IB · DP · Biology

40 mins 40 questions

Practice Paper 1

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Total Marks **/40**

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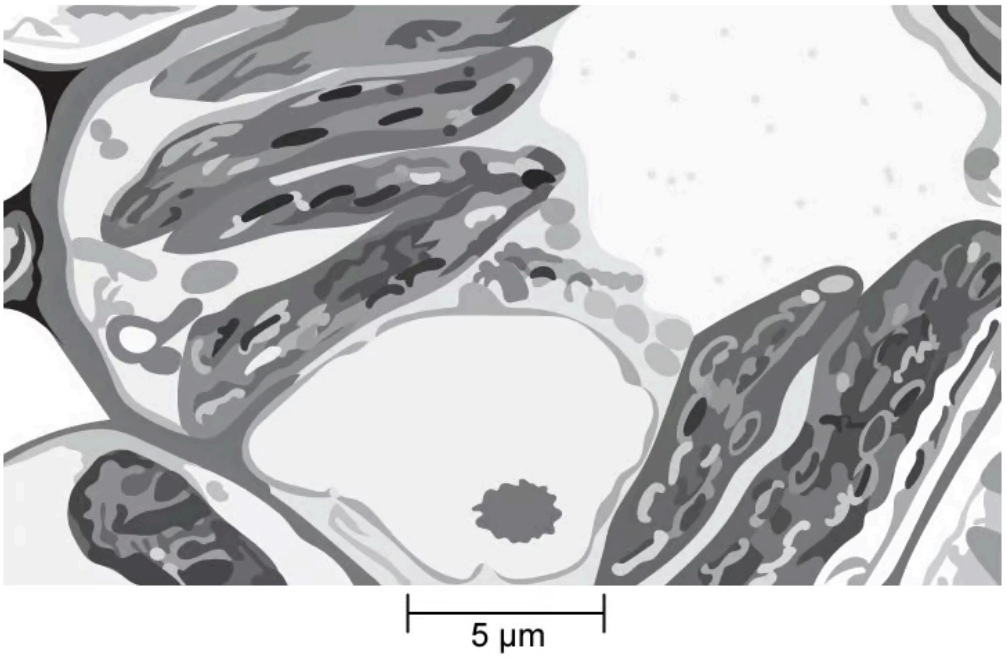
1 The electron micrograph shows the organelles in a leaf cell. A student uses their ruler to measure the length of the scale bar, which they find to be 1.5 cm.



What is the magnification?

A. × 7 000

B. × 7.5

C. × 3 000

D. × 300

(1 mark)

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2 Halophytes are plants that are able to survive in regions where they are regularly covered by salty seawater.

Which adaptation would you expect halophytes to have to enable them to live in this environment?

A. Root hair cells with a low osmolarity.

B. Cells with a high number of chloroplasts.

C. Root hair cells which accumulate salts and other solutes.

D. Cells with a low number of mitochondria.

(1 mark)

3 What properties does a human cell have just before it enters prophase?

	Nuclear membrane present	Spindle present	Number of chromatids
A	No	Yes	92
B	Yes	No	92
C	Yes	Yes	46
D	Yes	No	46

(1 mark)

4 The table shows the percentages of bases in DNA samples from various organisms.

Source of DNA	Adenine	Cytosine	Guanine	Thymine
Human liver	30	20	20	**Z**
Chicken liver	**W**	40	40	10
Dog liver	24	26	24	26
Mouse bone marrow	23	**X**	26	25
Sunflower leaf	10	39	**Y**	12

Which row of the table below correctly reflects the missing data values?

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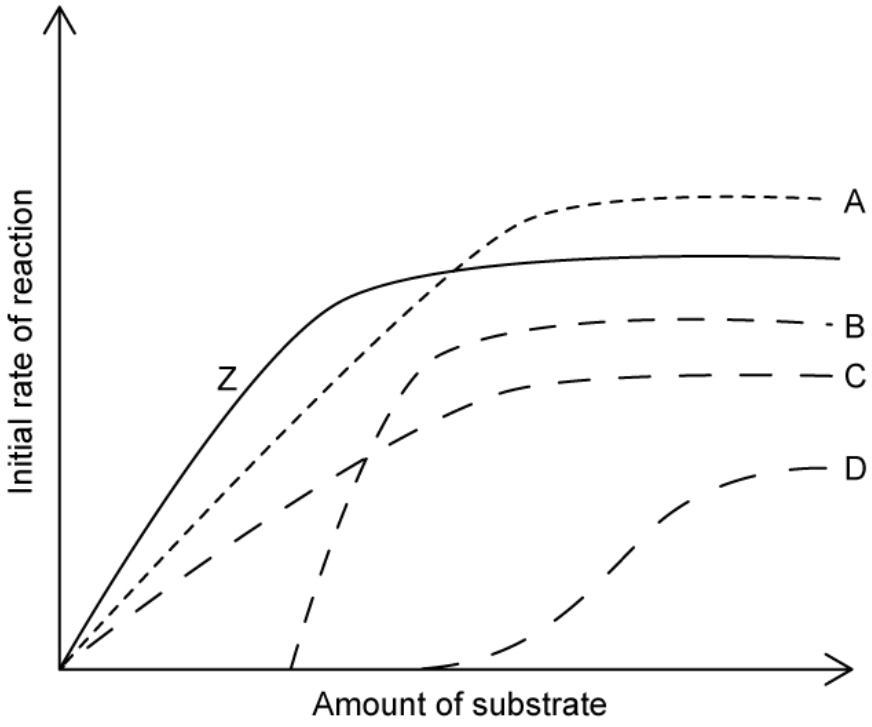
	W	X	Y	Z
A	9	24	38	30
B	10	26	39	31
C	10	26	39	30
D	10	25	38	29

(1 mark)

5 In the graph, **Z** represents the relationship between the initial rate of an enzyme-catalysed reaction and the concentration of its substrate under optimal conditions and without an inhibitor.



