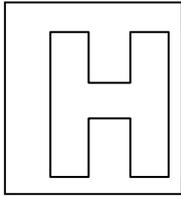


Class Adm No

Candidate Name: \_\_\_\_\_

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## 2018 End-of-Year Exams Pre-university 2

**Biology Higher 1**

**8876/01**

**Paper 1**

**17 September 2018**

**1 hour**

Additional Materials: Optical answer sheet

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### **READ THESE INSTRUCTIONS FIRST**

**Do not open this booklet until you are told to do so.**

Write your name, Adm No. and class on all the papers you hand in.

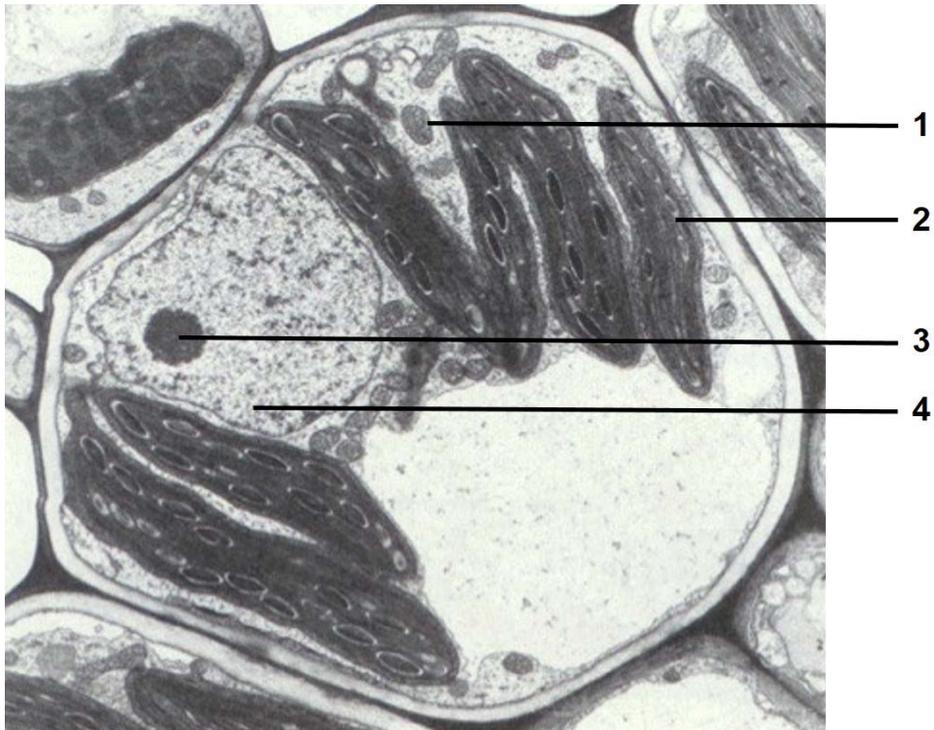
Do not use staples, paper clips, highlighters, glue or correction fluid.

#### **Paper 1**

There are **thirty** questions in this paper. Answer **all** questions. For each question, there are four possible answers, **A, B, C** and **D**. Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Multiple Choice Answer Sheet.

Calculators may be used.

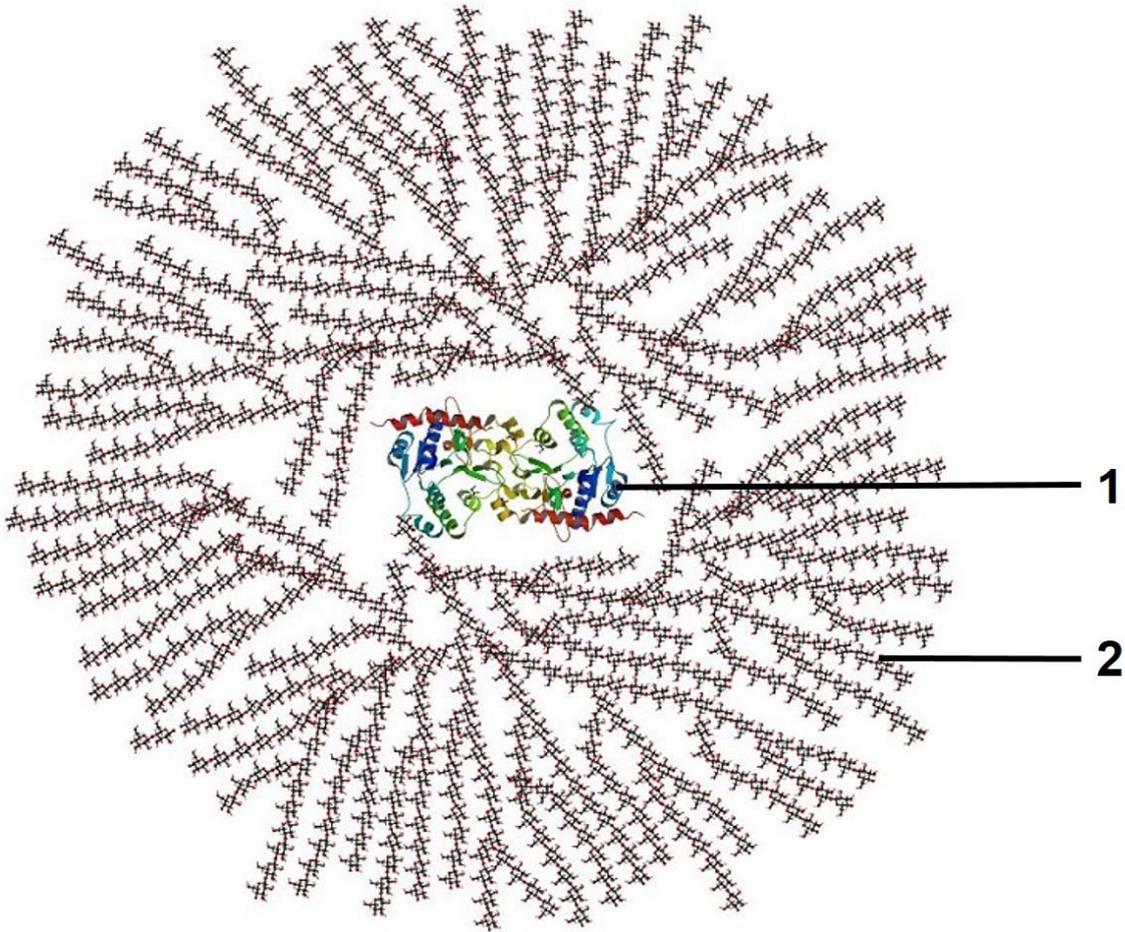
1. The figure below shows an electron micrograph of a plant cell.



Which of the following about structures 1-4 are correct?

	Take in oxygen	Take in carbon dioxide	Site of transcription	Site of translation
<b>A</b>	<b>1</b>	<b>1 and 2</b>	<b>3 and 4</b>	<b>1 and 2</b>
<b>B</b>	<b>1</b>	<b>2</b>	<b>1, 2, 3 and 4</b>	<b>1 and 2</b>
<b>C</b>	<b>2</b>	<b>1</b>	<b>1 and 2</b>	<b>4</b>
<b>D</b>	<b>1 and 2</b>	<b>2</b>	<b>1, 2 and 3</b>	<b>1, 2 and 4</b>

2. Glycogen are polysaccharides that functions as energy stores in animals. Glycogen granules can consist up to 30 000 glucose monomers, the following figure shows the structure of a glycogen granule.

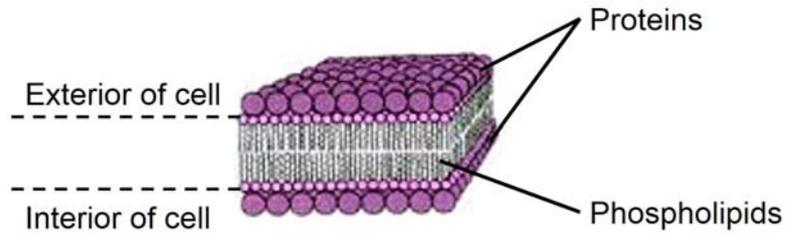


Which of the following statement(s) is/are true about structure 1 and 2?

- I Monomers in structure 1 and 2 are joined by only one type of bond.
- II Helices can be found in both structures 1 and 2.
- III Monomers in structure 2 are identical, whereas monomers in structure 1 are only similar and not completely identical.
- IV Both structures 1 and 2 can be hydrolysed to release the monomers that can enter glycolysis directly.

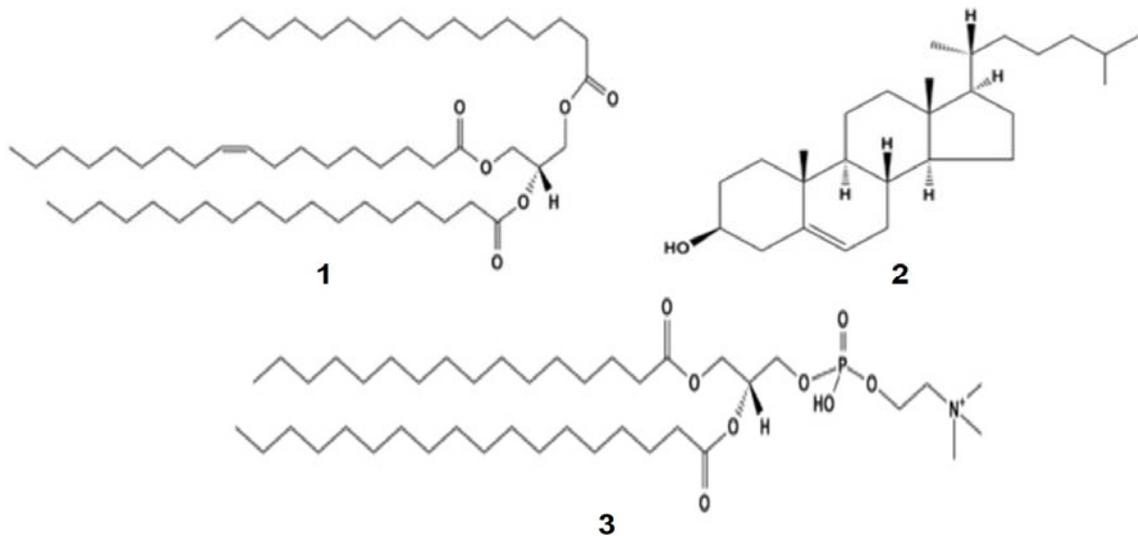
- A II only
- B II and III only
- C I, II and III only
- D I, III and IV only

3. In the development of the fluid mosaic model of the membrane, there were other models that were suggested. The figure below shows a particular model suggested by a pair of scientists, Davson and Danielli.



Which of the following observation would be a valid evidence to disprove this model?

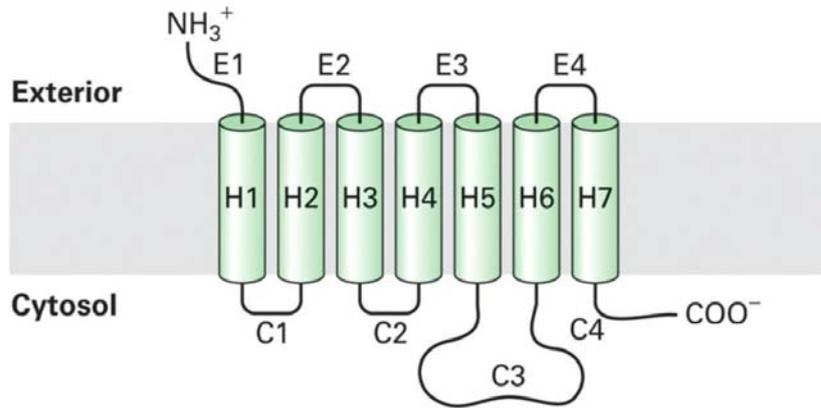
- A** Membrane fluidity increases with increasing temperature.  
**B** Analysis of the elements found in biomolecules of the membrane identified: C, H, O, N and P.  
**C** When the membrane were homogenised to a single layer, the surface area was twice that of the original membrane.  
**D** When cells were placed in a glucose solution, glucose was found to be present in the interior of cells.
4. The figure below shows three types of lipids.



Which of the following statements about lipids **1-3** are correct?

- I** All three lipids are components of the cell membrane.  
**II** Lipid **1** is hydrophobic while lipids **2** and **3** are amphipathic.  
**III** Hydrolysis of lipids **1** and **3** produces glycerol and fatty acids, while hydrolysis of lipid **2** produces only fatty acids.  
**IV** Lipid **1** stores more energy per gram as compared to glucose per gram due to a higher proportion of C-H bonds.
- A** I and IV only  
**B** II and IV only  
**C** II and III only  
**D** I, II and III only

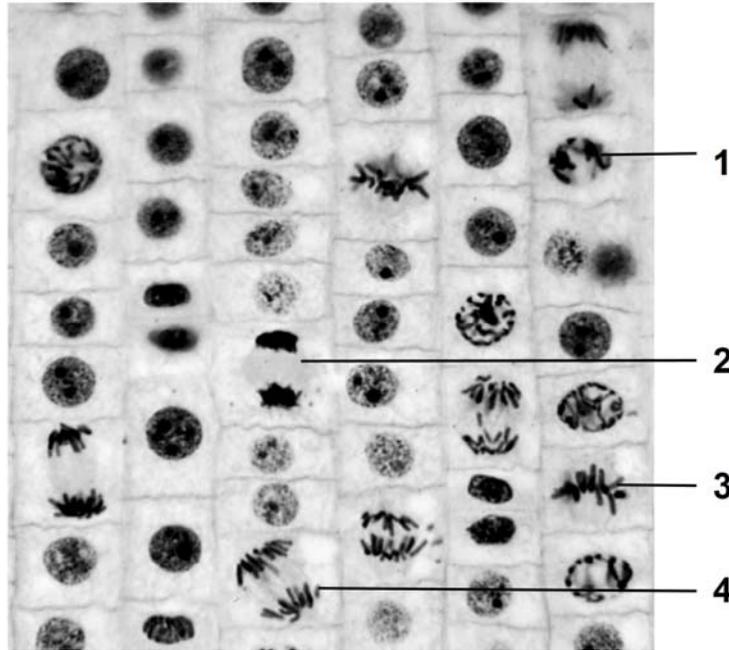
5. Rhodopsin is a receptor found in the rods of the retina. It is extremely sensitive to light, enabling vision under low-light conditions. Rhodopsin has a characteristic seven coiled cylindrical regions, which spans across the surface membrane bilayer, as shown in the diagram.



Which option best describes the regions containing **E3**, **H3** and **C3**?

	<b>E3</b>	<b>H3</b>	<b>C3</b>
<b>A</b>	interacts with G-protein	secondary structure held by hydrogen bonds	amino acids with polar R-groups
<b>B</b>	interacts with G-protein	tertiary structure held by R-group interactions	amino acids with polar R-groups
<b>C</b>	amino acids with polar R-groups	secondary structures held by hydrogen bonds	interacts with G-Protein
<b>D</b>	amino acids with polar R-groups	quaternary structure held by peptide bonds	interacts with G-Protein

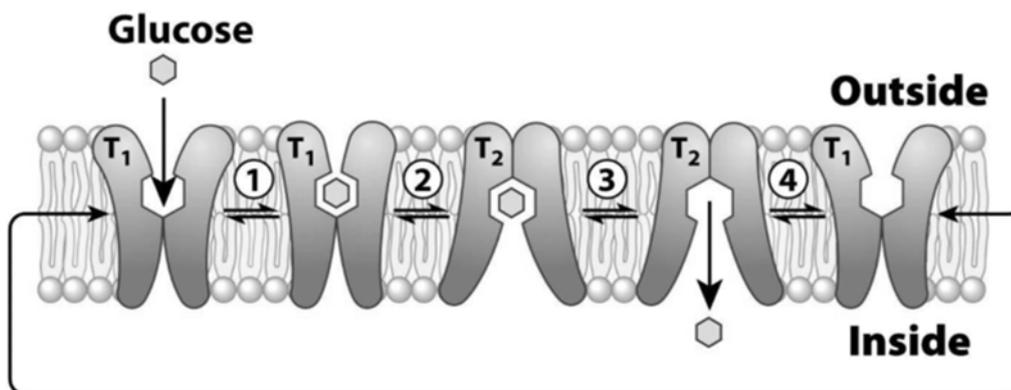
6. The diagram shows an electron micrograph of onion root epidermal cells undergoing mitosis. Cells 1 to 4 are each at different stage of mitosis.



Which of the following statement(s) is/are true about cells 1 to 4?

- I The number of chromosomes per cell is doubled in cells 2 and 4 as compared to cells 1 and 3.
  - II The order of the cells in sequential mitotic stages are: 3, 4, 2 and 1.
  - III Sister chromatids found in cells 2, 3 and 4 are no longer genetically identical due to crossing over that occurred during the stage that cell 1 is in.
  - IV Homologous chromosomes are present in all cells 1 to 4.
- A I only  
 B I and IV only  
 C II and III only  
 D I, II and IV only

7. When cells are placed in a solution containing glucose, membrane proteins called GLUT will transport glucose into the cell as shown in the figure below.



Which of the following statement is **false** about this process?

- A The binding site of GLUT is complementary to the 3D structure of glucose, as such it is specific in transporting of only glucose.
  - B The interior lining of GLUT contains amino acids with polar R-groups.
  - C When exterior glucose concentration is very high, the rate of glucose uptake is limited by the amount of GLUT.
  - D Energy is required in the form of ATP hydrolysis to cause a conformation change of GLUT in step 2.
8. Enzymes can be covalently bonded to the surface of a matrix (immobilised). The matrix has a very high surface area to volume ratio. A substrate can collide with the enzyme held in place for the reaction to occur.

The following data shows the effects of temperature on immobilised and free enzymes.

temperature / °C	immobilised P1 nuclease activity / arbitrary units	free P1 nuclease activity / arbitrary units
30	20	20
40	41	35
50	56	54
60	67	65
70	78	52
80	58	47

Which of the following is a valid conclusion based on the data?

- A As the enzymes are the same, the maximum activity for immobilised and free enzymes are the same.
- B Covalently binding enzymes to a matrix allows it to resist a higher level of thermal agitation.
- C Covalently binding enzymes to a matrix prevents it from denaturation.
- D Free enzymes are more active at lower temperatures as they are able to collide with substrates at a higher rate

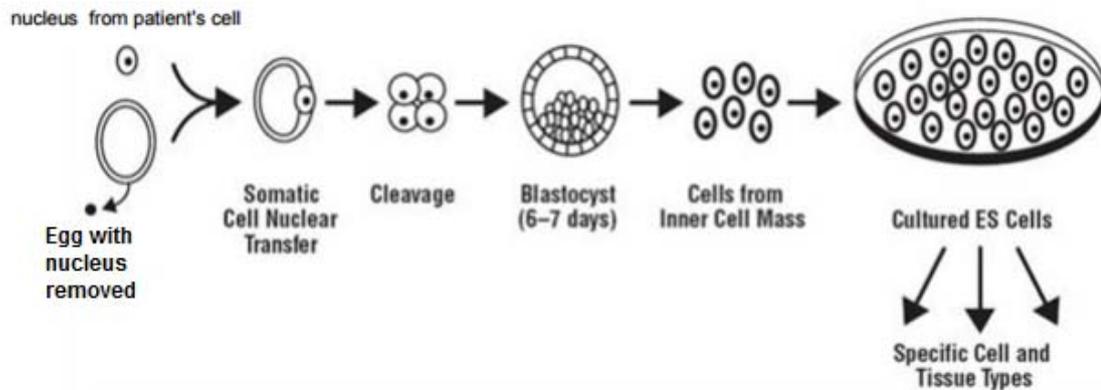
9. There are currently a variety of strategies applicable in treatment of wound healing like recovery from burns. Some of the options include:

- **Traditional strategies:** skin graft obtained from suitable donors.
- **Stem cell treatment:** make use of patient's own adult stem cells, donated embryonic stem cells or induced pluripotent stem cells to regenerate skin cells.

