more flattened membrane disks	Processes and packages proteins into vesicles
Lysosome	A round organelle with a single membrane containing digestive enzymes.	Digestion of molecular debris inside the cell.
Mitochondrion	An organelle with a double membrane. The outer membrane makes the shape of the organelle but the inner membrane folds into cristae	Carries out the reactions of the Krebs cycle / aerobic respiration