Which curve would represent the same experiment carried out in the presence of a low concentration of a non-competitive inhibitor?

(1 mark)

6 The nomogram below shows the range and classification of body mass index (BMI) values.

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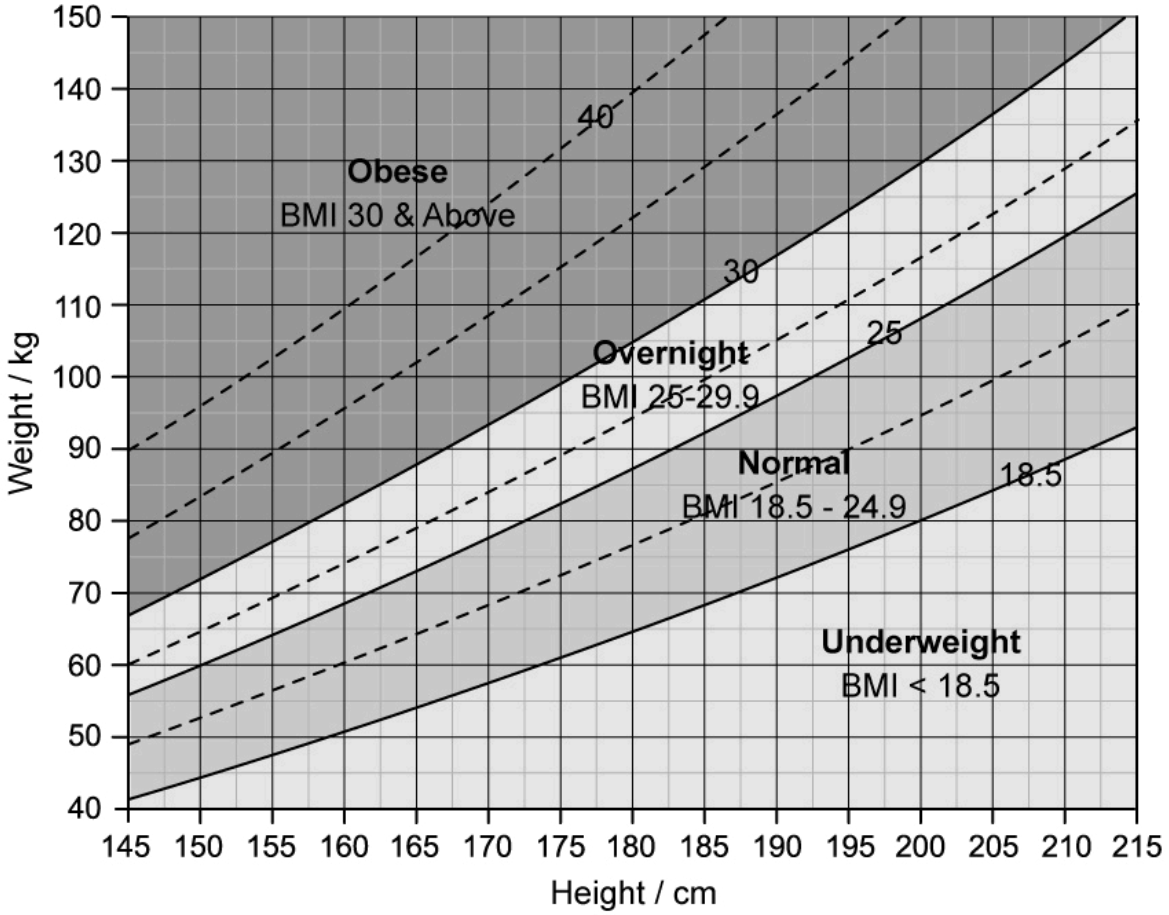

A person of height 170 cm has a mass of 105 kg.

What is the amount of mass this person would have to lose to reach a body mass within the normal BMI range?

A. 15 kg

B. 25 kg

C. 35 kg

D. 50 kg

(1 mark)

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7 Which property of carbon makes it a good basis for organic molecules?

A. It exists in hard and stable forms like graphite and diamond.

B. It forms a varying number of covalent bonds to other atoms.

C. It can form millions of different compounds in association with hydrogen and oxygen.

D. It forms strong, ionic bonds with other atoms.

(1 mark)

8 Which activity was **not** a direct contributor to Crick and Watsons' discovery of the double-helix structure of DNA?

A. Thin-layer chromatography.

B. X-ray molecular analysis.

C. Building physical models with clamps and stands.

D. Collaboration with scientists in other research institutions.

(1 mark)

9 Which is the most correct statement about chlorophyll?

A. Absorbs red and blue light.

B. Reflects red and blue light, and absorbs green light.

C. Absorbs the full spectrum of light equally.

D. Only absorbs blue light.

(1 mark)

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10 John Cairns carried out a study in which he kept *E. coli* bacteria in a solution containing radioactive thymine.