Which of the following correctly identifies a challenge for each method?

	skin graft from donor	adult stem cells	embryonic stem cells	induced pluripotent stem cells
<b>A</b>	availability of suitable donor	triggering immune response and cell rejection	ethical issues	reprogramming process
<b>B</b>	programming to differentiate into skin cells	triggering immune response and cell rejection	programming to differentiate into skin cells	ethical issues
<b>C</b>	availability of suitable donor	programming to differentiate into skin cells	ethical issues	reprogramming process
<b>D</b>	programming to differentiate into skin cells	programming to differentiate into skin cells	Differentiates to limited cell types	programming to differentiate into skin cells

10. Somatic cell nuclear transfer (SCNT) is a method used to develop embryonic stem cells from a patient's somatic cell. The developed embryonic stem cell can then be used to treat the patient. The process is outlined in the figure below.



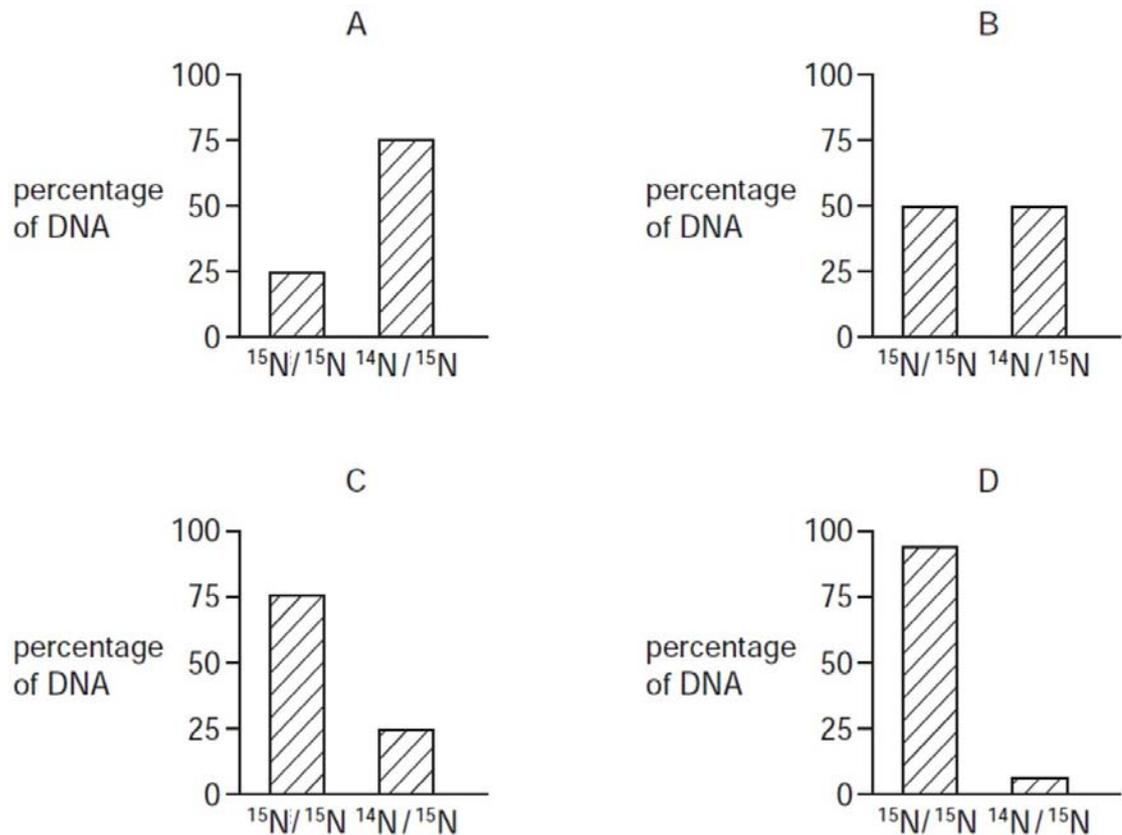
Which of the following statements(s) is/are true?

- I Cultured embryonic stem cells obtained via SCNT overcomes the problem of immune response.
  - II SCNT pose no ethical concerns as it does not involve the destruction of embryos.
  - III One concern of using SCNT is the potential for reproductive cloning.
  - IV The potency of the cultured embryonic stem cells is limited by origin of the nucleus used.
- A I only  
 B I and III only  
 C II and IV only  
 D I, III and IV only

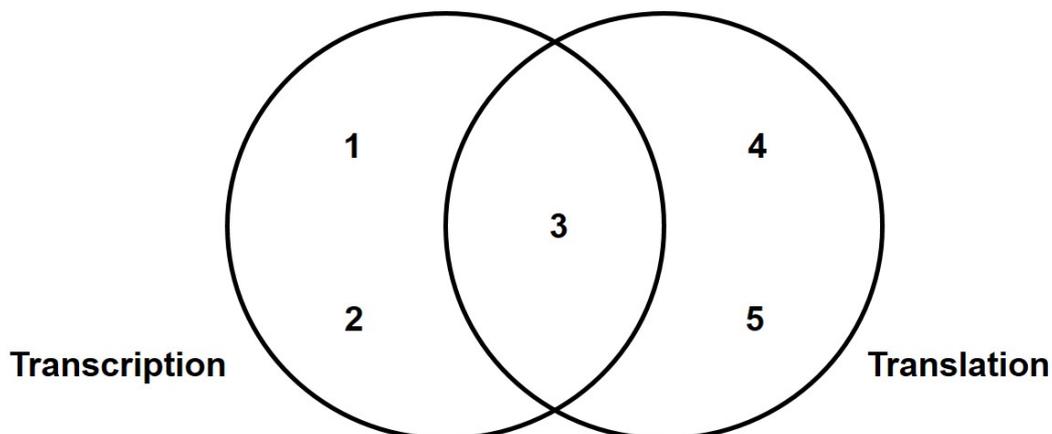
11. Bacteria were grown in a medium containing  $^{15}\text{N}$ . After several generations, all of the DNA contained  $^{15}\text{N}$ . Some of these bacteria were transferred to a medium containing the common isotope of nitrogen,  $^{14}\text{N}$ . The bacteria were allowed to divide once.

The bacteria were then transferred back to the medium containing  $^{15}\text{N}$ . The bacteria were allowed to divide once more.

What would be the percentage of  $^{15}\text{N}/^{15}\text{N}$  DNA molecules and  $^{14}\text{N}/^{15}\text{N}$  hybrid DNA molecules in the DNA extracted from the bacteria at the end of the experiment?



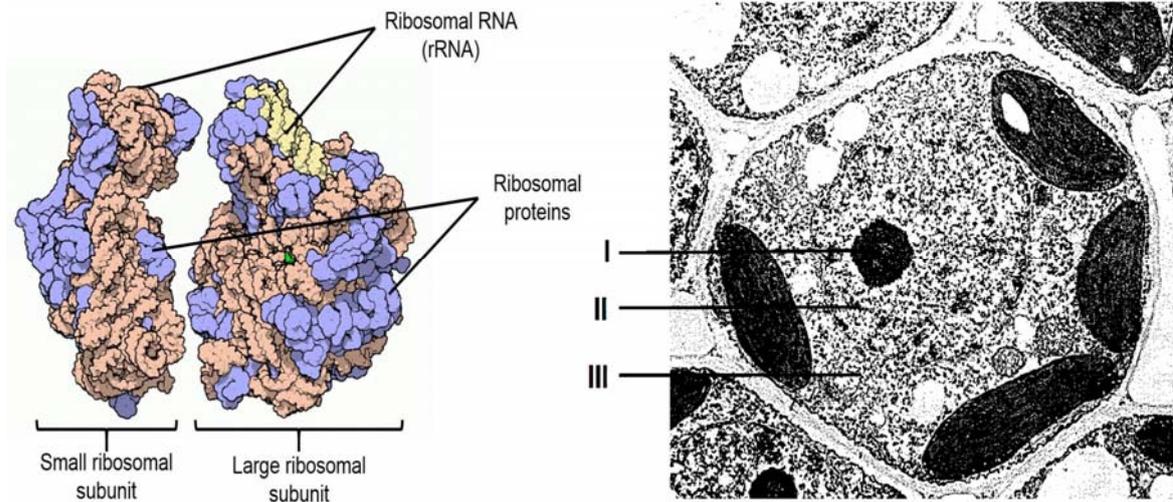
12. The following diagram shows two processes involved in the central dogma for eukaryotes, **1**, **2**, **4** and **5** represent properties unique to the individual processes, while **3** represent a property that is similar between the two processes.



Which of the following correctly identifies 1-5?

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>A</b>	formation of phosphodiester bonds	product synthesised from 5' to 3'	occurs in cytoplasm	formation of peptide bonds	product synthesised from N to C terminal
<b>B</b>	formation of peptide bonds	product synthesised from N to C terminal	occurs in cytoplasm	formation of phosphodiester bonds	product synthesised from 5' to 3'
<b>C</b>	formation of phosphodiester bonds	occurs in nucleus	requires energy	formation of peptide bonds	occurs in cytoplasm
<b>D</b>	formation of peptide bonds	occurs in nucleus	requires energy	formation of phosphodiester bonds	occurs in cytoplasm

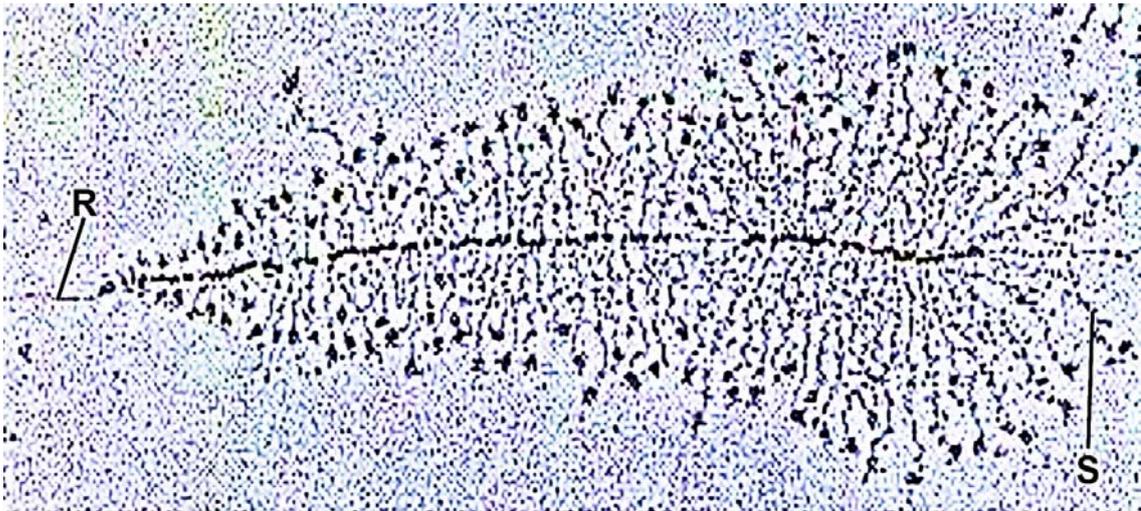
13. Ribosomes are organelles involved in protein synthesis, it is composed of two subunits, a small ribosomal subunit and a large ribosomal subunit. Each subunit consists of two components, a protein component and a RNA (rRNA) component. The ribosome structure is showed in the figure on the left. The figure on the right shows an electron micrograph of a eukaryotic cell with three regions labelled, I, II and III. These three regions are involved in the synthesis of each individual components and the assembly of each subunit (combining the protein component with rRNA component).



Which of the following correctly identifies the role(s) that each region plays in the synthesis of ribosomal subunits?

	I	II	III
A	transcription of rRNA genes to form rRNA	assembly of individual subunits	translation of rRNA to form ribosomal proteins
B	assembly of individual subunits	transcription of rRNA genes	translation of rRNA to form ribosomal proteins
C	assembly of individual subunits	transcription of rRNA and ribosomal protein genes to form rRNA and ribosomal protein mRNA	translation of ribosomal protein mRNA to form ribosomal proteins
D	transcription of rRNA genes to form rRNA and assembly of individual subunits	transcription of ribosomal protein genes to form ribosomal protein mRNA	translation of ribosomal protein mRNA to form ribosomal proteins

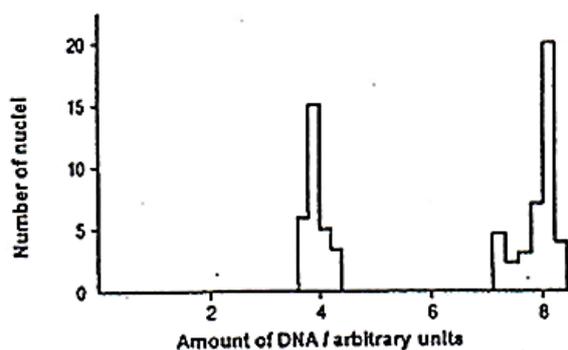
14. The electron micrograph shows protein synthesis in a bacteria cell.



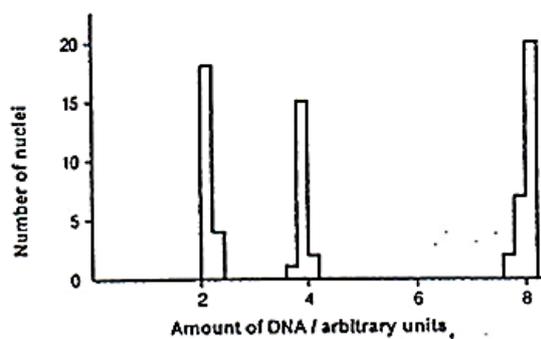
Which statements about the processes involved are correct?

- I Transcription occurs from left to right along template DNA, **R**.
  - II **S** is used as template for translation.
  - III Translation initiates only after transcription is completed.
  - IV Only one RNA polymerase is transcribing the template DNA, **R**, at any one time.
  - V **R** is the mRNA and it is translated by ribosomes to form polypeptide chains, **S**.
- A V only  
 B I and II only  
 C I, II and IV only  
 D III, IV and V only

15. The graphs below shows the amount of DNA per nuclei of cells taken from two different parts of a mammalian testis undergoing different types of nuclear division.



Graph 1



Graph 2

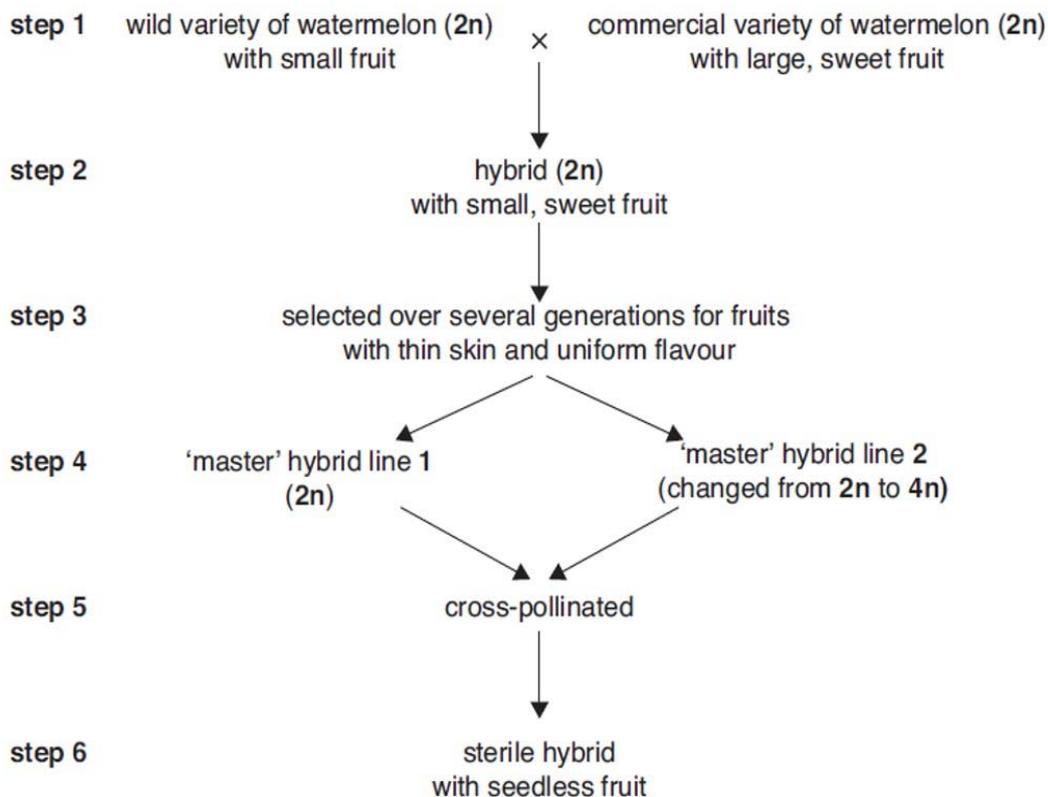
Various events that occurs in **graph 1** and **2** are listed as follows:

- I DNA replication
- II Breaking and rejoining of homologous regions of chromosomes
- III Separation of homologous chromosomes
- IV Separation of identical sister chromatids
- V Separation of non-identical sister chromatids

Which of the following correctly identify events that occurred in each graph?

	Graph 1	Graph 2
A	I and IV	I, II, III and V
B	II, III and V	I and IV
C	I and IV	II, III and V
D	III and IV	I, II and V

16. The following flowchart shows the steps involved in cultivating watermelon of desired phenotypes.



Which of the following statement(s) is/are true regarding the steps involved?

- I Step 3 is an example of artificial selection.
- II Drugs that prevent spindle fibre formation can be used to form diploid gametes that allows the formation of tetraploid 'master' hybrid line 2.
- III The seedless hybrid produced in step 6 is sterile due to absence of homologous chromosomes.
- IV The seedless hybrid produced in step 6 can be made fertile again by using the same method used in step 4 in producing tetraploid 'master' hybrid line 2.

- A II only
- B I and III only
- C I, II and IV only
- D II, III and IV only

17. Ras is a protein that functions as a signalling molecule in cells. When the appropriate signals are present, Ras is activated, and it signals for cell proliferation. Many cancer development process involves the mutation of the Ras gene, resulting in a mutant Ras protein.

Which of the following best explain why a mutant Ras leads to tumour progression?

- A Ras is a proto-oncogene, a loss of function mutation to Ras prevents it from detecting DNA damage and cell cycle arrest.
- B Ras is a tumour suppressor gene, a loss of function mutation to Ras prevents it from signaling normal cell proliferation.
- C Ras is a proto-oncogene, a gain of function mutation to Ras allows it to signal for cell proliferation in the absence of appropriate signals, resulting in uncontrolled cell division.
- D Ras is a tumour suppressor gene, a gain of function mutation to Ras results in signaling that allows the cell to bypass cell cycle checkpoints.

Refer to the following information for questions 18 and 19.

Dystrophin is a protein that function to maintain the cell membrane integrity of muscle fibers. Duchene muscular dystrophy (DMD) is a genetic disease caused by a mutation in the dystrophin gene.

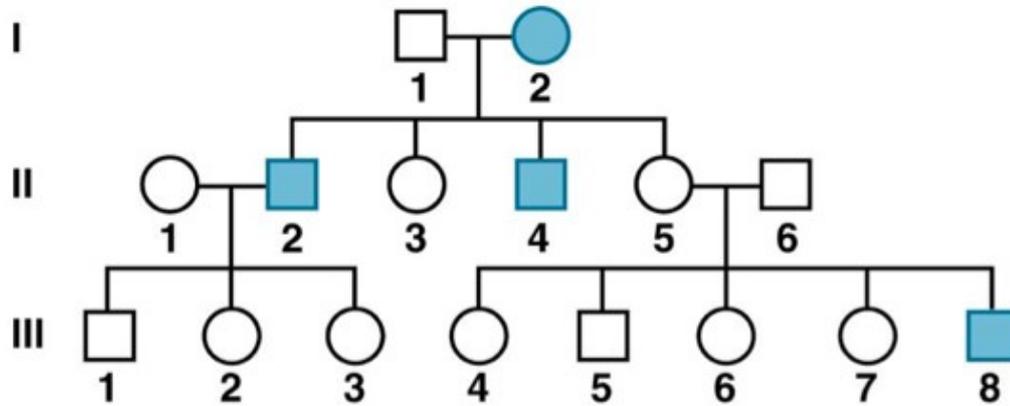
18. The sequence of part of the normal and mutated alleles for dystrophin gene is shown below.