What was he able to conclude from the results of his study?

A. Prokaryotes have a circular chromosome.

B. *E. coli* have a circular chromosome.

C. Autoradiography does not produce clear enough results to determine whether bacteria have one chromosome or many.

D. Bacteria replicate their DNA using a structure called a replication fork.

(1 mark)

11 The following statement describes some of Louis Pasteur's findings:

> Broth was first boiled, killing all organisms in it. The broth was then transferred to a swan-necked flask, which prevented organisms from entering. The result was that no organism subsequently grew in the broth. The swan-necked flask was then broken. The result was that mould subsequently grew in the broth.

What did these findings suggest?

A. Mould needs nutrients in order to grow.

B. Aerobic respiration requires the presence of oxygen.

C. Mould is a form of microorganism.

D. Spontaneous generation of cells does not occur.

(1 mark)

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12 Which of the following statements help to explain why DNA replication happens before meiosis?

I. A gamete-producing cell ends up producing 4 gametes.
II. The cell undergoes reduction division during meiosis.
III. Gametes contain double the amount of genetic material than somatic cells.
IV. Each parent's genome is replicated to allow two copies of their alleles to be inherited with equal probability.

A. I, II, and IV only.

B. II and III only.

C. I and IV only.

D. I, II, III, and IV.

(1 mark)

13 Events in meiosis play an important role in determining the inheritance of alleles. Which row of the table states the correct words to name the processes being described?

	The orientation of chromosomes pairing up in prophase I	**Chromosome are pulled towards the poles of the cell in anaphase I**
A	Synapsis	Assortment
B	Segregation	Assortment
C	Assortment	Segregation
D	Segregation	Cytokinesis

(1 mark)

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14 Which of the following species are most closely related?

I. Marsh tit (*Poecile palustris)*
II. Coal tit (*Periparus ater)*
III. Marsh warbler (*Acrocephalus palustris)*
IV. Willow tit (*Poecile montanus)*

A. I and II

B. I and III

C. I and IV

D. II and IV

(1 mark)

15 Why are ecosystems considered to be sustainable?

A. They do not require any outside input.

B. Nutrients such as nitrogen and carbon are constantly recycled.

C. Nutrients and energy are constantly recycled.

D. Nutrients are recycled and photosynthesis converts light energy into chemical energy.

(1 mark)

16 From each molecule of substance X (in the diagram), how many molecules of ATP can be produced?

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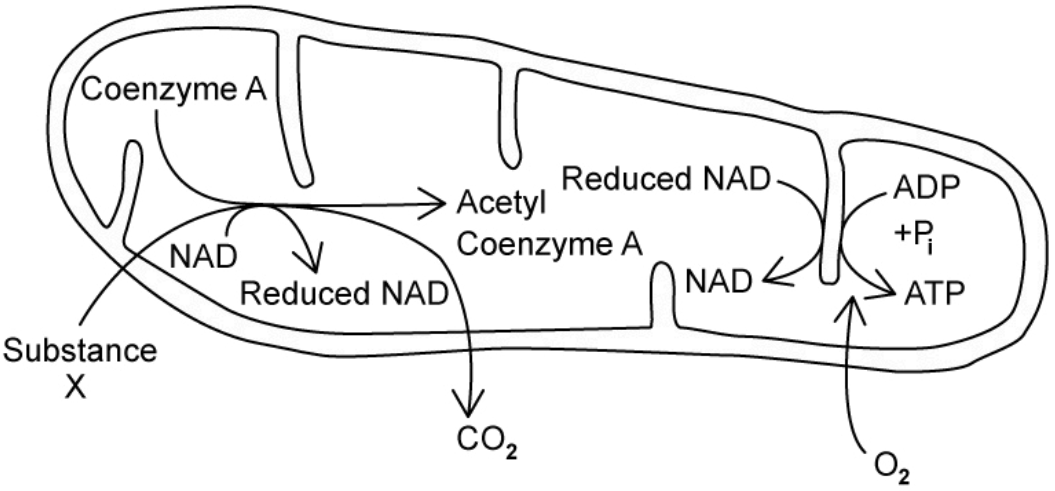

A. 17

B. 34

C. 36

D. 18

(1 mark)

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17 From the three examples listed below, which describe the occurrence of speciation?

I. Two plant populations of the same species are pollinated by different species of insect that are active at different times of the day. There is no overlap between when the two insect species are active. Mutations occur within the two populations leading to them to become genetically distinct from each other.

II. A small number of lizards float on a wooden log and start a new population on another island. Mutations occur within the two populations leading to them to become genetically distinct from the original population.

III. A mutation occurs that causes a small population of a species of plant to become tetraploid instead of the usual diploid cells.

A. II. only

B. I. and II. only

C. I. and III. only

D. All of I., II. and III.

(1 mark)

18 Theories can change when new evidence emerges. Evidence relating to the evolutionary relationships between organisms can lead to their reclassification. What led to the reclassification of the figwort plant family?

A. Observations about flower shape.

B. The figwort family was too large.

C. The figwort family formed a clade.

D. Analysis of chloroplast DNA

(1 mark)

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19 In eukaryotic cells, ribosomes can be either free or bound.

Which of the following proteins would most likely be synthesised by bound ribosomes?

A. Mitochondrial outer membrane protein

B. Glyceraldehyde 3-phosphate dehydrogenase involved in glycolysis

C. Lysosomal acid lipase

D. Histone protein

(1 mark)

20 Which of the following statements about metabolism are correct?

I. Metabolism involves chemicals called metabolites.
II. Metabolism involves reactions in a linear chain.
III. Metabolism involves reactions in a cycle.
IV. Metabolism involves only the breakdown of molecules.

A. I and IV only

B. II and III

C. All of the statements

D. I, II and III

(1 mark)

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21 A student studied the structure of a blood vessel and found:

1. An innermost layer of endothelial cells
2. A thick middle layer of smooth muscle and elastic tissue
3. An outer layer of collagen fibres

Which vessel was the student studying?

A. Vein

B. Capillary

C. Venule

D. Artery

(1 mark)

22 Bacteria and viruses are the main pathogens in humans. Antibiotics can be used to treat bacterial infections but not viral infections.

Which of the following statements explains why?

A. Viruses need a host to survive.

B. Viruses consist of just nucleic acid and a protein coat.

C. Bacteria have peptidoglycan cell walls.

D. Viruses are significantly smaller than bacteria.

(1 mark)

23 What is specific immunity?

A. Treating a specific disease through use of antibiotics.

B. Production of monoclonal antibodies.

C. Production of antibodies by lymphocytes.

D. Endocytosis of pathogens by phagocytes.

(1 mark)

24 Which event directly results in the production of an action potential?

A. Diffusion of neurotransmitter across the synaptic cleft.

B. Fusion of vesicles with the presynaptic membrane.

C. Membrane potential reaches the resting potential.

D. Membrane potential reaches the threshold potential.

(1 mark)

25 The bambooleaf wrasse, *Pseudolabrus japonicus*, is a species of fish found off the coast of Japan. During the breeding season male wrasse release gametes (a process known as spawning) on a daily cycle in the presence of a single female.

The graph below shows some of the events occurring inside the testes of bambooleaf wrasse during a 24 hour period.

Note that lobules are regions within fish testes.

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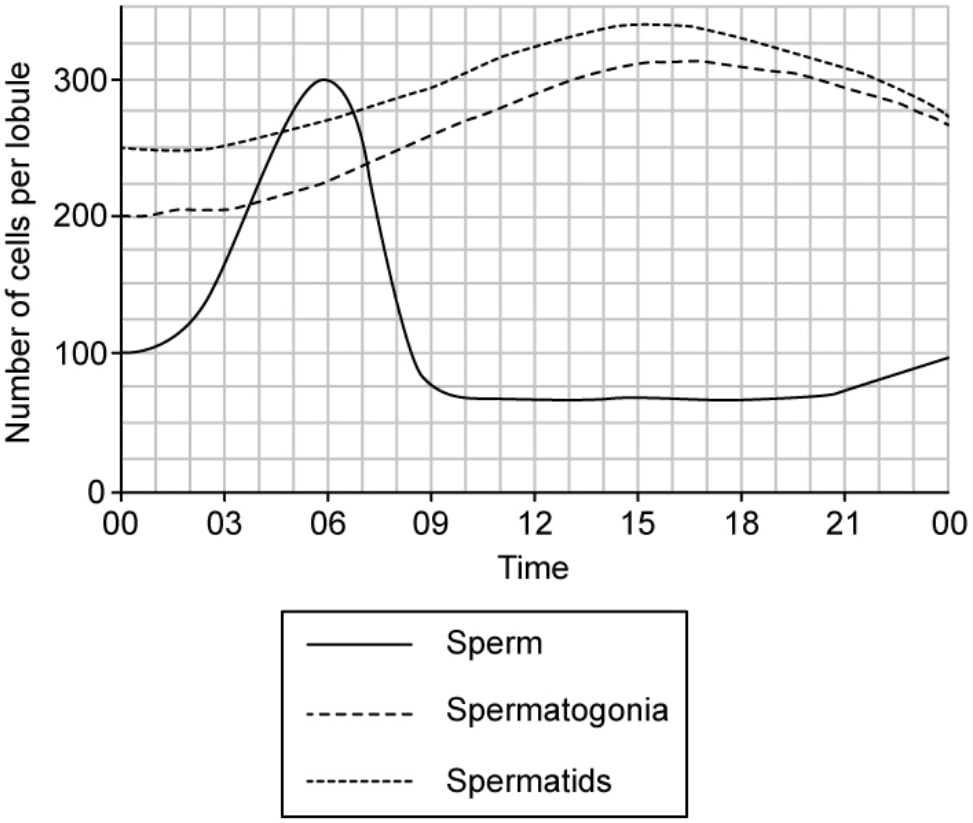

Which of the following statements relating to spermatogenesis and fertilisation in wrasse are correct?

I. Wrasse spawning occurs between 06:00 and 10:00.

II. Both mitosis and meiosis are occurring between 00:00 and 15:00.

III. The percentage increase in the number of sperm per lobule between 00:00 and 06:00 is $66.\dot{6}$ %.

IV. Wrasse use external fertilisation.

A. I and II only.

B. I, II, III, and IV.

C. I, II, and IV only.

D. I and IV only.

(1 mark)

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26 A specific androgen receptor (AR) found in the cytoplasm of cells interacts with the sex hormone, testosterone.

A repeating nucleotide base sequence, CAG, found in the gene for AR has been associated with the risk of developing prostate cancer.

The table below shows the results of two statistical tests which found an association between the number of CAG repeats and the risk of developing prostate cancer.