<b>Normal allele</b>									
Codon	180	181	182	183	184	186	187	188	189
mRNA	CGU	AGA	UGG	AAA	UCA	UAA	ACU	GAC	UCU
<b>Mutant allele</b>									
Codon	180	181	182	183	184	186	187	188	189
mRNA	CGU	AGU	GAA	AUC	AUA	AAC	UGA	CUC	UUG

Using the information of the normal and mutated alleles above, which of the following is a valid conclusion?

- A An addition of two nucleotides at codon 181 caused a frame shift mutation, resulting in a premature stop codon at codon 189.
- B A deletion of a single nucleotide at codon 181 caused a frame shift mutation, resulting in a premature stop codon at codon 189.
- C A substitution of a single nucleotide at codon 181 and a deletion of two nucleotides at codon 187, causing a frame shift, resulting in a premature stop codon at codon 187.
- D A deletion of a single nucleotide at codon 181 and at codon 182 caused a frame shift mutation, resulting in a premature stop codon at codon 187.

19. The pedigree chart shows the inheritance of DMD in a family.



What is the mode of inheritance for DMD?

- A Sex-linked dominant
  - B Autosomal dominant
  - C Sex-linked recessive
  - D Autosomal recessive
20. *Abraxas grossulariata* is a Moth native to North America. There are two different phenotypes observed for their wing colour, dark and light. Two crosses were carried out to determine the inheritance of wing colour in *Abraxas grossulariata*.

Cross 1: Pure-breeding female moths with dark coloured wings crossed with pure breeding male moths with light coloured wings

Result: All offspring were showed dark coloured wings.

Cross 2: Pure-breeding female moths with light coloured wings crossed with pure breeding male moths with dark coloured wings

Result: All female offspring had dark coloured wings while all male offspring had light coloured wings.

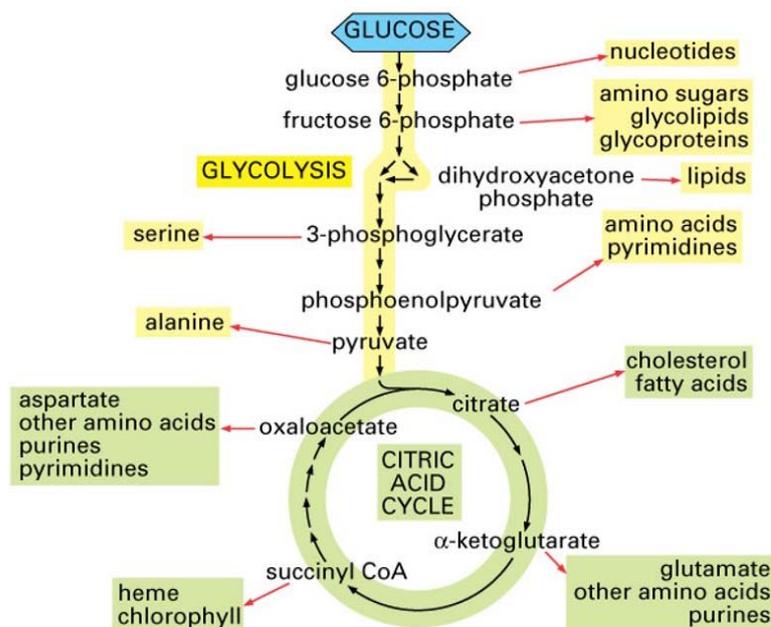
Based on the results of the two crosses, what can be deduced about the inheritance of wing colour in *Abraxas grossulariata*?

- A Wing colour is sex-linked, the allele for dark wing colour is dominant to allele for light wing colour
- B Wing colour is not sex-linked, the allele for dark wing colour is dominant to allele for light wing colour
- C Wing colour is sex-linked, the allele for light wing colour is dominant to allele for dark wing colour
- D Wing colour is not sex-linked, the allele for light wing colour is dominant to allele for dark wing colour

21. In a particular breed of tomato plant, the presence of hair on stems is determined by a single gene. Pure breeding tomato plant with hairy stem was crossed with pure breeding tomato plant with hairless stem. The resulting F1 all had a different phenotype of short hair on stem.

Which of the following best explains the result?

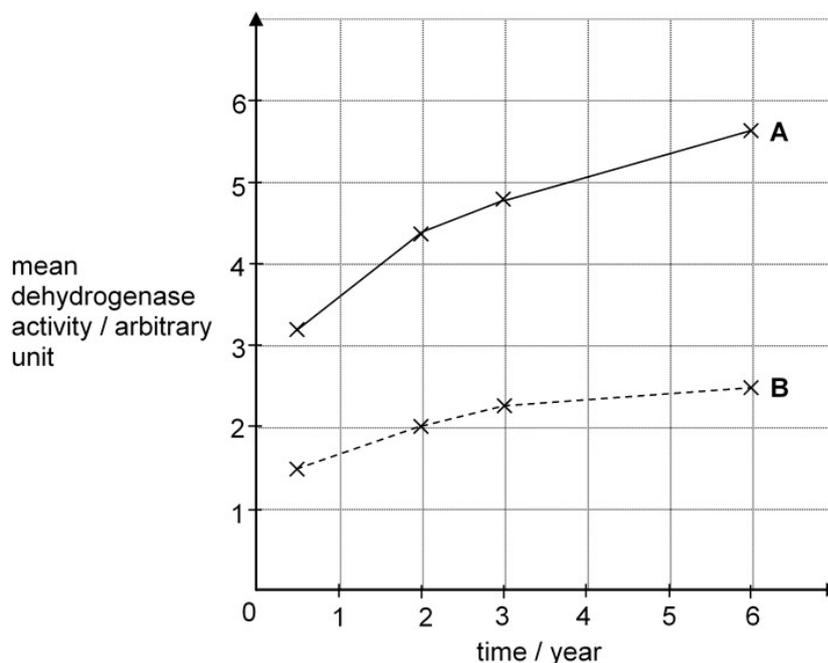
- A The allele for hairy stem is dominant over the allele for hairless stem.  
 B For heterozygotes, the two alleles have an equal effect on the phenotype.  
 C There are multiple alleles for the gene controlling presence of hair on stems.  
 D For heterozygotes, the two alleles do not contribute equally to the phenotype.
22. In cancer cells, it was observed that lactate fermentation occurs even under aerobic conditions. The uptake of glucose by cancer cells is also greatly increased by increasing the amount of glucose transporters on the cell surface membrane. Lactate fermentation under aerobic conditions is also commonly seen in normal cells that are rapidly dividing. The following figure outlines the relationship of glucose metabolism and other metabolic processes in normal cells.



Which of the following statements best explains how lactate fermentation in the presence of oxygen benefits cancer cells?

- A Anaerobic respiration allows for production of intermediates that can be used to synthesise other biomolecules for growth.  
 B Glycolysis alone provides less ATP which allows for cancer cells to grow slowly over a prolonged period of time.  
 C Anaerobic respiration allows for the buildup of lactate which can be converted into other biomolecules for growth.  
 D Absence of citric acid cycle reduces the amount of cholesterol and fatty acids formed which prolongs the life-span of cancer cells.

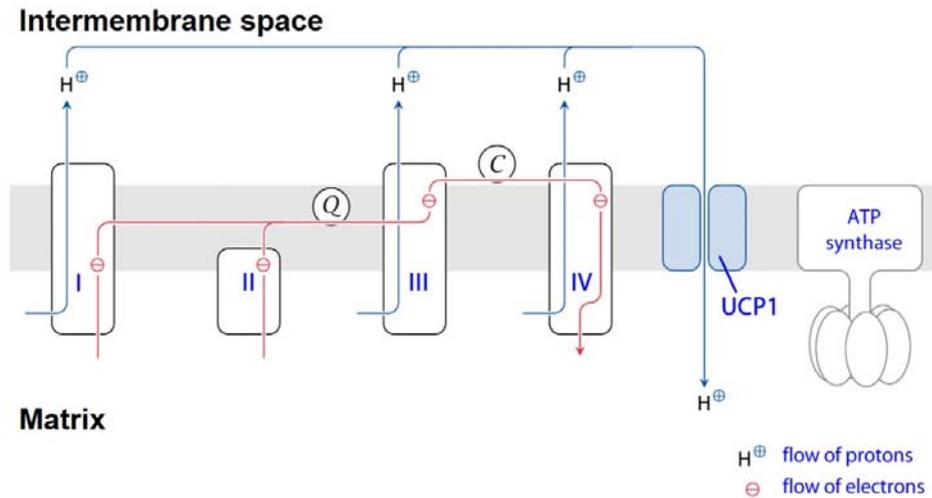
23. To investigate the effect of soil depth on the rate of aerobic respiration in soil-dwelling aerobic bacteria, soil samples were taken at two depths. The samples were taken over a span of six years to determine the activity of dehydrogenases, enzymes involved in the Krebs cycle. The results are shown in the figure below.



Which of the following is a valid conclusion based on the results?

- A Graph A shows the results of samples taken from a deeper depth as the amount of bacteria increases with increasing depth.
- B Only samples from graph A showed an increasing rate of aerobic respiration over the time span of six years.
- C Samples from graph B are taken from a deeper depth, as oxygen concentration decreases with deeper depth, resulting in lower dehydrogenase activity.
- D Dehydrogenases found in bacteria samples from graph B have evolved higher affinity for substrates due to lower concentration of oxygen.

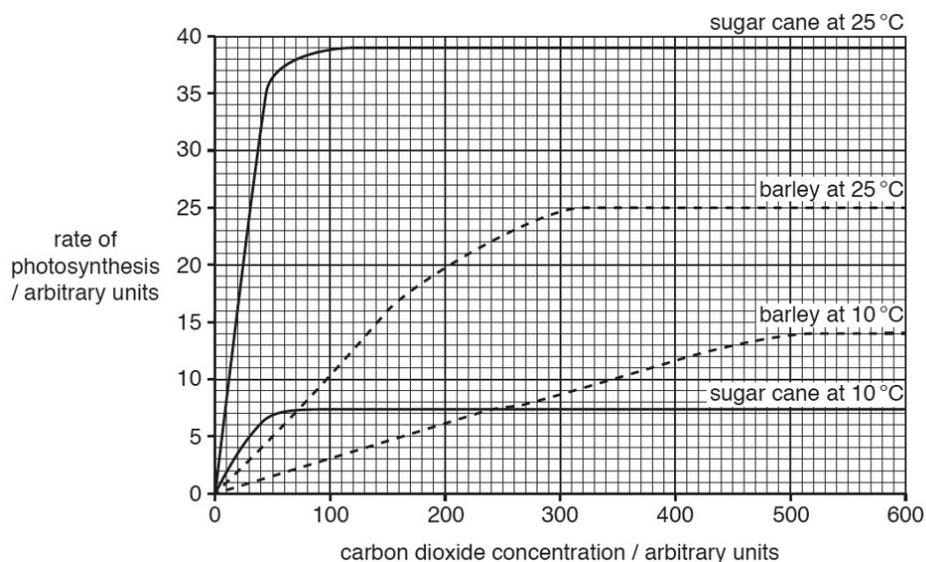
24. Brown adipose tissues are found together with white adipose tissues, they are present in all mammals but are more abundant in mammals that have to survive prolonged winters. The distinct difference of brown adipose tissues lies in the extra proton channel (UCP1) found in the inner membrane of mitochondria, which allows protons to flow back from the intermembrane space to matrix. The structure of the inner membrane along with the proteins embedded on it are shown in the figure below.



Which of the following explains the physiological significance of the proton channel UCP1 in mammals that have to survive prolonged winter?

- A Flow of proton back to matrix allows for more proton to be pumped across the membrane via the electron transport chain.
- B Energy released from the flow of protons is loss as heat which helps keep the mammal warm.
- C Less proton flowing through ATP synthase results in less ATP synthesised, this lowers the mammal's metabolism allowing it to survive better in the winter.
- D Flow of proton back to matrix maintains the positive charge in the matrix which speeds up the rate of electron flow, allowing for faster rate of ATP synthesis.

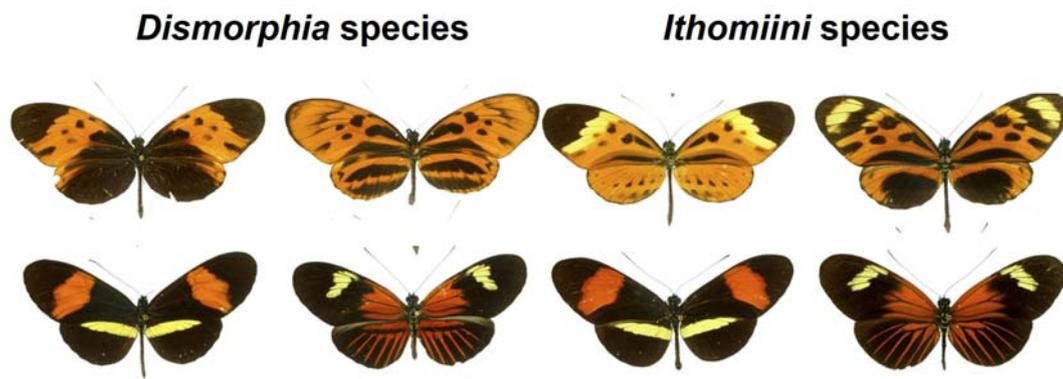
25. IPCC has reported a rising trend in both global temperature and carbon dioxide levels. Both these factors are key variables to the process of photosynthesis in plants. The figure below shows how the rate of photosynthesis in two types of plants, sugar cane and barley plants are affected by changes in temperature and carbon dioxide levels.



Which of the following is a valid conclusion from the data?

- I Sugar cane is more sensitive to changes in carbon dioxide concentration at low carbon dioxide levels.
  - II Climate change is beneficial to plants as it results in the increase in rate of photosynthesis.
  - III Rubisco found in both sugar cane and barley are only saturated at high levels of carbon dioxide.
  - IV Sugar cane adapts better to increase in temperature and carbon dioxide.
- A** I and IV only  
**B** II and IV only  
**C** II and III only  
**D** I, III and IV only

26. The figure below shows two species of butterfly commonly found together in the rainforests of Brazil, the *Dismorphia* species and the *Ithomiini* species.



A property about the *Dismorphia* species is that they produce a certain metabolite that deters predators. As such, predators would learn to avoid eating them. However, *Ithomiini* species on the other hand does not produce the metabolite.

In terms of appearance, the two species looks very similar. In fact, the *Ithomiini* species was found to have evolved to “mimic” the appearance of *Dismorphia* species.

Which of the following statement is true?

- A *Dismorphia* species would benefit by being at a selective advantage when majority of the butterflies are *Ithomiini* species that mimics its appearance.
- B *Ithomiini* species that mimics the appearance of *Dismorphia* species would be at a selective advantage when majority of the butterflies are *Ithomiini* species.
- C *Dismorphia* species would not be affected by frequency of *Ithomiini* species that mimics its appearance.
- D *Ithomiini* species that mimics the appearance of *Dismorphia* species would be at a selective advantage when majority of the butterflies are *Dismorphia* species.

27. Prior to Charles Darwin's publication on his theory of evolution by natural selection in his famous book, a French biologist by the name of Jean-Baptiste Lamarck crafted a hypothesis that tried to explain inheritance of traits and evolution. His hypothesis revolved around two central ideas:

- I Individuals loses traits that are not required, or use, and develop characteristics that are useful.
- II These acquired useful traits are passed on to subsequent generations.

His hypothesis was soon proved to be wrong with the introduction of Darwin's theory of evolution by natural selection, along with the better understanding of genetics contributed by Gregor Mendel.

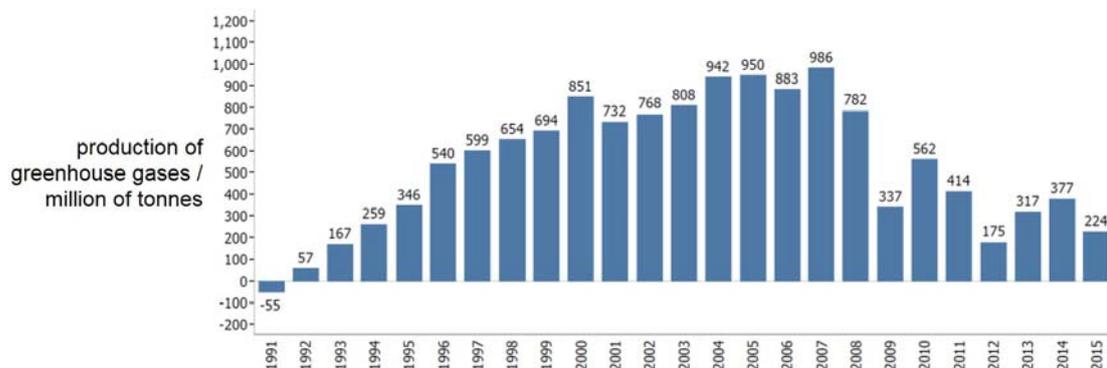
Which of the following examples would **not** be evidence against Lamarck's hypothesis?

- A Human ancestors used to feed primarily on plants, they had larger jaws and a third molar that was useful in grinding plant tissue, with the change in diet over time, the jaws became smaller but the third molar remains up till today, commonly known as the "wisdom tooth".
- B Athletes who trained hard and excelled in their field of sports had children whom was not "naturally gifted" in the same field of sports.
- C Scientists found that one's DNA can be modified during their lifetime via the addition of "chemical tags" based on their environmental conditions, and these "tags" would be passed on to their offspring.
- D A couple whom was phenotypically normally throughout their lifetime had a child with sickle cell anaemia.

28. Evolution by natural selection provides an explanation for the vast number of species. Evolution can also be driven by artificial selection, where the selection pressure is applied by man and selected traits are chosen by man to be passed on.

Which of the following examples does not describe artificial selection?

- A Ancestral wolves that were domesticated by man were selected for tameness traits which gave rise to the various species of dogs today.
- B Ancestral mammals that colonized Australia were isolated from the rest of the mainland with a unique environment and interactions with humans, resulting in development of unique species not seen anywhere else.
- C Crops producing larger fruits were selected by farmers to breed resulting in the gradual increase in size of the fruit.
- D The excessive use of antibiotics by farmers resulted in a population of bacteria that is resistant to all current known antibiotics
29. The graph shows the production of greenhouse gases (carbon dioxide and methane) in the United States from 1991 to 2015, measured in millions of tonnes.



Which of the following would **not** contribute to the trend seen between 2007 and 2015?

- A increasing the cost of carbon tax
- B decreased consumption of meat-based products
- C increased import and export of crops with trade partners
- D decreased use of agricultural machinery for crop harvesting

30. With recent changes to global climate, many agricultures have been negatively impacted. The following figure shows the changes in variables of climate conditions during the different seasons for each major crop in Pakistan. Each of the crops are harvested at specific seasons.

Variables	Major Crops			
	Wheat	Rice	Maize	Sugarcane
Max Temp	-1.7991 *	3.9200 *	0.1174	0.4743 *
Min Temp	0.6216 *	-0.7041 *	0.5458	0.2578 *
Rainfall	-0.1195 *	-0.0126	-0.703	-0.0094

\*Indicates significant difference

Which of the following statement(s) is/are valid conclusion(s) drawn from the data?