Number of CAG repeats in AR gene	Probability (P) value
≤ 10	0.02
≥ 20	0.25

The null hypothesis was;

'There is no significant association between the number of CAG repeats and the risk of developing prostate cancer'

Identify the conclusion which can be drawn from the data in the table.

A. With 20 or more CAG repeats, we can reject the null hypothesis

B. Prostate cancer is more likely with 20 or more CAG repeats with more than a 5% probability that results are due to chance

C. With 10 or fewer than 10 repeats the association is not-significant with less than a 5% probability that results are due to chance

D. With 10 or fewer than 10 repeats the association is significant with less than a 5% probability that results are due to chance

(1 mark)

27 The simplified diagram below shows a section of DNA where a methyl ($-CH_3$) group has been added to a cytosine base.

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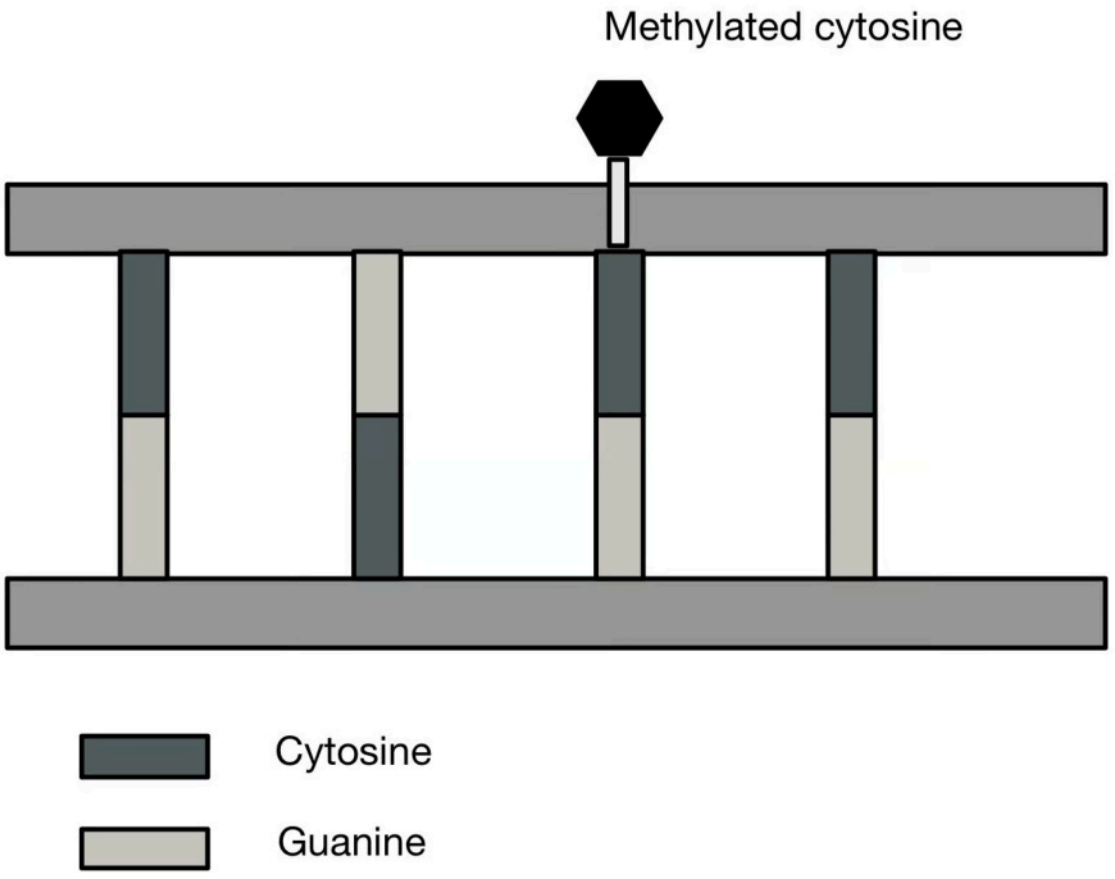

Which of the following best describes the outcome of direct methylation of DNA?

A. It stimulates the expression of the gene.

B. It prevents guanine from forming hydrogen bonds.

C. It inhibits the binding of transcription factors.

D. It causes breaks in the phosphate deoxyribose backbone.

(1 mark)

28 The following steps describes the events taking place during the elongation of a polypeptide in no particular order.

I. Free tRNA molecules bind to their corresponding amino acids due to their specific anticodon and transport it to the ribosome
II. A tRNA with a complementary anticodon binds to the "A" site bringing its specific amino acid along
III. The initiator tRNA moves from the "P" to the "E" site on the ribosome where it initiates translation
IV. The amino acid carried by the tRNA at the "P" site is linked to the polypeptide chain by a peptide bond
V. tRNA carrying the peptide chain moves from the "A" site to the "P" site as the ribosome moves in the 5' → 3' direction along the mRNA molecule

Which of these steps contain incorrect information?

A. I., III. and V.

B. II., III. and V.

C. I., III. and IV.

D. I., III., IV. and V.

(1 mark)

29 Which of the following is **not** a correct description of the “transition state” in enzyme-controlled reactions?

A. The enzyme-substrate complex, prior to the products being formed, can be said to be in the transition state.

B. The enzyme-product complex, prior to the products being released, can be said to be in the transition state.

C. The transition state occurs when a substrate binds to the enzyme’s active site.

D. Transition state is a temporary state

(1 mark)

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30 Which statements correctly describe phosphorylation and dephosphorylation reactions?