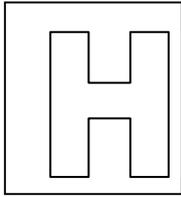
- I Climate change has caused Pakistan to be drier and warmer for majority of the seasons.
  - II Climate change caused significant increased rainfall and flooding of all crops.
  - III Climate change caused an increase in variability of temperature range during the rice crop season.
  - IV The impact on wheat is likely to be more significant than the other three crops.
- A III only  
 B I and II only  
 C II and IV only  
 D I, III and IV only

**End of Paper**

Class Adm No

Candidate Name: \_\_\_\_\_

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## 2018 End-of-Year Exams Pre-university 2

**Biology Higher 1**

**8876/01**

**Paper 1**

**17 September 2018**

**1 hour**

Additional Materials: Optical answer sheet

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### **READ THESE INSTRUCTIONS FIRST**

**Do not open this booklet until you are told to do so.**

Write your name, Adm No. and class on all the papers you hand in.  
Do not use staples, paper clips, highlighters, glue or correction fluid.

#### **Paper 1**

There are **thirty** questions in this paper. Answer **all** questions. For each question, there are four possible answers, **A, B, C** and **D**. Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Multiple Choice Answer Sheet.

Calculators may be used.

1. The figure below shows an electron micrograph of a plant cell.

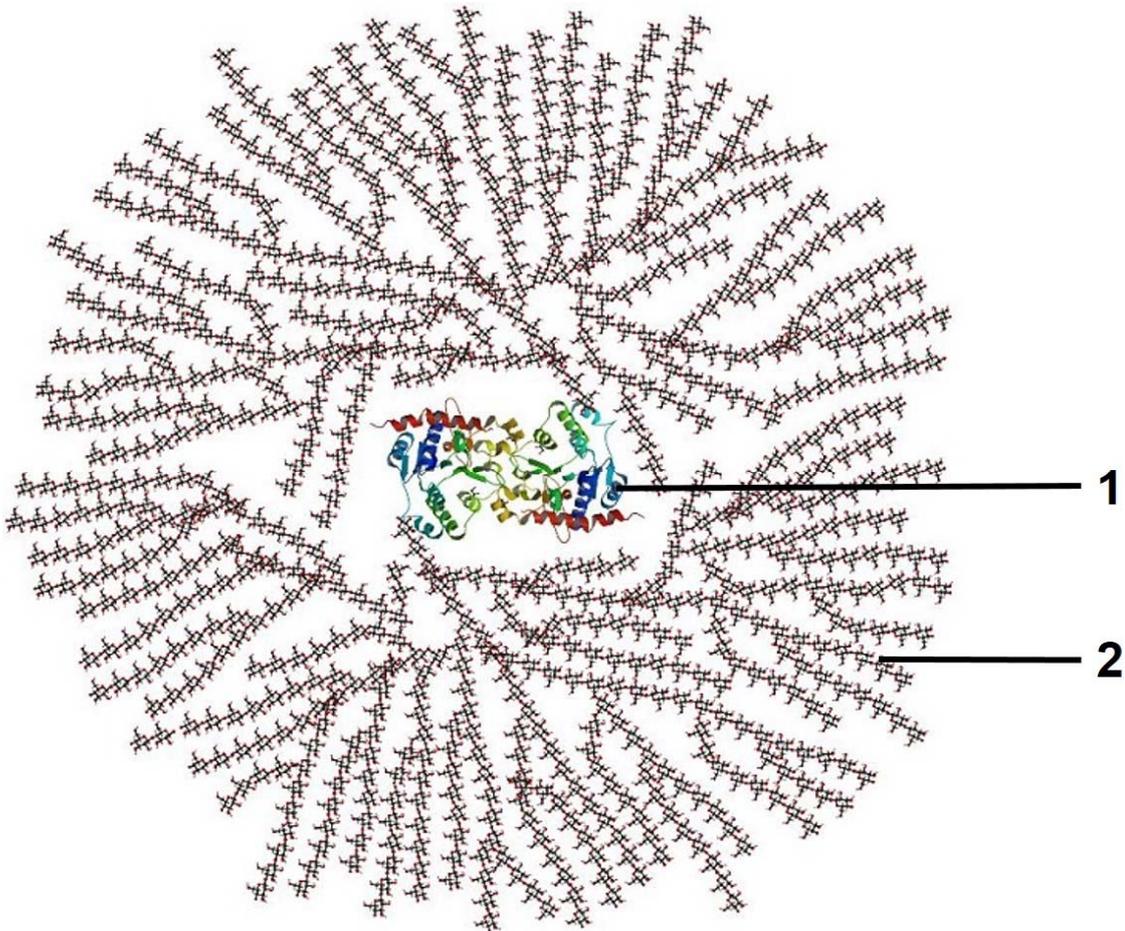


**Answer: B**

Which of the following about structures 1-4 are correct?

	Take in oxygen	Take in carbon dioxide	Site of transcription	Site of translation
<b>A</b>	<b>1</b>	<b>1 and 2</b>	<b>3 and 4</b>	<b>1 and 2</b>
<b>B</b>	<b>1</b>	<b>2</b>	<b>1, 2, 3 and 4</b>	<b>1 and 2</b>
<b>C</b>	<b>2</b>	<b>1</b>	<b>1 and 2</b>	<b>4</b>
<b>D</b>	<b>1 and 2</b>	<b>2</b>	<b>1, 2 and 3</b>	<b>1, 2 and 4</b>

2. Glycogen are polysaccharides that functions as energy stores in animals. Glycogen granules can consist up to 30 000 glucose monomers, the following figure shows the structure of a glycogen granule.



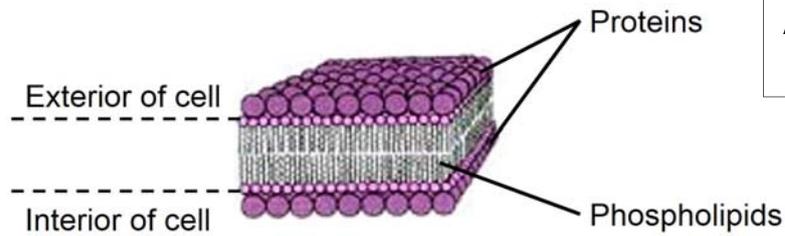
Which of the following statement(s) is/are true about structure 1 and 2?

- I Monomers in structure 1 and 2 are joined by only one type of bond.
- II Helices can be found in both structures 1 and 2.
- III Monomers in structure 2 are identical, whereas monomers in structure 1 are only similar and not completely identical.
- IV Both structures 1 and 2 can be hydrolysed to release the monomers that can enter glycolysis directly.

Answer: B

- A II only
- B II and III only
- C I, II and III only
- D I, III and IV only

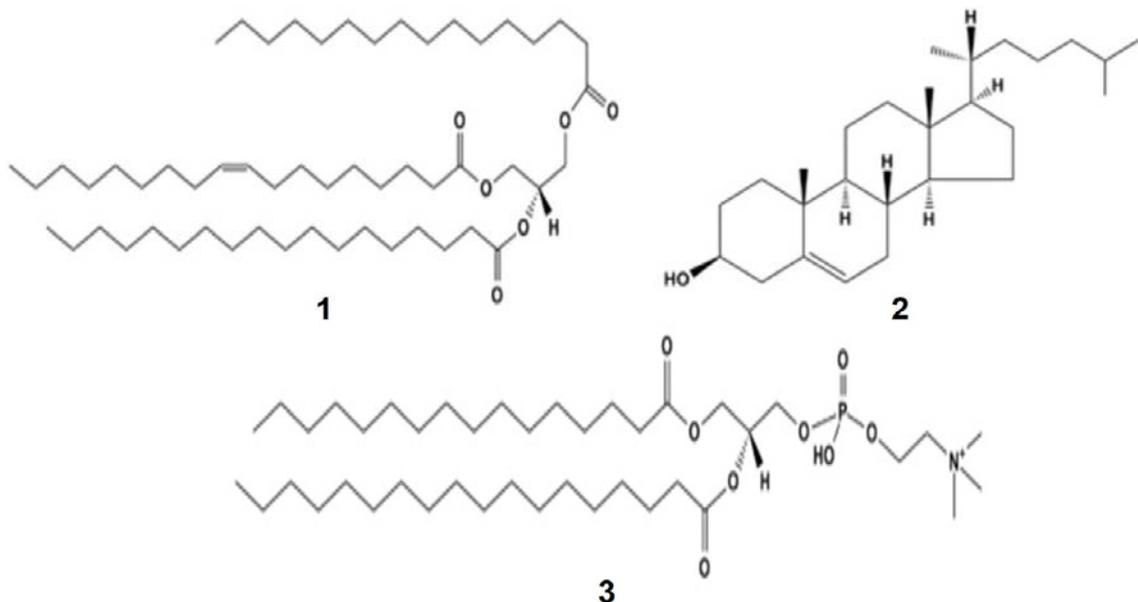
3. In the development of the fluid mosaic model of the membrane, there were other models that were suggested. The figure below shows a particular model suggested by a pair of scientists, Davson and Danielli.



Answer: D

Which of the following observations would be a valid evidence to disprove this model?

- A** Membrane fluidity increases with increasing temperature.  
**B** Analysis of the elements found in biomolecules of the membrane identified: C, H, O, N and P.  
**C** When the membrane were homogenised to a single layer, the surface area was twice that of the original membrane.  
**D** When cells were placed in a glucose solution, glucose was found to be present in the interior of cells.
4. The figure below shows three types of lipids.



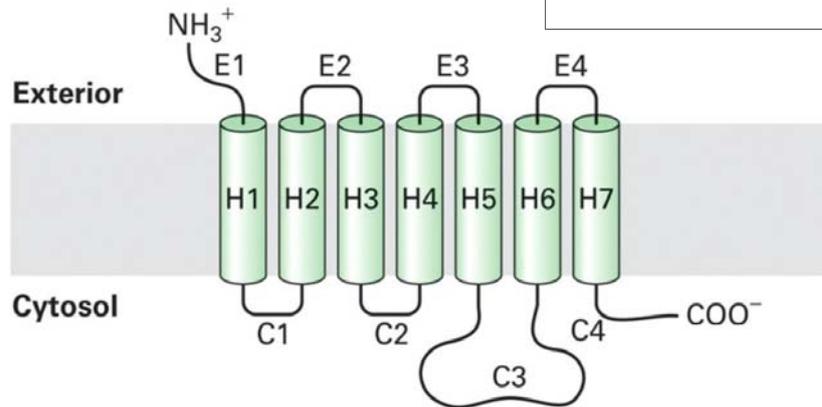
- I** All three lipids are components of the cell membrane.  
**II** Lipid 1 is hydrophobic while lipids 2 and 3 are amphipathic.  
**III** Hydrolysis of lipids 1 and 3 produces glycerol and fatty acids, while hydrolysis of lipid 2 produces only fatty acids.  
**IV** Lipid 1 stores more energy per gram as compared to glucose per gram due to a higher proportion of C-H bonds.

- A** I and IV only  
**B** II and IV only  
**C** II and III only  
**D** I, II and III only

Answer: B

5. Rhodopsin is a receptor found in the rods of the retina. It is extremely sensitive to light, enabling vision under low-light conditions. Rhodopsin has a characteristic seven coiled cylindrical regions, which spans across the surface membrane bilayer, as shown in the diagram.

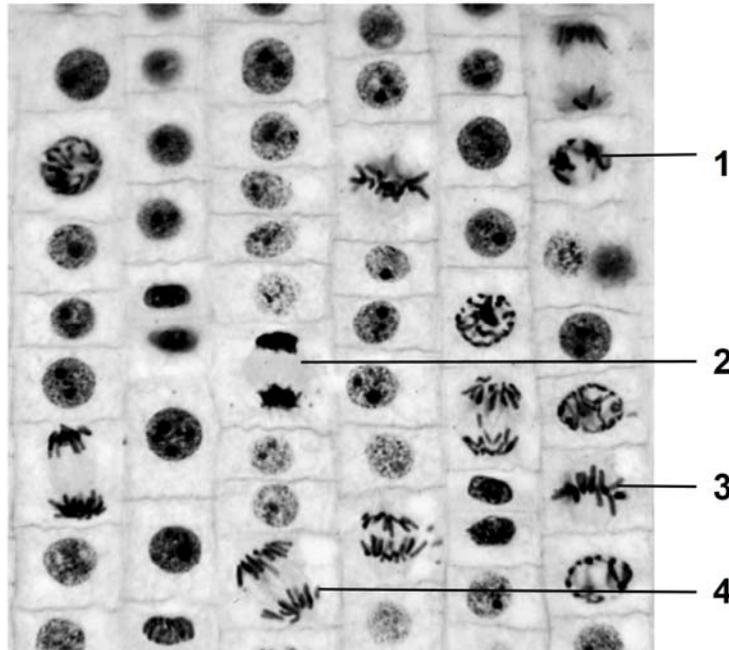
Answer: C



Which option best describes the regions containing **E3**, **H3** and **C3**?

	<b>E3</b>	<b>H3</b>	<b>C3</b>
<b>A</b>	interacts with G-protein	secondary structure held by hydrogen bonds	amino acids with polar R-groups
<b>B</b>	interacts with G-protein	tertiary structure held by R-group interactions	amino acids with polar R-groups
<b>C</b>	amino acids with polar R-groups	secondary structures held by hydrogen bonds	interacts with G-Protein
<b>D</b>	amino acids with polar R-groups	quaternary structure held by peptide bonds	interacts with G-Protein

6. The diagram shows an electron micrograph of onion root epidermal cells undergoing mitosis. Cells 1 to 4 are each at different stage of mitosis.



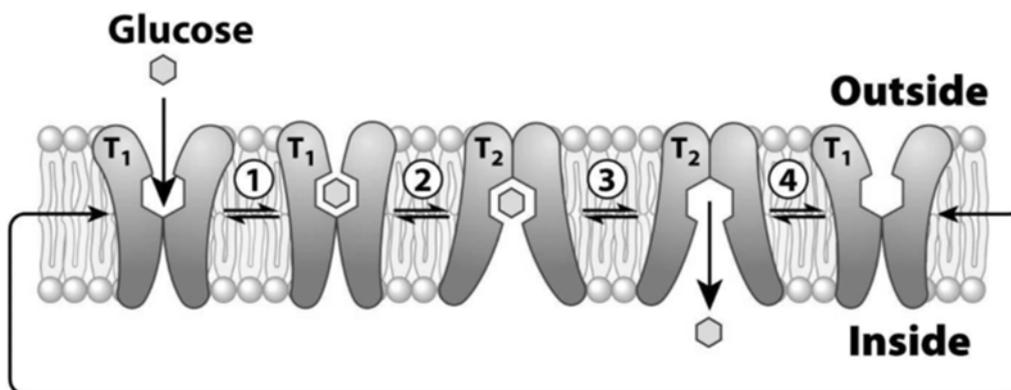
Which of the following statement(s) is/are true about cells 1 to 4?

- I The number of chromosomes per cell is doubled in cells 2 and 4 as compared to cells 1 and 3.
- II The order of the cells in sequential mitotic stages are: 3, 4, 2 and 1.
- III Sister chromatids found in cells 2, 3 and 4 are no longer genetically identical due to crossing over that occurred during the stage that cell 1 is in.
- IV Homologous chromosomes are present in all cells 1 to 4.

Answer: B

- A I only
- B I and IV only
- C II and III only
- D I, II and IV only

7. When cells are placed in a solution containing glucose, membrane proteins called GLUT will transport glucose into the cell as shown in the figure below.



Answer: D

Which of the following statement is **false** about this process?

- A The binding site of GLUT is complementary to the 3D structure of glucose, as such it is specific in transporting of only glucose.
  - B The interior lining of GLUT contains amino acids with polar R-groups.
  - C When exterior glucose concentration is very high, the rate of glucose uptake is limited by the amount of GLUT.
  - D Energy is required in the form of ATP hydrolysis to cause a conformation change of GLUT in step 2.
8. Enzymes can be covalently bonded to the surface of a matrix (immobilised). The matrix has a very high surface area to volume ratio. A substrate can collide with the enzyme held in place for the reaction to occur.

The following data shows the effects of temperature on immobilised and free enzymes.

temperature / °C	immobilised P1 nuclease activity / arbitrary units	free P1 nuclease activity / arbitrary units
30	20	20
40	41	35
50	56	54
60	67	65
70	78	52
80	58	47

Answer: B

Which of the following is a valid conclusion based on the data?

- A As the enzymes are the same, the maximum activity for immobilised and free enzymes are the same.
- B Covalently binding enzymes to a matrix allows it to resist a higher level of thermal agitation.
- C Covalently binding enzymes to a matrix prevents it from denaturation.
- D Free enzymes are more active at lower temperatures as they are able to collide with substrates at a higher rate

9. There are currently a variety of strategies applicable in treatment of wound healing like recovery from burns. Some of the options include:

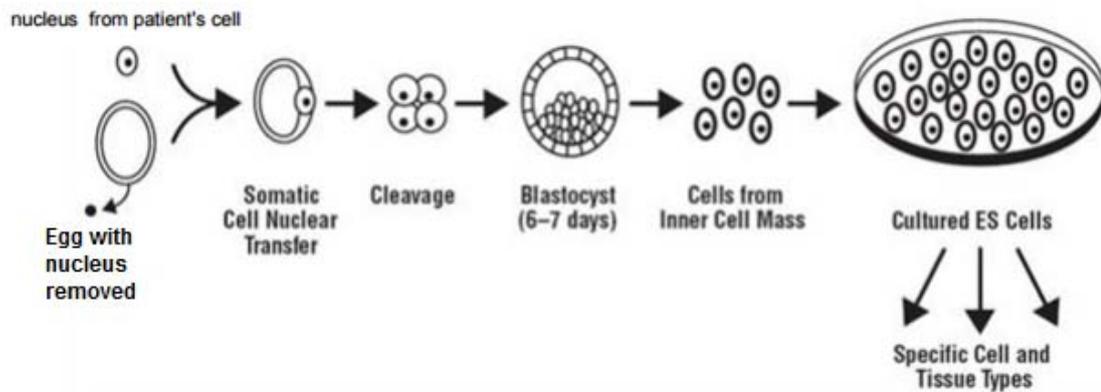
- **Traditional strategies:** skin graft obtained from suitable donors
- **Stem cell treatment:** make use of patient's own adult stem cells, donated embryonic stem cells or induced pluripotent stem cells to regenerate skin.

Answer: C

Which of the following identifies a challenge of each method?

	skin graft from donor	adult stem cells	embryonic stem cells	induced pluripotent stem cells
<b>A</b>	availability of suitable donor	triggering immune response and cell rejection	ethical issues	reprogramming process
<b>B</b>	programming to differentiate into skin cells	triggering immune response and cell rejection	programming to differentiate into skin cells	ethical issues
<b>C</b>	availability of suitable donor	programming to differentiate into skin cells	ethical issues	reprogramming process
<b>D</b>	programming to differentiate into skin cells	programming to differentiate into skin cells	Differentiates to limited cell types	programming to differentiate into skin cells

10. Somatic cell nuclear transfer (SCNT) is a method used to develop embryonic stem cells from a patient's somatic cell. The developed embryonic stem cell can then be used to treat the patient. The process is outlined in the figure below.



Which of the following statements(s) is/are true?

- I Cultured embryonic stem cells obtained via SCNT overcomes the problem of immune response.
- II SCNT pose no ethical concerns as it does not involve the destruction of embryos.
- III One concern of using SCNT is the potential for reproductive cloning.
- IV The potency of the cultured embryonic stem cells is limited by origin of the nucleus used.

- A I only
- B I and III only
- C II and IV only
- D I, III and IV only

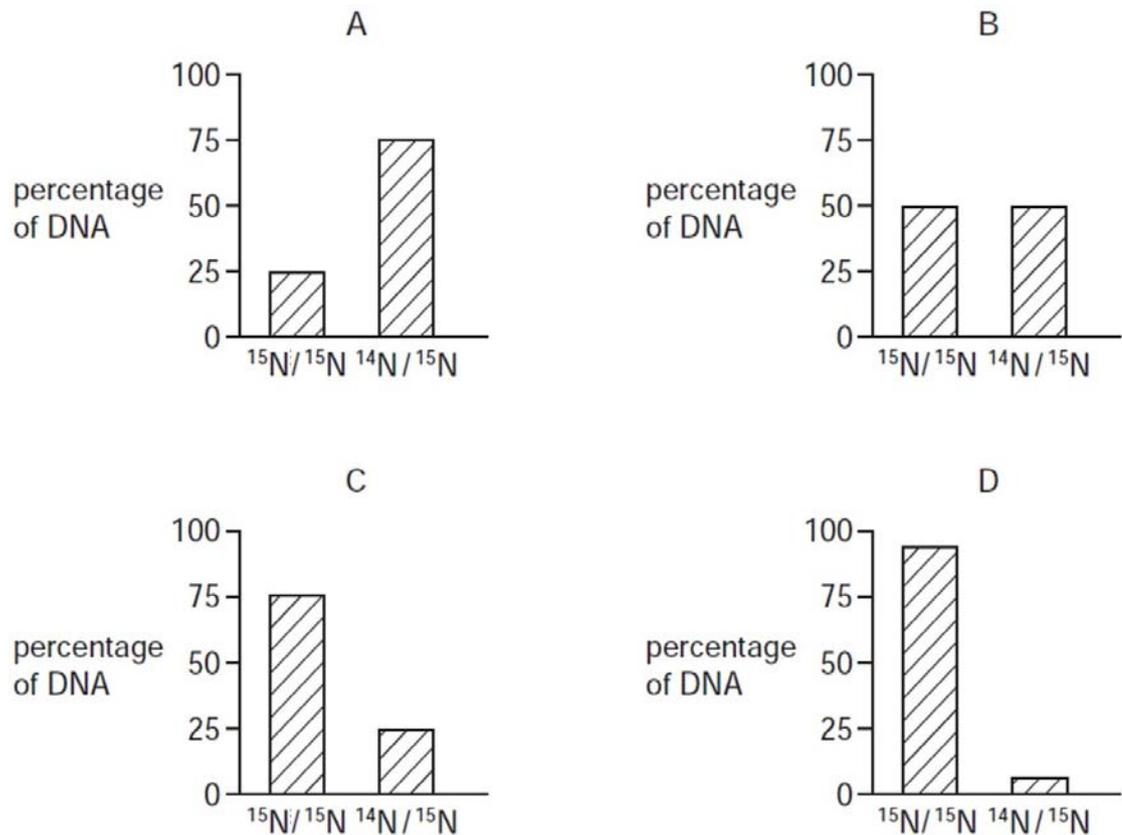
**Answer: B**

11. Bacteria were grown in a medium containing  $^{15}\text{N}$ . After several generations, all of the DNA contained  $^{15}\text{N}$ . Some of these bacteria were transferred to a medium containing the common nitrogen,  $^{14}\text{N}$ . The bacteria were allowed to divide once.

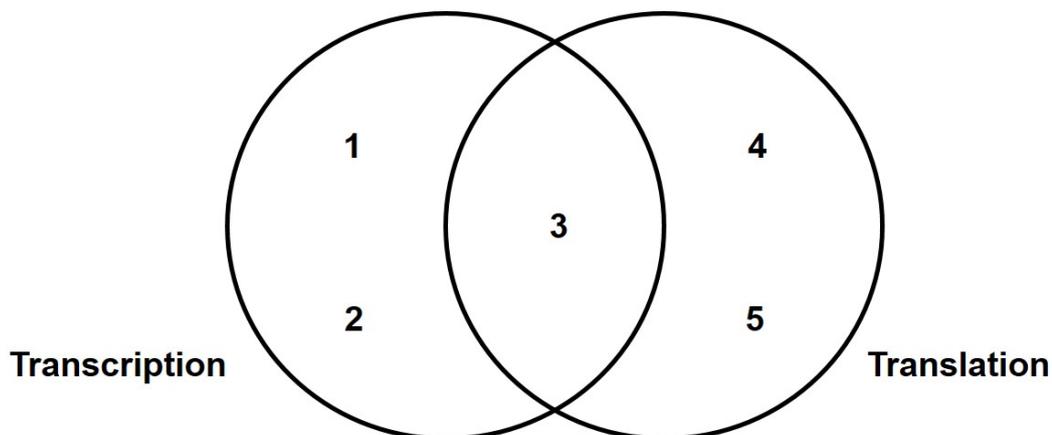
Answer: B

The bacteria were then transferred back to the medium containing  $^{15}\text{N}$ . The bacteria were allowed to divide once more.

What would be the percentage of  $^{15}\text{N}/^{15}\text{N}$  DNA molecules and  $^{14}\text{N}/^{15}\text{N}$  hybrid DNA molecules in the DNA extracted from the bacteria at the end of the experiment?



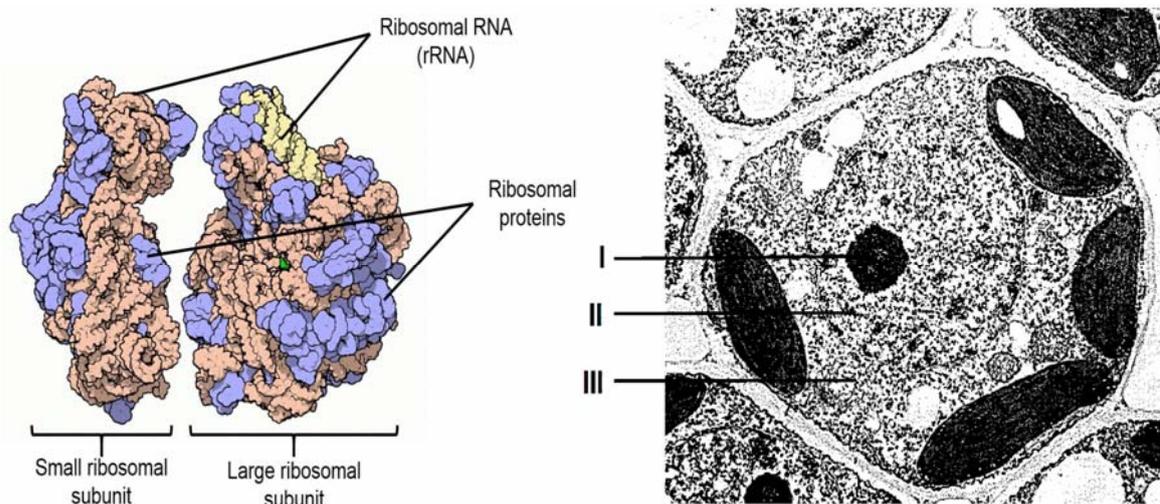
12. The following diagram shows two processes involved in the central dogma for eukaryotes, **1**, **2**, **4** and **5** represent properties unique to the individual processes, while **3** represent a property that is similar between the two processes.


**Answer: C**

Which of the following correctly identifies 1-5?

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>A</b>	formation of phosphodiester bonds	product synthesised from 5' to 3'	occurs in cytoplasm	formation of peptide bonds	product synthesised from N to C terminal
<b>B</b>	formation of peptide bonds	product synthesised from N to C terminal	occurs in cytoplasm	formation of phosphodiester bonds	product synthesised from 5' to 3'
<b>C</b>	formation of phosphodiester bonds	occurs in nucleus	requires energy	formation of peptide bonds	occurs in cytoplasm
<b>D</b>	formation of peptide bonds	occurs in nucleus	requires energy	formation of phosphodiester bonds	occurs in cytoplasm

13. Ribosomes are organelles involved in protein synthesis, it is composed of two subunits, a small ribosomal subunit and a large ribosomal subunit. Each subunit consists of two components, a protein component and a RNA (rRNA) component. The ribosome structure is showed in the figure on the left. The figure on the right shows an electron micrograph of a eukaryotic cell with three regions labelled, I, II and III. These three regions are involved in the synthesis of each individual components and the assembly of each subunit (combining the protein component with rRNA component).

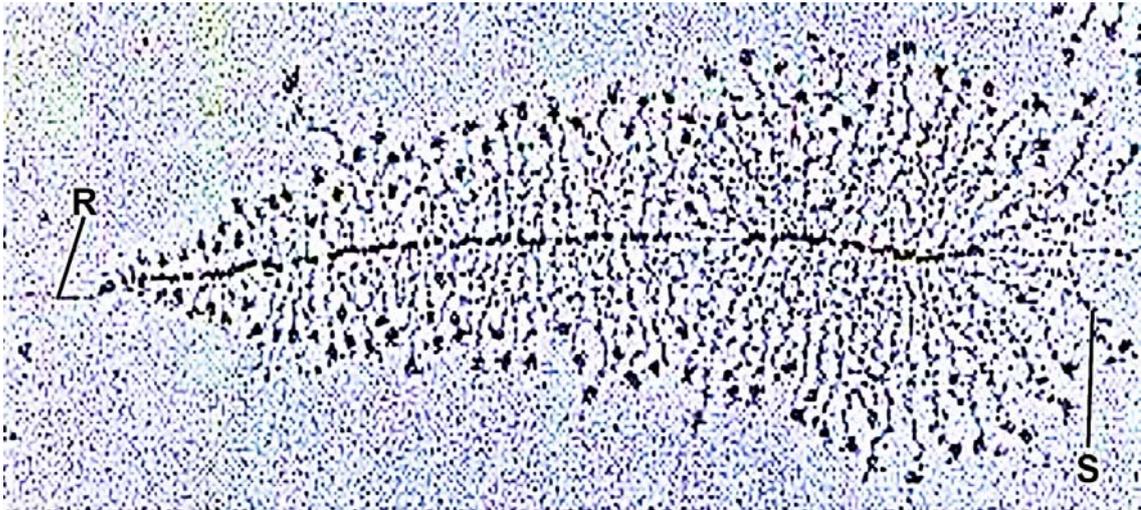


Which of the following correctly identifies the role(s) that each region plays in the synthesis of ribosomal subunits?

	I	II	III
A	transcription of rRNA genes to form rRNA	assembly of individual subunits	translation of rRNA to form ribosomal proteins
B	assembly of individual subunits	transcription of rRNA genes	translation of rRNA to form ribosomal proteins
C	assembly of individual subunits	transcription of rRNA and ribosomal protein genes to form rRNA and ribosomal protein mRNA	translation of ribosomal protein mRNA to form ribosomal proteins
D	transcription of rRNA genes to form rRNA and assembly of individual subunits	transcription of ribosomal protein genes to form ribosomal protein mRNA	translation of ribosomal protein mRNA to form ribosomal proteins

**Answer: D**

14. The electron micrograph shows protein synthesis in a bacteria cell.



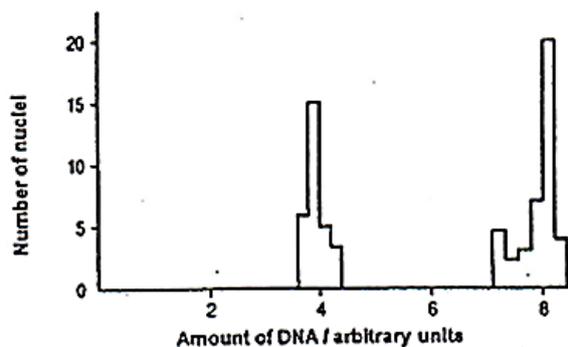
Which statements about the processes involved are correct?

- I Transcription occurs from left to right along template DNA, **R**.
- II **S** is used as template for translation.
- III Translation initiates only after transcription is completed.
- IV Only one RNA polymerase is transcribing the template DNA, **R**, at any one time.
- V **R** is the mRNA and it is translated by ribosomes to form polypeptide chains, **S**.

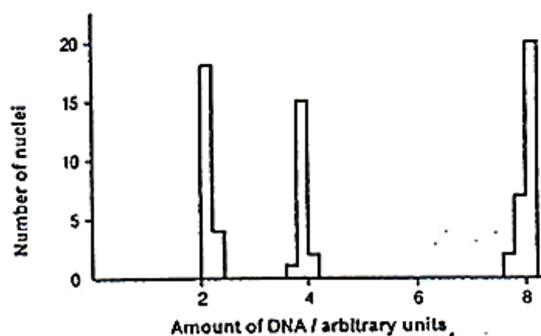
- A V only
- B I and II only
- C I, II and IV only
- D III, IV and V only

Answer: B

15. The graphs below show the amount of DNA per nuclei of cells taken from two different parts of a mammalian testis undergoing different types of nuclear division.



Graph 1



Graph 2

Various events that occurs in **graph 1** and **2** are listed as follows

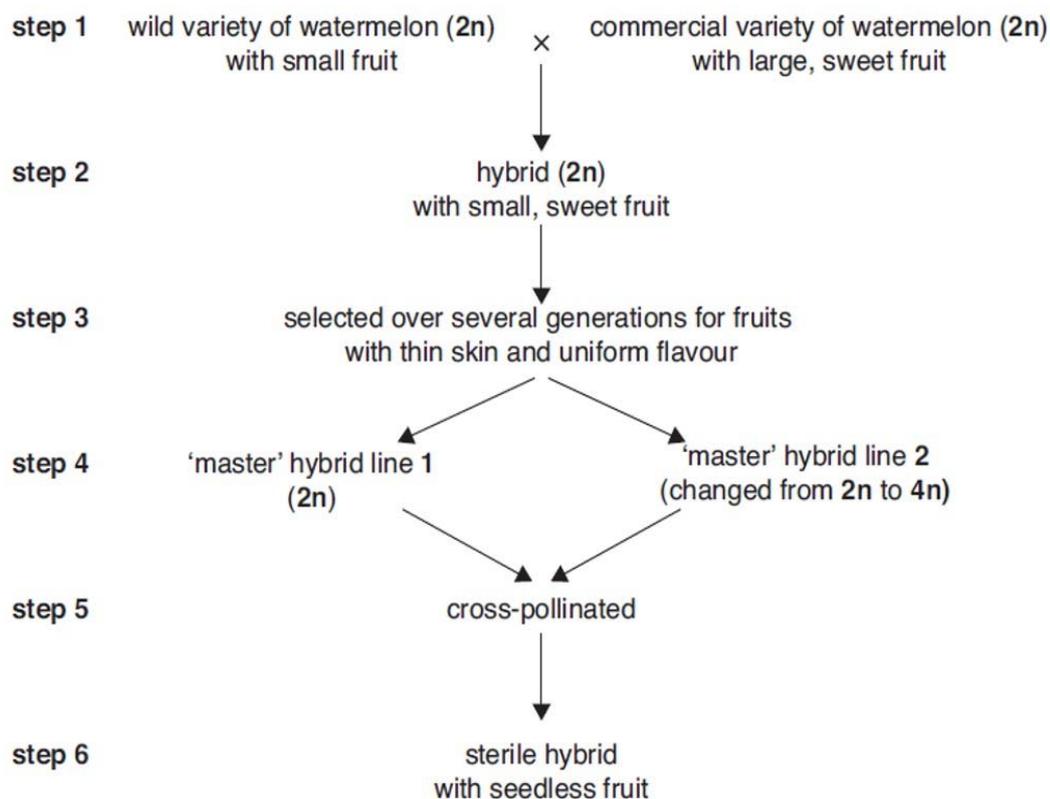
Answer: A

- I DNA replication
- II Breaking and rejoining of homologous regions of chromosomes
- III Separation of homologous chromosomes
- IV Separation of identical sister chromatids
- V Separation of non-identical sister chromatids

Which of the following correctly identify events that occurred in each graph?

	Graph 1	Graph 2
A	I and IV	I, II, III and V
B	II, III and V	I and IV
C	I and IV	II, III and V
D	III and IV	I, II and V

16. The following flowchart shows the steps involved in cultivating watermelon of desired phenotypes.



Which of the following statement(s) is/are true regarding the steps involved?

- I Step 3 is an example of artificial selection.
- II Drugs that prevent spindle fibre formation can be used to form diploid gametes that allows the formation of tetraploid 'master' hybrid line 2.
- III The seedless hybrid produced in step 6 is sterile due to absence of homologous chromosomes.
- IV The seedless hybrid produced in step 6 can be made fertile again by using the same method used in step 4 in producing tetraploid 'master' hybrid line 2.

- A II only
- B I and III only
- C I, II and IV only
- D II, III and IV only

Answer: C

17. Ras is a protein that functions as a signalling molecule in cells. When the appropriate signals are present, Ras is activated, and it signals for cell proliferation. Many cancer development process involves the mutation of the Ras gene, resulting in a mutant Ras protein.

**Answer: C**

Which of the following best explain why a mutant Ras leads to tumour progression?

- A** Ras is a proto-oncogene, a loss of function mutation to Ras prevents it from detecting DNA damage and cell cycle arrest.
- B** Ras is a tumour suppressor gene, a loss of function mutation to Ras prevents it from signaling normal cell proliferation.
- C** Ras is a proto-oncogene, a gain of function mutation to Ras allows it to signal for cell proliferation in the absence of appropriate signals, resulting in uncontrolled cell division.
- D** Ras is a tumour suppressor gene, a gain of function mutation to Ras results in signaling that allows the cell to bypass cell cycle checkpoints.

Refer to the following information for questions 10 and 11.

Dystrophin is a protein that function to maintain the cell membrane integrity of muscle fibers. Duchene muscular dystrophy (DMD) is a genetic disease caused by a mutation in the dystrophin gene.

18. The sequence of part of the normal and mutated alleles for dystrophin gene is shown below.

**Answer: D**

**Normal allele**

Codon	180	181	182	183	184	186	187	188	189
mRNA	CGU	AGA	UGG	AAA	UCA	UAA	ACU	GAC	UCU

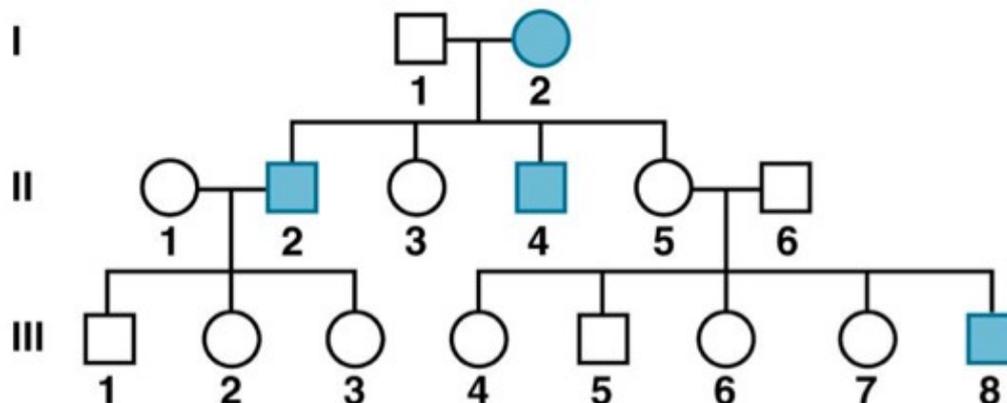
**Mutant allele**

Codon	180	181	182	183	184	186	187	188	189
mRNA	CGU	AGU	GAA	AUC	AUA	AAC	UGA	CUC	UUG

Using the information of the normal and mutated alleles above, which of the following is a valid conclusion?

- A** An addition of two nucleotides at codon 181 caused a frame shift mutation, resulting in a premature stop codon at codon 189.
- B** A deletion of a single nucleotide at codon 181 caused a frame shift mutation, resulting in a premature stop codon at codon 189.
- C** A substitution of a single nucleotide at codon 181 and a deletion of two nucleotides at codon 187, causing a frame shift, resulting in a premature stop codon at codon 187.
- D** A deletion of a single nucleotide at codon 181 and at codon 182 caused a frame shift mutation, resulting in a premature stop codon at codon 187.