I. The phosphorylation of ADP is an endergonic reaction.
II. The dephosphorylation of ATP is an endergonic reaction.
III. The phosphorylation of ADP is a hydrolysis reaction.
IV. The dephosphorylation of ATP is a hydrolysis reaction.

A. I and II

B. II and III

C. I and IV

D. II and IV

(1 mark)

31 Which of the following would be a suitable definition for the term 'photolysis'?

A. The splitting of water molecules using light energy

B. The splitting of an oxygen molecule into oxygen atoms

C. The splitting of water into protons, neutrons and oxygen

D. The splitting of water by means of hydrolysis reactions

(1 mark)

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32 Identify which of the adaptations below is **not** found amongst the group of plants known as xerophytes.

A. Having long hairs on their surface, so air moisture is absorbed at night

B. Having reduced leaves in the form of spines, so the surface area for transpiration is reduced

C. Having reduced numbers of stomata, so there are fewer pores through which water can be lost

D. Having hinge cells that shrink when flaccid, so the leaves roll up

(1 mark)

33 Which of the following best describes the factor that determines the direction of mass flow of phloem sap between leaves and fruit?

A. The active loading of sucrose into phloem sieve tubes near the fruit will create a hydrostatic pressure gradient that will facilitate mass flow between the leaves and fruit.

B. The movement of water molecules in the phloem sieve tubes from the leaves to the fruit will contribute to the hydrostatic pressure gradient between them.

C. The movement of organic compounds into the phloem sieve tubes near leaves will increase the hydrostatic pressure in the sieve tubes and create a pressure gradient between leaves and fruit.

D. The unloading of organic compounds from the phloem sieve tubes at the fruit will increase the osmolarity of the sieve tubes and create a hydrostatic pressure gradient between the leaves and fruit.

(1 mark)

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34 What would **not** be considered a function of auxins?

A. Stimulates cell elongation in shoots, leading to an increase in plant height

B. Stimulates the development of axillary buds further away from the shoot apical meristem

C. Inhibits the development of axillary buds close to the shoot apical meristem

D. Inhibits cell elongation in root cells, therefore slowing down root growth

(1 mark)

35 Which event causes genetic variety in the gametes formed during meiosis?

A. Linkage of genes in prophase 1 and crossing over in metaphase 1

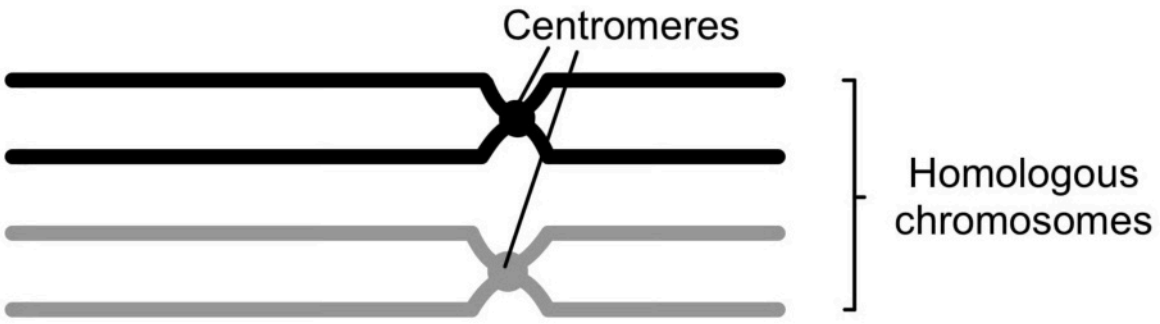
B. Crossing over during prophase 1 and independent assortment of chromosomes during metaphase 1

C. Linkage of genes in metaphase 1 and independent assortment of chromosomes in prophase 1

D. Crossing over during metaphase 1 and independent assortment of chromosomes during prophase 1

(1 mark)

36 The diagram shows a pair of homologous chromosomes at the beginning of prophase I of meiosis and four possible examples of crossing over, **A - D**