19. The pedigree chart shows the inheritance of DMD in a family.



What is the mode of inheritance for DMD?

- A Sex-linked dominant
- B Autosomal dominant
- C Sex-linked recessive
- D Autosomal recessive

Answer: C

20. *Abraxas grossulariata* is a Moth native to North America. There are two different phenotypes observed for their wing colour, dark and light. Two crosses were carried out to determine the inheritance of wing colour in *Abraxas grossulariata*.

Cross 1: Pure-breeding female moths with dark coloured wings crossed with pure breeding male moths with light coloured wings

Result: All offspring were showed dark coloured wings.

Cross 2: Pure-breeding female moths with light coloured wings crossed with pure breeding male moths with dark coloured wings

Result: All female offspring had dark coloured wings while all male offspring had light coloured wings.

Based on the results of the two crosses, what can be deduced about the inheritance of wing colour in *Abraxas grossulariata*?

- A Wing colour is sex-linked, the allele for dark wing colour is dominant to allele for light wing colour
- B Wing colour is not sex-linked, the allele for dark wing colour is dominant to allele for light wing colour
- C Wing colour is sex-linked, the allele for light wing colour is dominant to allele for dark wing colour
- D Wing colour is not sex-linked, the allele for light wing colour is dominant to allele for dark wing colour

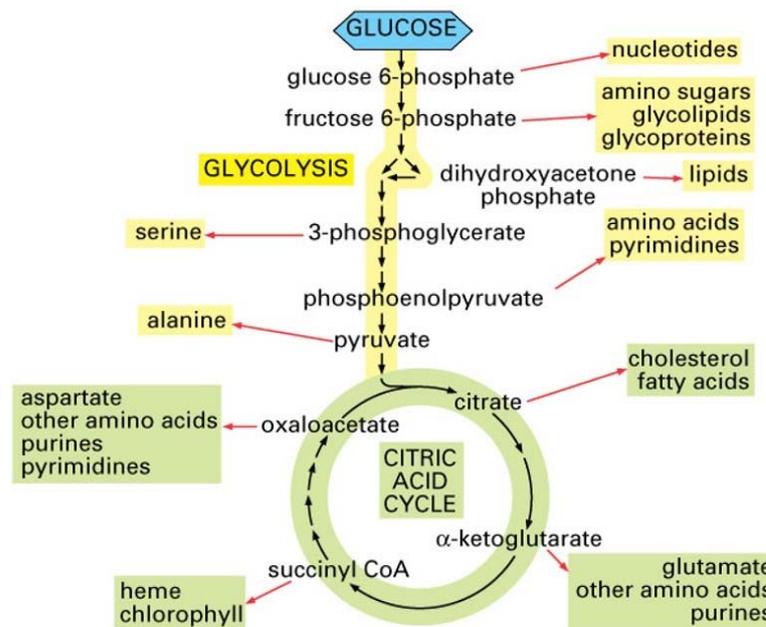
Answer: A

21. In a particular breed of tomato plant, the presence of hair on stems is determined by a single gene. Pure breeding tomato plant with hairy stem was crossed with pure breeding tomato plant with hairless stem. The resulting F1 all had a different phenotype of short hair on stem.

Answer: D

Which of the following best explains the result?

- A The allele for hairy stem is dominant over the allele for hairless stem.  
 B For heterozygotes, the two alleles have an equal effect on the phenotype.  
 C There are multiple alleles for the gene controlling presence of hair on stems.  
 D For heterozygotes, the two alleles do not contribute equally to the phenotype.
22. In cancer cells, it was observed that lactate fermentation occurs even under aerobic conditions. The uptake of glucose by cancer cells is also greatly increased by increasing the amount of glucose transporters on the cell surface membrane. Lactate fermentation under aerobic conditions is also commonly seen in normal cells that are rapidly dividing. The following figure outlines the relationship of glucose metabolism and other metabolic processes in normal cells.

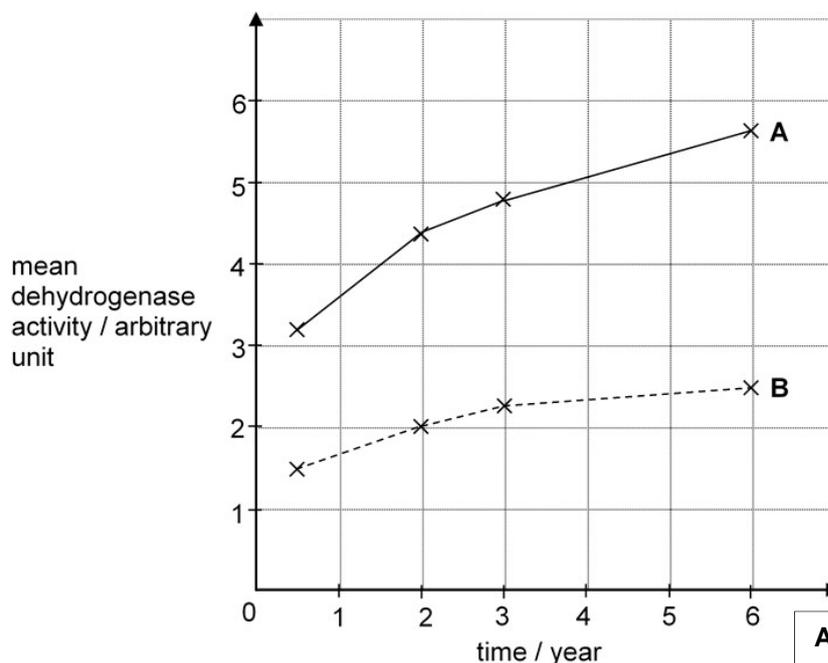


Answer: A

Which of the following statements best explains how lactate fermentation in the presence of oxygen benefits cancer cells?

- A Anaerobic respiration allows for production of intermediates that can be used to synthesise other biomolecules for growth.  
 B Glycolysis alone provides less ATP which allows for cancer cells to grow slowly over a prolonged period of time.  
 C Anaerobic respiration allows for the buildup of lactate which can be converted into other biomolecules for growth.  
 D Absence of citric acid cycle reduces the amount of cholesterol and fatty acids formed which prolongs the life-span of cancer cells.

23. To investigate the effect of soil depth on the rate of aerobic respiration in soil-dwelling aerobic bacteria, soil samples were taken at two depths. The samples were taken over a span of six years to determine the activity of dehydrogenases, enzymes involved in the Krebs cycle. The results are shown in the figure below.

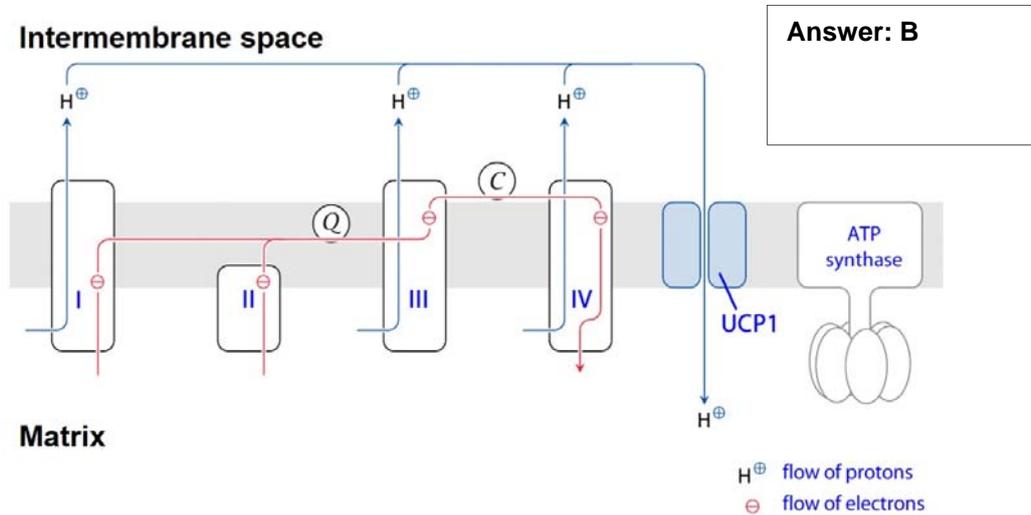


Answer: C

Which of the following is a valid conclusion based on the results?

- A Graph A shows the results of samples taken from a deeper depth as the amount of bacteria increases with increasing depth.
- B Only samples from graph A showed an increasing rate of aerobic respiration over the time span of six years.
- C Samples from graph B are taken from a deeper depth, as oxygen concentration decreases with deeper depth, resulting in lower dehydrogenase activity.
- D Dehydrogenases found in bacteria samples from graph B have evolved higher affinity for substrates due to lower concentration of oxygen.

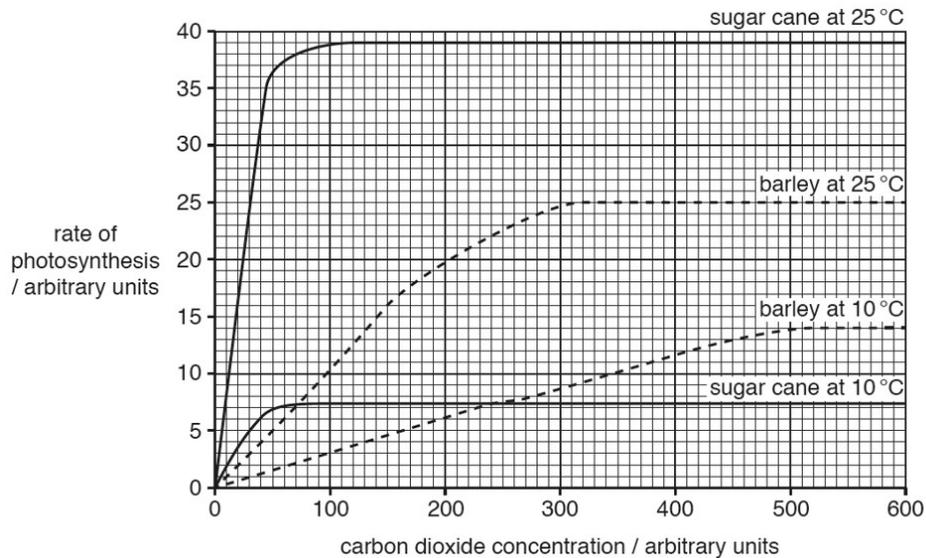
24. Brown adipose tissues are found together with white adipose tissues, they are present in all mammals but are more abundant in mammals that have to survive prolonged winters. The distinct difference of brown adipose tissues lies in the extra proton channel (UCP1) found in the inner membrane of mitochondria, which allows protons to flow back from the intermembrane space to matrix. The structure of the inner membrane along with the proteins embedded on it are shown in the figure below.



Which of the following explains the physiological significance of the proton channel UCP1 in mammals that have to survive prolonged winter?

- A Flow of proton back to matrix allows for more proton to be pumped across the membrane via the electron transport chain.
- B Energy released from the flow of protons is loss as heat which helps keep the mammal warm.
- C Less proton flowing through ATP synthase results in less ATP synthesised, this lowers the mammal's metabolism allowing it to survive better in the winter.
- D Flow of proton back to matrix maintains the positive charge in the matrix which speeds up the rate of electron flow, allowing for faster rate of ATP synthesis.

25. IPCC has reported a rising trend in both global temperature and carbon dioxide levels. Both these factors are key variables to the process of photosynthesis in plants. The figure below shows how the rate of photosynthesis in two types of plants, sugar cane and barley plants are affected by changes in temperature and carbon dioxide levels.

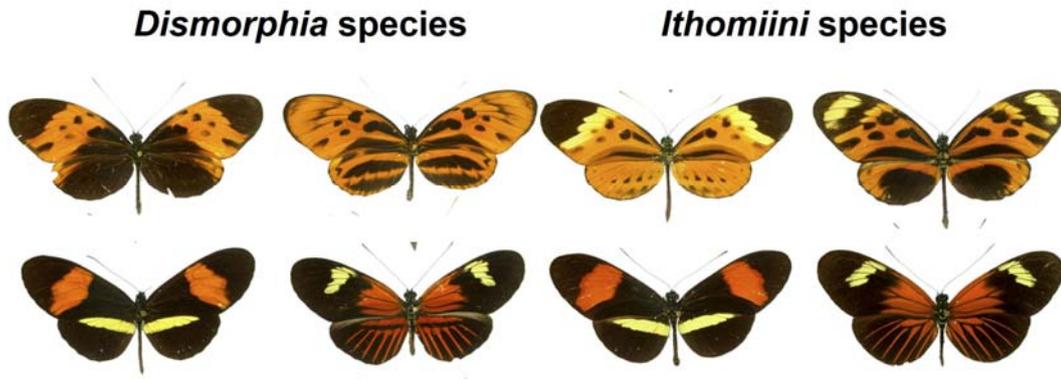


Answer: A

Which of the following is a valid conclusion from the data?

- I Sugar cane is more sensitive to changes in carbon dioxide at low carbon dioxide levels.
  - II Climate change is beneficial to plants as it results in the increase in rate of photosynthesis.
  - III Rubisco found in both sugar cane and barley are only saturated at high levels of carbon dioxide
  - IV Sugar cane adapt better to increase in temperature and carbon dioxide.
- A I and IV only**  
**B II and IV only**  
**C II and III only**  
**D I, III and IV only**

26. The figure below shows two species of butterfly commonly found together in the rainforests of Brazil, the *Dismorphia* species and the *Ithomiini* species.



A property about the *Dismorphia* species is that they produce a certain metabolite that deters predators. As such, predators would learn to avoid eating them. However, *Ithomiini* species on the other hand does not produce the metabolite.

In terms of appearance, the two species looks very similar, in fact, the *Ithomiini* species was found to have evolved to “mimic” the appearance of *Dismorphia* species.

Which of the following statement is true?

- A** *Dismorphia* species would benefit by being at a selective advantage when majority of the butterflies are *Ithomiini* species that mimics its appearance.
- B** *Ithomiini* species that mimics the appearance of *Dismorphia* species would be at a selective advantage when majority of the butterflies are *Ithomiini* species.
- C** *Dismorphia* species would not be affected by frequency of *Ithomiini* species that mimics its appearance.
- D** *Ithomiini* species that mimics the appearance of *Dismorphia* species would be at a selective advantage when majority of the butterflies are *Dismorphia* species.

Answer: D

27. Prior to Charles Darwin's publication on his theory of evolution by natural selection in his famous book, a French biologist by the name of Jean-Baptiste Lamarck crafted a hypothesis that tried to explain inheritance of traits and evolution. His hypothesis revolved around two central ideas:

- I Individuals loses traits that are not required, or use, and develop characteristics that are useful.
- II These acquired useful traits are passed on to subsequent generations.

His hypothesis was soon proved to be wrong with the introduction of Darwin's theory of evolution by natural selection, along with the better understanding of genetics contributed by Gregor Mendel.

Answer: C

Which of the following examples would **not** be evidence against Lamarck's hypothesis?

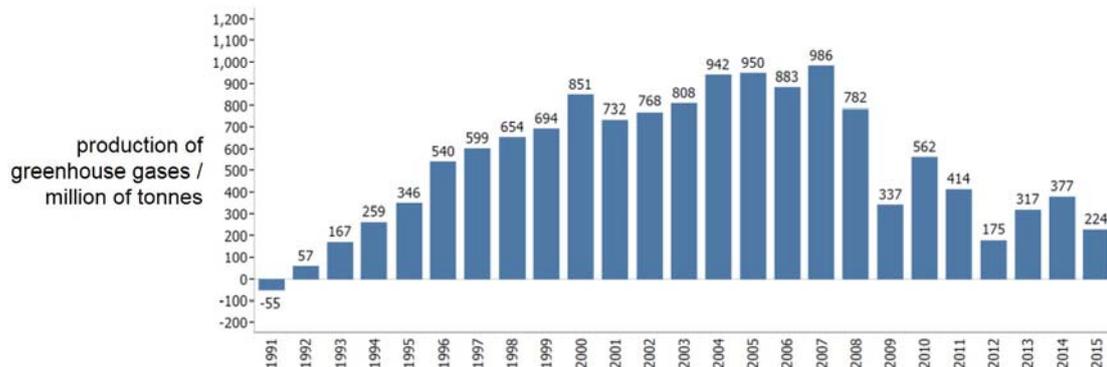
- A Human ancestors used to feed primarily on plants, they had larger jaws and a third molar that was useful in grinding plant tissue, with the change in diet over time, the jaws became smaller but the third molar remains up till today, commonly known as the "wisdom tooth".
- B Athletes who trained hard and excelled in their field of sports had children whom was not "naturally gifted" in the same field of sports.
- C Scientists found that one's DNA can be modified during their lifetime via the addition of "chemical tags" based on their environmental conditions, and these "tags" would be passed on to their offspring.
- D A couple whom was phenotypically normally throughout their lifetime had a child with sickle cell anaemia.

28. Evolution by natural selection provides an explanation for the vast number of species. Evolution can also be driven by artificial selection, where the selection pressure is applied by man and selected traits are chosen by man to be passed on.

Which of the following examples does not describe artificial selection?

**Answer: B**

- A** Ancestral wolves that were domesticated by man were selected for tameness traits which gave rise to the various species of dogs today.
- B** Ancestral mammals that colonized Australia were isolated from the rest of the mainland with a unique environment and interactions with humans, resulting in development of unique species not seen anywhere else.
- C** Crops producing larger fruits were selected by farmers to breed resulting in the gradual increase in size of the fruit.
- D** The excessive use of antibiotics by farmers resulted in a population of bacteria that is resistant to all current known antibiotics
29. The graph shows the production of greenhouse gases (carbon dioxide and methane) in the United States from 1991 to 2015, measured in millions of tonnes.



Which of the following would **not** contribute to the trend seen between 2007 and 2015?

- A** increasing the cost of carbon tax
- B** decreased consumption of meat-based products
- C** increased import and export of crops with trade partners
- D** decreased use of agricultural machinery for crop harvesting

**Answer: C**

30. With recent changes to global climate, many agriculture has been negatively impacted. The following figure shows the changes in variables of climate conditions during the different seasons for each major crop in Pakistan. Each of the crops are harvested at specific seasons.

Variables	Major Crops			
	Wheat	Rice	Maize	Sugarcane
Max Temp	-1.7991 *	3.9200 *	0.1174	0.4743 *
Min Temp	0.6216 *	-0.7041 *	0.5458	0.2578 *
Rainfall	-0.1195 *	-0.0126	-0.703	-0.0094

\*Indicates significant difference

Which of the following statements are valid conclusions drawn from the data?

- I Climate change has caused Pakistan to be drier and warmer for majority of the seasons.
- II Climate change caused significant increased rainfall and flooding of all crops.
- III Climate change caused an increase in variability of temperature range during the rice crop season.
- IV The impact on wheat is likely to be more significant than the other three crops.

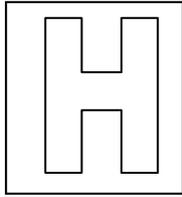
- A III only
- B I and II only
- C II and IV only
- D I, III and IV only

Answer: D

End of Paper

Candidate Name: \_\_\_\_\_

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## 2018 End-of-Year Exams Pre-University 2

### H1 Biology

**8876/02**

Paper 2 Core Paper

**10 September 2018**

**2 hours**

Additional Materials: Writing paper

### READ THESE INSTRUCTIONS FIRST

**Do not open this booklet until you are told to do so.**

Write your Admission number and name on all the work you hand in.  
Write in dark blue or black pen on both sides of the paper.  
You may use a soft pencil for any diagrams, graphs or rough working.  
Do not use staples, paper clips, highlighters, glue or correction fluid.

#### Section A

Answer **all** questions.

#### Section B

Answer any **one** question.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question. At the end of the examination, fasten all your work securely together.

For Examiner's Use	
<b>Section A</b>	
<b>1</b>	/ 11
<b>2</b>	/ 8
<b>3</b>	/ 7
<b>4</b>	/ 10
<b>5</b>	/ 9
<b>Section B</b>	/ 15
<b>Total</b>	/ 60

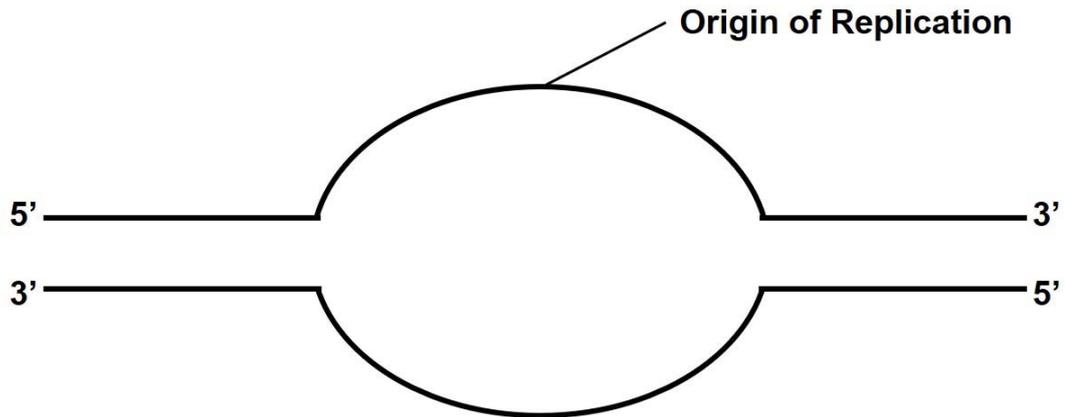
This question paper consists of 14 printed pages.

[Turn over

### Section A

Answer **all** questions in this section.

1. The process of DNA replication is sometimes described as “*asymmetrical*” replication as the daughter strands are synthesised slightly differently in the form of a leading strand and a lagging strand. Fig. 1.1 shows a replication bubble and the origin of replication.



**Fig. 1.1**

(a) (i) On Fig. 1.1, draw the following with respect to one of the replication fork:

- Leading and lagging strands
- Arrow heads ( $\rightarrow$ ) on leading and lagging strands to indicate direction of synthesis
- 5' and 3' ends of leading and lagging strands

[2]

(ii) Explain why the two daughter strands are synthesised asymmetrically.

.....  
 .....  
 .....  
 .....[2]

Telomeres are short repetitive sequences found at the ends of chromosomes. Length of telomeres can be used to estimate cellular age as telomeres shorten over time.

**(b)** State what causes telomeres to shorten over time.

.....  
.....[1]

A single human diploid cell contains around six billion base pairs, amounting to around two meters in length. The diameter of a nucleus is around  $10^{-15}$  meters.

**(c)** Describe how DNA are packaged such that it can fit into the nucleus.

.....  
.....  
.....  
.....  
.....  
.....[3]

Senescence cells are cells that have telomeres that have shortened to a critical length such that the cells no longer undergo cell division.

**(d) (i)** State the cell cycle stage that senescence cells are in.

.....[1]

**(ii)** Explain the purpose for limiting the number of times a cell can divide.

.....  
.....  
.....  
.....[2]

**[Total: 11]**

2. Rubisco is an enzyme catalysing the first stage of Calvin cycle, its function is vital in maintaining life on Earth.

(a) (i) State the initial reactants and final product(s) of Calvin cycle.

.....  
 .....[1]

(ii) Explain how Rubisco plays a role in maintaining life on Earth.

.....  
 .....  
 .....  
 .....[2]

Rubisco gene is found in all photosynthetic plants. A study was carried out to investigate the effect of temperature on the catalytic activity of Rubisco found in different plants. Fig. 2.1 shows the results.

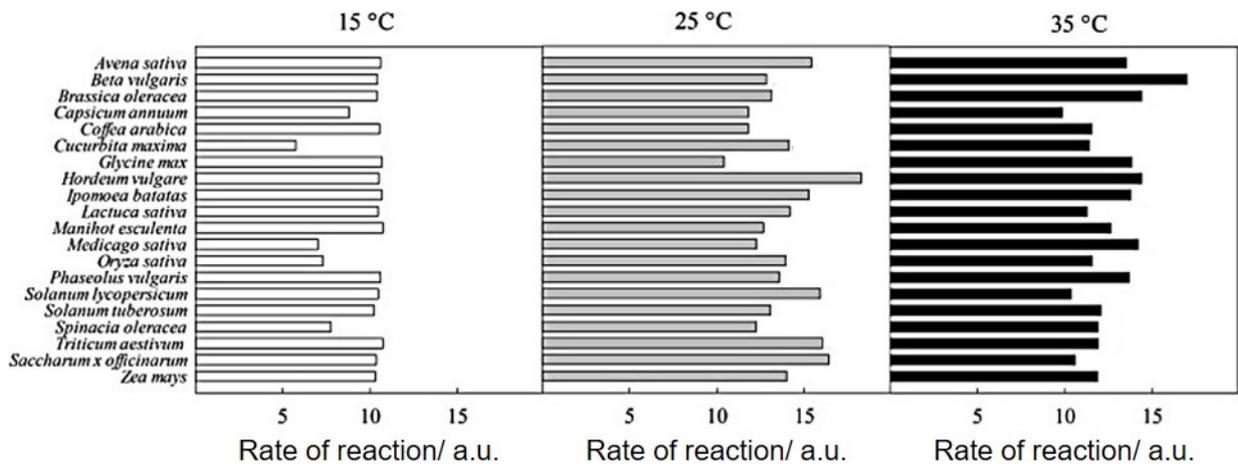


Fig. 2.1

**(b)** With reference to Fig. 2.1, conclude if Rubisco found in different plants have the same optimal temperature range.

.....  
.....  
.....  
.....  
.....  
.....  
.....[3]

**(c)** Explain why Rubisco from different plants exhibit different catalytic activity under the same temperature condition with all other conditions kept constant.

.....  
.....  
.....  
.....[2]

**[Total: 8]**

3. In *Drosophila melanogaster*, the common fruit fly, wing shape is controlled by a gene with multiple alleles. These alleles are listed below in no particular order. When pure-breeding *Drosophila* with long wings were crossed with pure-breeding *Drosophila* with vestigial wings, all offspring had long wings.

Long =  $W^L$

Vestigial =  $W^V$

Antlered =  $W^a$

*Drosophila* with vestigial wings crossed with *Drosophila* with antlered wings produce all offspring with wings of a new phenotype that appears to be an intermediate between vestigial and antlered phenotype, called vestigial-antlered.

- (a) Suggest an explanation for the new phenotype.

.....

.....

.....

.....[2]

Eye colour of *Drosophila* is determined by a gene located on the X chromosome. Sex determination in *Drosophila* is similar to that of humans. *Drosophila* can either have red eyes or white eyes, the allele coding for red eyes is dominant over the allele for white eyes.

Pure breeding female *Drosophila* with long wings and red eyes were crossed with pure breeding male *Drosophila* with vestigial wings and white eyes.

In the F1 generation, all female and male *Drosophila* had long wings and red eyes.

Female and male flies from F1 generation were then crossed to produce the F2 generation.

The observed number of F2 flies with each phenotype were as follows:

Female, long wings, red eyes	595
Female, vestigial wings, red eyes	201
Male, long wings, red eyes	304
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Male, vestigial wings, white eyes	100

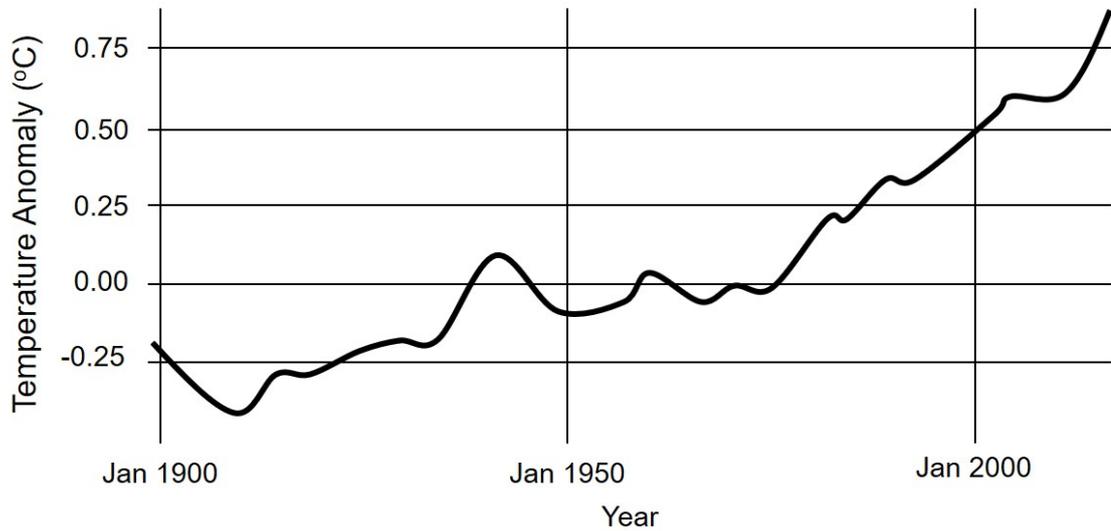
**(b)** Draw a genetic diagram to explain the observed results of the cross between female flies and male flies from the F1 generation.

**[5]**

**[Total: 7]**

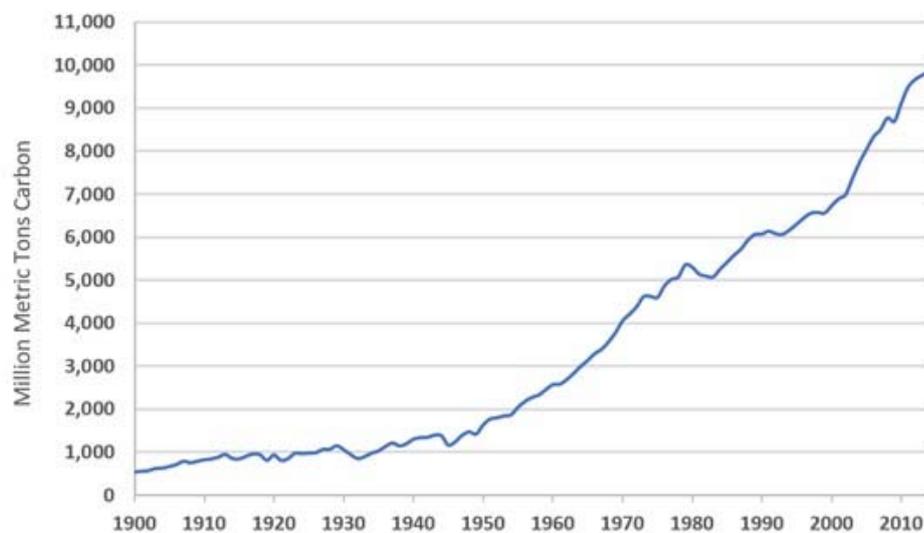
**[Turn over**

4. Global temperature records show temperature anomaly ( $^{\circ}\text{C}$ ), which is the difference in temperature of a particular year to the average temperature of a reference year-span. Fig 4.1 shows the global temperature records from 1900 to 2014 relative to the average temperature from 1951 to 1980.



**Fig. 4.1**

Fig. 4.2 shows the global carbon emission from burning of fossil fuel from 1900 to 2014.



**Fig. 4.2**

**(a)** Comment on the trend observed for both global temperature records and global carbon emission from 1950s onwards.

.....  
.....  
.....  
.....[2]

Changes in global temperature will have an impact on many other abiotic and biotic factors, one of them being sea levels.

**(b)** With reference to Fig. 4.1, account for how sea levels have been affected.

.....  
.....  
.....  
.....  
.....  
.....[3]



The Intergovernmental Panel on Climate Change (IPCC) has made predictions on future global surface temperature based on past trends and existing data. If no actions are done, the trend observed in Fig. 4.1 can be expected to continue.

**(d)** Assuming if the trend in Fig. 4.1 continues, predict how dengue would spread in the future.

.....

.....

.....

.....[2]

**[Total: 10]**



**(b)** Suggest one limitation of using fossil records in evolutionary studies.

.....  
.....[1]

We would expect natural selection to eliminate genetic variations with negative effects from human population. However, the study on human genetics reveals that several recessive alleles that are known to cause diseases have been preserved in human populations.

For instance, the sickle-cell allele is carried by half the people in some areas of Africa. This distribution seems to result from the counterbalancing effects of anaemia and malaria, a disease that formally causes high death rates in equatorial Africa.

**(c)** Account for the high frequency of sickle cell anaemia allele in the African populations.

.....  
.....  
.....  
.....  
.....[3]

**(d)** Explain why population is the smallest unit that can evolve.

.....  
.....  
.....[2]

**[Total: 9]**

**Section B**

Answer **one** question.

Write your answers on the separate answer paper provided.

Your answers should be illustrated by large, clearly labelled diagrams, where appropriate.

Your answers must be in continuous prose, where appropriate.

Your answers must be set out in sections **(a)**, **(b)** etc., as indicated in the question.

1.

**(a)** Compare aerobic and anaerobic respiration in animals. **[7]**

**(b)** Both Darwin and Wallace independently came up with the theory of evolution by natural selection. They concluded that organisms had to struggle for survival, and that each subsequent generation slowly became better adapted to the environment.

Using named example, explain how environmental factors act as forces of natural selection. **[8]**

**[Total: 15]**

2.

**(a)** Contrast between stem cells and cancer cells. **[6]**

**(b)** Based on data collected over the years on weather patterns and greenhouse gas emissions, researchers have concluded a causal relationship between greenhouse gas emission and enhanced global warming. Biotic factors like coral reefs are sensitive and vulnerable to changes in climate.

Discuss how weather patterns would be affected and the consequences of such changes, along with how corals reefs are impacted by enhanced global warming. **[9]**

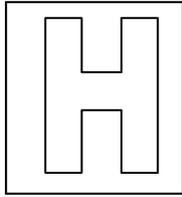
**[Total: 15]**

**End of Paper**

**[Total: 15]**

Candidate Name: \_\_\_\_\_

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## 2018 End-of-Year Exams Pre-University 2

### H1 Biology

**8876/02**

Paper 2 Core Paper

**10 September 2018**

**2 hours**

Additional Materials: Writing paper

### READ THESE INSTRUCTIONS FIRST

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You may use a soft pencil for any diagrams, graphs or rough working.  
Do not use staples, paper clips, highlighters, glue or correction fluid.

#### Section A

Answer **all** questions.

#### Section B

Answer any **one** question.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question. At the end of the examination, fasten all your work securely together.

For Examiner's Use	
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<b>5</b>	/ 9
<b>Section B</b>	/ 15
<b>Total</b>	/ 60

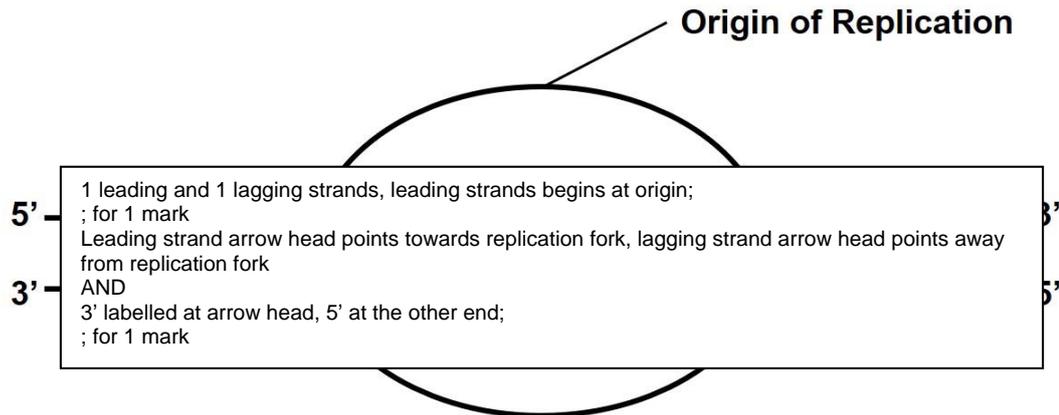
This question paper consists of 14 printed pages.

[Turn over

## Section A

Answer **all** questions in this section.

1. The process of DNA replication is sometimes described as “*asymmetrical*” replication as the daughter strands are synthesised slightly differently in the form of a leading strand and a lagging strand. Fig. 1.1 shows a replication bubble and the origin of replication.



**Fig. 1.1**

- (a) (i) On Fig. 1.1, draw the following with respect to one of the replication fork:

- Leading and lagging strands
- Arrow heads ( $\rightarrow$ ) on leading and lagging strands to indicate direction of synthesis
- 5' and 3' ends of leading and lagging strands

[2]

- (ii) Explain why the two daughter strands are synthesised, “asymmetrically”.

- DNA polymerase can only add new nucleotides to 3' -OH ends;
- DNA is anti-parallel;

; for 1 mark

[2]

Telomeres are short repetitive sequences found at the ends of chromosomes. Length of telomeres can be used to estimate cellular age as telomeres shorten over time.

**(b)** State what causes telomeres to shorten over time.

End replication problem; ; for 1 mark	.....
--	-------

.....[1]

A single human diploid cell contains around six billion base pairs, amounting to around two meters in length. The diameter of a nucleus is around  $10^{-15}$  meters.

**(c)** Describe how DNA are packaged such that it can fit in the nucleus.

<ul style="list-style-type: none"> <li>DNA is wound around <u>histone</u> proteins forming <u>nucleosomes</u>; ; for 1 mark</li> <li>Nucleosomes are packed/ fold up to form 30nm <u>chromatin</u> fibre;</li> <li>Chromatin fibres are further packed/ fold up to form 300nm <u>loops</u>;</li> <li>300nm loops are further condensed to form <u>chromosomes</u>; ; for 1 mark, max 2 mark</li> </ul>	.....
--	-------

.....

.....

.....[3]

Senescence cells are cells that have telomeres that have shortened to a critical length such that the cells no longer undergo cell division.

**(d) (i)** State the cell cycle stage that senescence cells are in.

G <sub>0</sub> ; ; for 1 mark	.....
----------------------------------	-------

.....[1]

**(ii)** Explain the purpose for limiting the number of times a cell can divide.

<ul style="list-style-type: none"> <li>Prevent the <u>loss of genetic information / coding sequence</u>;</li> <li>Prevent the <u>accumulation of mutations</u>;</li> <li>Prevent <u>oncogenesis / cancer</u> formation;</li> </ul> ; for 1 mark, max 2 marks	.....
--	-------

.....[2]

[Total: 11]

2. Rubisco is an enzyme catalysing the first stage of Calvin cycle, its function is vital in maintaining life on Earth.

(a) (i) State the initial reactants and final product(s) of Calvin cycle.

Initial reactants: Carbon dioxide, RuBP, ATP and NADPH  
Final Products: G3P, ADP and NADP<sup>+</sup>;  
; for 1 mark

[1]

(ii) Explain how Rubisco plays a role in maintaining life on Earth.

- Rubisco catalyses Calvin cycle which converts inorganic carbon to organic carbon;
  - Heterotrophs / organisms / secondary consumers that are unable to make their own food relies on plants as food source for organic carbon that is essential for growth/OWTTE;
- ; for 1 mark

[2]

Rubisco gene is found in all photosynthetic plants. A study was carried out to investigate the effect of temperature on the catalytic activity of Rubisco found in different plants. Fig. 2.1 shows the results.