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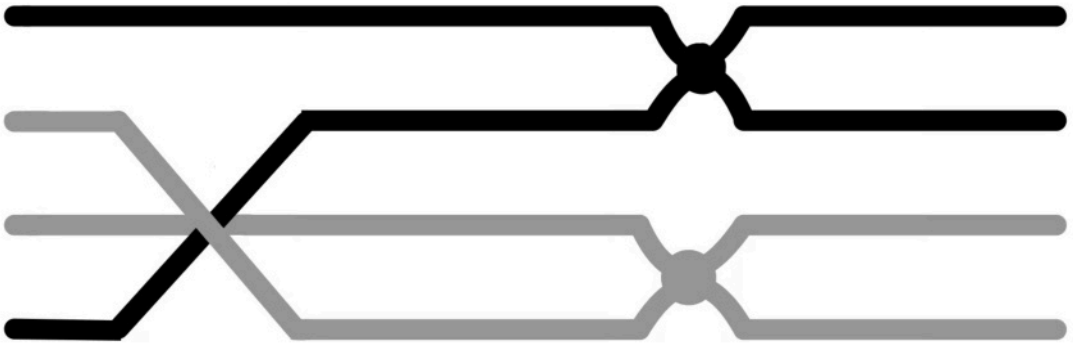
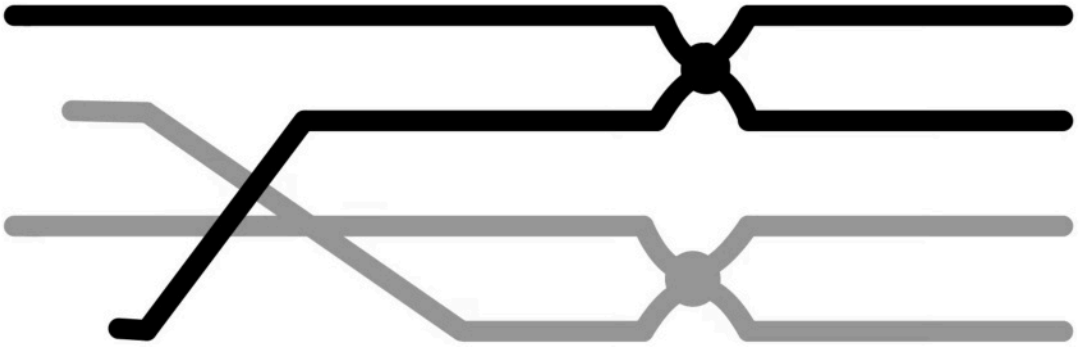
Which of the four representations of crossing over **cannot occur** in meiosis I?

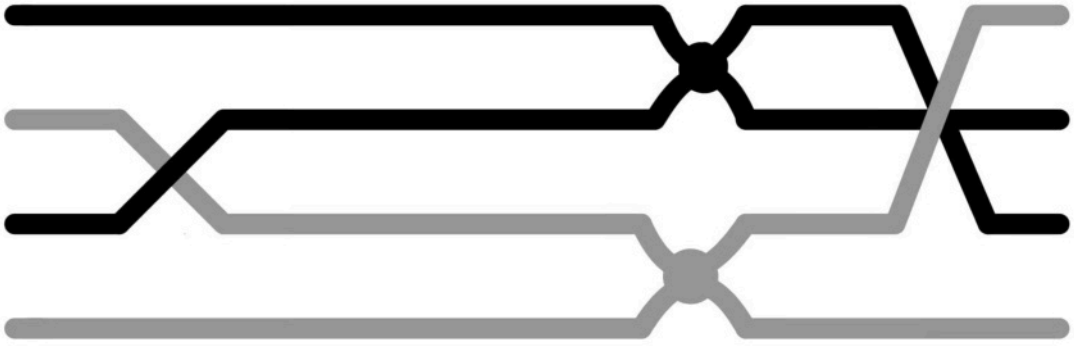
A.



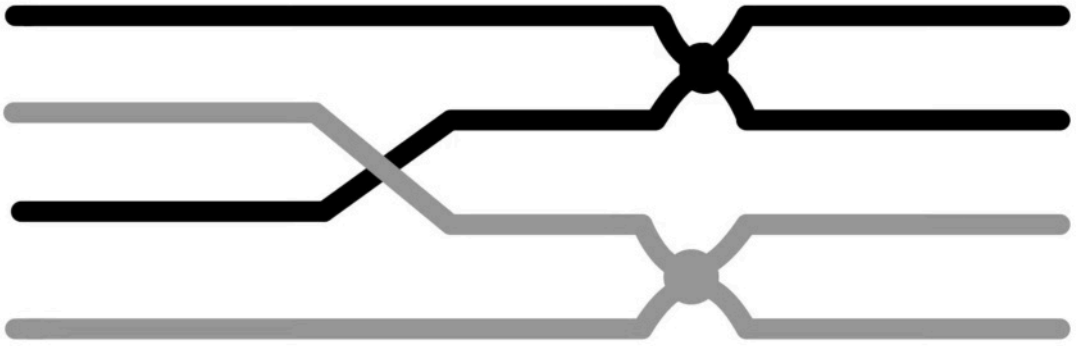
B.



C.

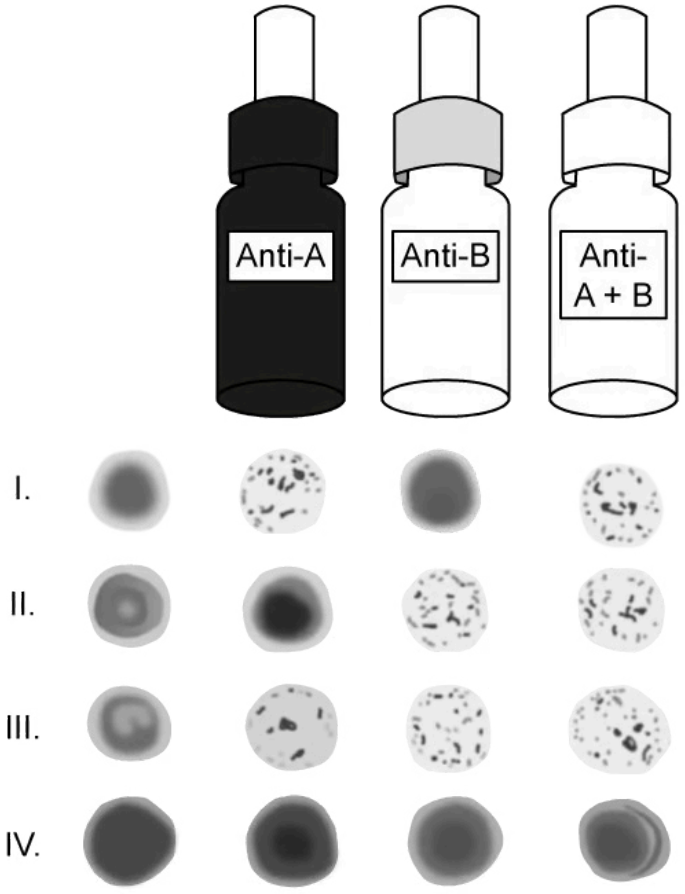


D.



(1 mark)

37 If a patient is given a transfusion of the wrong blood type, an immune response results. This response involves agglutination followed by haemolysis, where red blood cells are destroyed and blood may then coagulate. Blood typing involves mixing blood samples with antibodies. The diagram below shows the results of a blood typing test, showing the reactions between blood types (rows) and antibody serums (columns). The first column shows the appearance of each blood sample before testing occurred.



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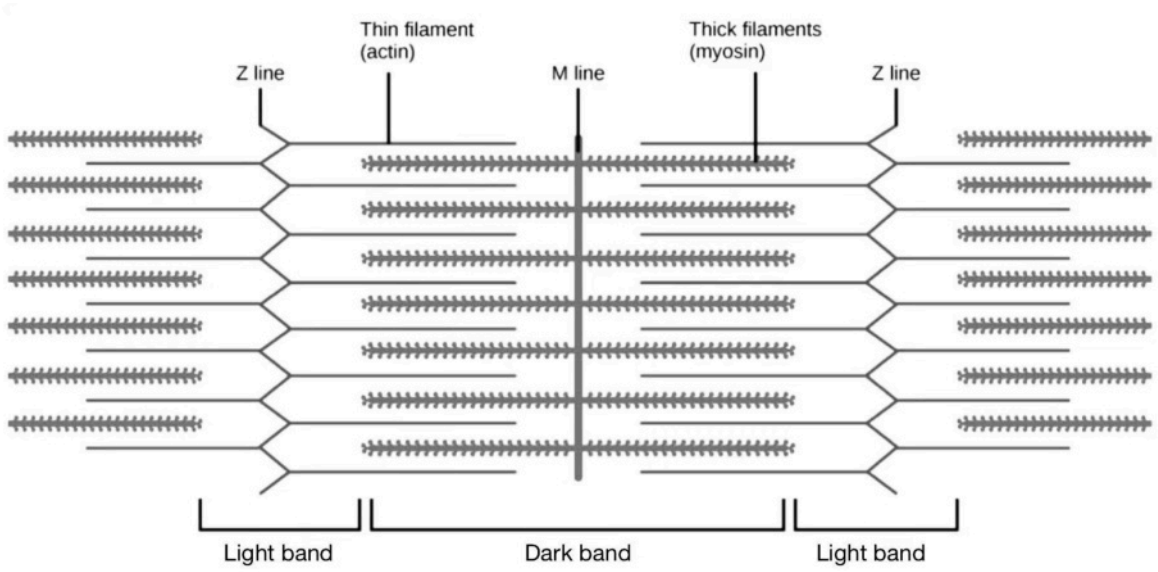
Identify the row in the table below that correctly identifies the blood type of blood samples I - IV.

	I	II	III	IV
A	O	O	O	AB
B	A	B	AB	O
C	AB	AB	AB	O
D	B	A	AB	O

(1 mark)

38 The diagram below shows the sarcomere of a muscle fibre.



Which of the following statements correctly describes the events observed during a muscle contraction?

A. The length of the sarcomere stays the same, the dark band gets longer and the light bands stay the same

B. The length of the sarcomere gets shorter, the dark band gets longer, the distance between the two Z lines gets shorter

C. The length of the sarcomere stays the same, the dark band gets longer and the distance between the two Z lines gets shorter

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D. The length of the sarcomere gets shorter, the dark band gets longer and the light bands get shorter

(1 mark)

39 Which of the following statements describe features that aid the process of ultrafiltration?

I. The glomerulus has an afferent arteriole and an efferent arteriole.
II. The blood in the afferent arteriole has a different composition to the blood in the efferent arteriole.
III. The basement membrane prevents the passage of large proteins out of the glomerulus.
IV. The afferent arteriole is wider than the efferent arteriole.

A. I and II only

B. II and III only

C. III only

D. III and IV only

(1 mark)

40 The zona pellucida in mice contains three different types of glycoprotein, known as ZP1, ZP2, and ZP3. The roles of each glycoprotein type are thought to be as follows:

ZP1 - provides structural support to the zona pellucida.

ZP2 - a secondary binding protein to which sperm cells bind after the initial stages of fertilisation are complete. The enzymes contained in cortical granules are thought to break down ZP2.

ZP3 - a primary binding protein to which sperm bind at the beginning of the fertilisation process.

Which row correctly explains the mutation that is most likely to result in polyspermy?

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	Mutation in gene that codes for...	Explanation
A.	ZP1	ZP1 proteins are no longer complementary to the active sites of acrosome enzymes
B.	ZP2	Sperm can no longer bind to ZP2 and initiate the acrosome reaction
C.	ZP2	ZP2 proteins are no longer complementary to the active sites of cortical granule enzymes
D.	ZP3	Sperm can no longer bind to ZP3 and initiate exocytosis

(1 mark)

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