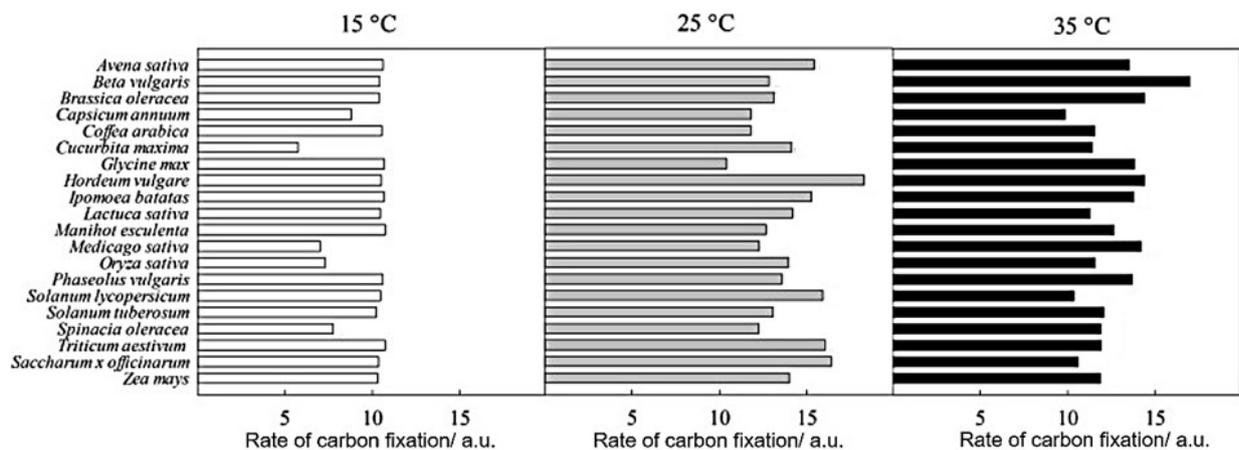


Fig. 2.1



3. In *Drosophila melanogaster*, the common fruit fly, wing shape is controlled by a gene with multiple alleles. These alleles are listed below in no particular order. When pure-breeding *Drosophila* with long wings were crossed with pure-breeding *Drosophila* with vestigial wings, all offspring had long wings.

Long =  $W^L$

Vestigial =  $W^V$

Antlered =  $W^a$

*Drosophila* with vestigial wings crossed with *Drosophila* with antlered wings produce all offspring with wings of a new phenotype that appears to be an intermediate between vestigial and antlered phenotype, called vestigial-antlered.

- (a) Suggest an explanation for the cross.

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• <u>Vestigial allele / <math>W^V</math></u> and <u>antlered allele / <math>W^a</math></u> exhibits <u>incomplete dominance</u>; ; for 1 mark</li> <li>• Both parents are <u>homozygotes / pure-bred / homozygous</u> for vestigial and antlered wings respectively; ; for 1 mark</li> </ul> | <p>.....</p> <p>.....</p> <p>.....</p> |
|---|--|

[2]

Eye colour of *Drosophila* is determined by a gene located on the X chromosome. Sex determination in *Drosophila* is similar to that of humans. *Drosophila* can either have red eyes or white eyes, the allele coding for red eyes is dominant over the allele for white eyes.

Pure breeding female *Drosophila* with long wings and red eyes were crossed with pure breeding male *Drosophila* with vestigial wings and white eyes.

In the F1 generation, all female and male *Drosophila* had long wings and red eyes.

Female flies and male flies from F1 generation were then crossed to produce the F2 generation.

The observed number of F2 flies with each phenotype were as follows:

Female, long wings, red eyes	595
Female, vestigial wings, white eyes	201
Male, long wings, red eyes	304
Male, long wings, white eyes	299
Male, vestigial wings, red eyes	101
Male, vestigial wings, white eyes	100

Draw a genetic diagram to explain the observed results of the cross between female flies and male flies from the F1 generation.

Let  $X^R$  be the allele on the X-chromosome that code for red eyes

Let  $X^r$  be the allele on the X-chromosome that codes for white eyes

Let  $W^L$  be the allele coding for long wings

Let  $W^V$  be the allele coding for vestigial wings

F1 phenotype	Female, long wings, red eyes				Male, long wings, red eyes		
F1 genotype	$W^L W^V X^R X^r$				$W^L W^V X^R Y$		
Gamete							
Punnett square	$W^L X^R$	$W^L X^R$ $W^L W^L X^R X^R$ Female, long wings, red eyes	$W^L Y$ $W^L W^L X^R Y$ Male, long wings, red eyes	$W^V X^R$ $W^L W^V X^R X^R$ Female, long wings, red eyes	$W^V Y$ $W^L W^V X^R Y$ Male, long wings, red eyes		
	$W^L X^r$	$W^L W^L X^R X^r$ Female, long wings, red eyes	$W^L W^L X^r Y$ Male, long wings, white eyes	$W^L W^V X^R X^r$ Female, long wings, red eyes	$W^L W^V X^r Y$ Male, long wings, white eyes		
	$W^V X^R$	$W^L W^V X^R X^R$ Female, long wings, red eyes	$W^L W^V X^R Y$ Male, long wings, red eyes	$W^V W^V X^R X^R$ Female, vestigial wings, red eyes	$W^V W^V X^R Y$ Male, vestigial wings, red eyes		
	$W^V X^r$	$W^L W^V X^R X^r$ Female, long wings, red eyes	$W^L W^V X^r Y$ Male, long wings, white eyes	$W^V W^V X^R X^r$ Female, vestigial wings, red eyes	$W^V W^V X^r Y$ Male, vestigial wings, white eyes		
F2 genotype	1/16 $W^L W^L X^R X^R$	1/16 $W^V W^V X^R X^R$	1/16 $W^L W^L X^R Y$	1/16 $W^L W^L X^r Y$	1/16 $W^V W^V X^R Y$	1/16 $W^V W^V X^r Y$	
F2 phenotype	Female Long wings, red eyes	Female Vestigial wings, Red eyes	Male Long wings, red eyes	Male Long wings white eyes	Male vestigial wings, red eyes	Male vestigial wings, white eyes	
F2 Phenotypic ratio	6 :	2 :	3 :	3 :	1:	1	

Correct parental phenotypes and genotypes;

Correct gametes drawn;

Correct Punette's square drawn including phenotypes;

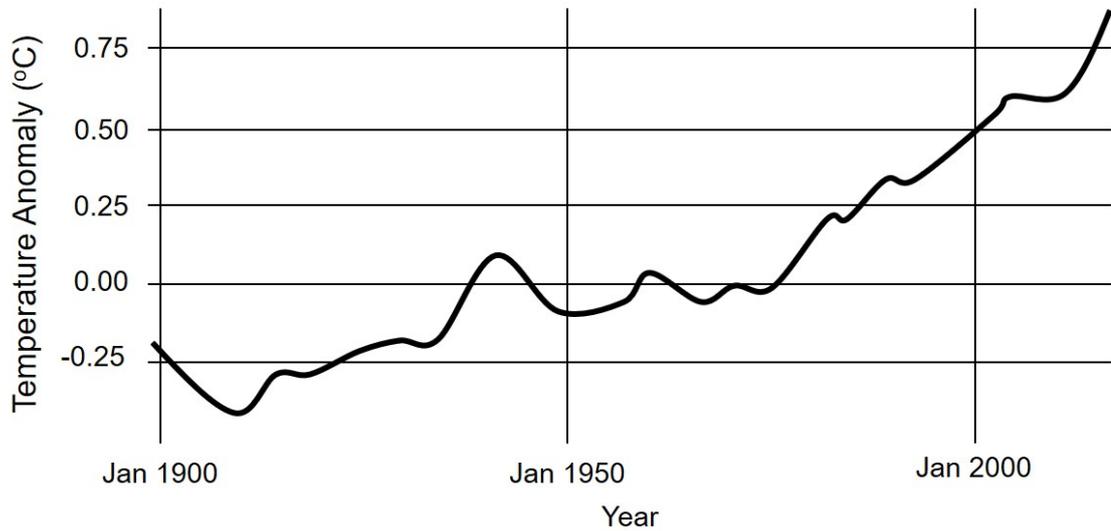
Correct F2 phenotypes and genotypes;

Correct phenotypic ratio;

[5]

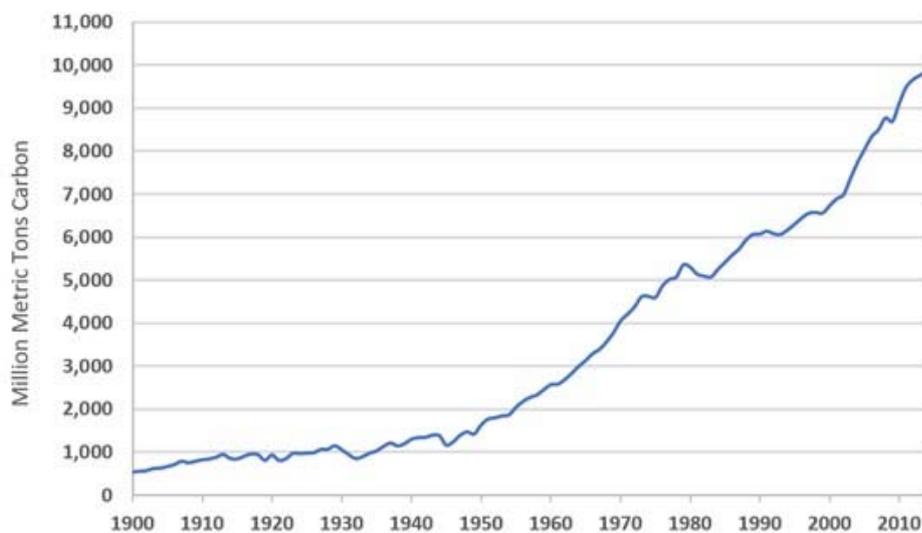
[Total: 7]

4. Global temperature records show temperature anomaly ( $^{\circ}\text{C}$ ), which is the difference in temperature of the measured year to the average temperature of a reference year-span. Fig 4.1 shows the global temperature records from 1900 to 2014 relative to the average temperature from 1951 to 1980.



**Fig. 4.1**

Fig. 4.2 shows the global carbon emission from burning of fossil fuel from 1900 to 2014.



**Fig. 4.2**

(a) Comment on the trend observed for both global temperature records and global carbon emission from 1950s onwards.

- Temperature anomaly increased from -0.2°C to around +0.8°C while carbon emission increased from around 1500 million metric tons to just below 10000 million metric tons;
- Increase in carbon emission imply the increase in the greenhouse gas carbon dioxide;
- Increase greenhouse gas results in absorbing of more solar radiation / enhancing greenhouse effect causing temperature to rise;  
; for 1 mark, max 2 marks

.....  
.....  
.....

[2]

Changes in global temperature will have an impact on many other abiotic and biotic factors, one of them being sea levels.

(b) With reference to Fig. 4.1, account for how sea levels have been affected.

.....

- Rising temperatures have caused sea levels to rise;  
; for 1 mark
- Higher temperature causes melting of ice sheets, which adds fresh water to sea water;
- Higher temperature causes thermal expansion of water;
- Loss of ice sheets leads to less reflective surface, more heat absorbed by sea water which further accelerates melting of ice sheets;  
; for 1 mark

.....  
.....  
.....

[3]

Another factor that is impacted by changes in global temperature is the spread of mosquito borne diseases like Dengue fever (DF), caused by the dengue virus. Fig. 4.3 shows the number of reported DF cases globally from 1980 to 2002.

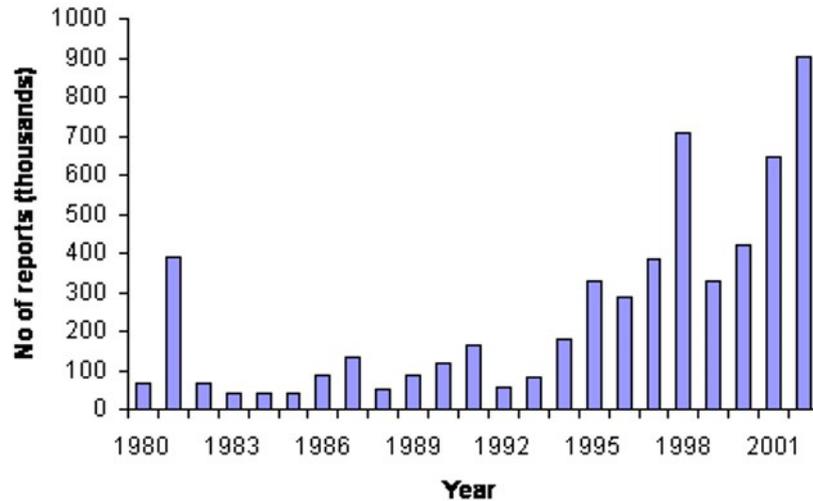


Fig. 4.3

(c) Explain how the data in Fig. 4.1 can account for the general trend observed in Fig. 4.3.

- Increased temperature, increased dengue fever cases;
  - Higher temperature leads to increased survival rate / less prone to predation / parasites and diseases of Aedes Mosquito;
  - Higher temperature leads to increased metabolism rate in Aedes Mosquito;
  - accelerates emergence of mosquitoes /shorter hatching time / life cycle shorten;
  - increasing mosquito population;
  - reduce extrinsic incubation period of virus in insect;
  - increasing the number of infective vector;
  - female mosquitoes digest blood faster and feed more frequently;
  - higher temperature may lead to increased precipitation, resulting in more breeding sites for mosquitoes;
  - Expand towards higher latitudes;
- ; for 1 mark, max 3 marks

[3]

The Intergovernmental Panel on Climate Change (IPCC) has made predictions on future global surface temperature based on past trends and existing data. If no actions are done, the trend observed in Fig. 4.1 can be expected to continue.

(d) Assuming if the trend in Fig. 4.1 continues, predict how dengue would spread in the future.

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>• Global surface temperature is predicted to continue to increase, causing areas <u>outside of the tropics to get warmer</u>;</li> <li>• Mosquitoes would spread to areas outside of the tropics, as such diseases like dengue would also <u>spread beyond the tropics / towards to poles</u>;</li> <li>• Lower altitudes may get too hot, causing mosquitoes to spread to cooler <u>higher altitudes</u>;</li> <li>• AVP<br/>; for 1 mark</li> </ul> | <p>.....</p> <p>.....</p> <p>.....</p> |
|--|--|

.....[2]

**[Total: 10]**



**(b)** Suggest one limitation of using fossil records in evolutionary studies.

.. Fossil specimens may not be identified correctly; .. Age of specimens may not be accurate; .. Fossils may be incomplete; .. for 1 mark, max is 1 marks	..... .....[1]
--	-------------------

We would expect natural selection to eliminate genetic variations with negative effects from human population. However, the study on human genetics reveals that several recessive alleles that are known to cause diseases have been preserved in human populations.

For instance, the sickle-cell allele is carried by half the people in some areas of Africa. This distribution seems to result from the counterbalancing effects of anaemia and malaria, a disease that formally cause high death rates in equatorial Africa.

**(c)** Account for the high frequency of sickle cell anaemia allele in the African populations.

<u>Heterozygous advantage:</u> Heterozygotes do not exhibit sickle cell anaemia / phenotypically normal; Heterozygous / sickle cell traits individuals are at <u>selective advantage</u> in malaria affected areas / more <u>resistant to malaria</u> ; Heterozygous individuals survive to reproduce and pass on the sickle cell allele to offspring; Hence <u>increasing the HbS allele frequencies</u> in the population within these malaria areas over time;  for 1 mark, max is 3 marks	..... ..... ..... ..... .....[3]
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**(d)** Explain why population is the smallest unit that can evolve.

Evolution takes place over <u>extended periods of time/many generations</u> through <u>adaptations/favourable characteristics</u> that are passed through the <u>reproduction</u> between individuals; Evolution is measured only as <u>change</u> in relative <u>proportions of variations / change in allele frequency</u> in a <u>population</u> over a succession of generations; <u>Natural selection</u> involves <u>interactions between individual</u> organisms and their <u>environment</u> ; <u>Variation</u> exists among individuals of a population; <u>Natural selection</u> favours the <u>survival and reproduction</u> of some individuals over others;  for 1 mark, max is 2 marks	..... ..... .....[2]
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**tal: 9]**

**Section B**

Answer **one** question.

Write your answers on the separate answer paper provided.

Your answers should be illustrated by large, clearly labelled diagrams, where appropriate.

Your answers must be in continuous prose, where appropriate.

Your answers must be set out in sections **(a)**, **(b)** etc., as indicated in the question.

1.

**(a)** Compare aerobic and anaerobic respiration in animals. **[7]**

**(b)** Both Darwin and Wallace independently came up with the theory of evolution by natural selection. They concluded that organisms had to struggle for survival, and that each subsequent generation slowly became better adapted to the environment.

Using named example, explain how environmental factors act as forces of natural selection. **[8]**

**[Total: 15]**

2.

**(a)** Contrast between stem cells and cancer cells. **[6]**

**(b)** Based on data collected over the years on weather patterns and greenhouse gas emissions, researchers have concluded a causal relationship between greenhouse gas emission and enhanced global warming. Biotic factors like coral reefs are sensitive and vulnerable to changes in climate.

Discuss how weather patterns would be affected and the consequences of such changes, along with how corals reefs are impacted by enhanced global warming. **[9]**

**[Total: 15]**

**End of Paper**

1.

**(a) Compare aerobic and anaerobic respiration in animals.****[7]**

Similarities:

- [Purpose] Both serve to generate energy in terms of ATP molecules to sustain energy-requiring activities;
- [Common process] Glycolysis is common to both, whereby glucose is broken down into pyruvate, giving rise to a net gain of 2 ATP molecules, and producing 2 NADH molecules as well in the cytoplasm;
- [Involvement of hydrogen acceptor] Both needs NAD<sup>+</sup> as a hydrogen acceptor / co-enzyme for dehydrogenase to complete dehydrogenation reactions in glycolysis;
- [Regeneration of NAD<sup>+</sup>] Both have a process to regenerate the hydrogen acceptor NAD<sup>+</sup> to support further glycolysis (can also put this as a difference: describe the mechanism involved in regenerating NAD<sup>+</sup>);
- Both only harvest a portion of the chemical energy stored in glucose molecule, with a large amount of energy lost as heat;
- AVP

; for 1 mark, max 5 marks

Differences:

Feature	Aerobic respiration	Anaerobic respiration
Location	In cytoplasm and mitochondria	Only in cytoplasm
Hydrogen acceptor	NAD <sup>+</sup> and FAD	Only NAD <sup>+</sup>
Stages involved in generating ATP	Glycolysis, link reaction, Krebs cycle and oxidative phosphorylation	Only glycolysis and fermentation
Mechanism of ATP synthesis	Direct ATP synthesis via Substrate level phosphorylation during glycolysis and krebs cycle; Oxidative phosphorylation through electron transport chain and chemiosmosis.	Only substrate-level phosphorylation during glycolysis
Number of ATP synthesized per glucose molecule	38 (4 via substrate-level phosphorylation and 34 via oxidative phosphorylation)	Only 2 via substrate-level phosphorylation
Final products	CO <sub>2</sub> , ATP, H <sub>2</sub> O	Lactate, ATP
Type of chemical reactions involved in breaking down glucose	Dehydrogenation, Oxidative decarboxylation,	Only dehydrogenation
Mechanism where hydrogen acceptor is regenerated	Via electron transport chain during oxidative phosphorylation, whereby NADH and FADH <sub>2</sub> donate the electrons and protons to the electron carriers	Via reduction reaction (pyruvate to lactate) during fermentation
Involvement of O <sub>2</sub>	Yes, as the final electron acceptor in the ETC (Reject: just 'Yes' without elaboration)	No.

; for 1 mark, max 5 marks

**(b) Using named example, explain how environmental factors act as forces of natural selection.****[8]****Example 1**

- Industrial melanism in Britain/United Kingdom;
- Before the industrial revolution, light-coloured peppered moths dominated the moth population with the dark coloured/melanic moths being largely uncommon;
- Since the light-coloured peppered moths are extremely well camouflaged as its colouration merges with the pale lichens on trees;
- Light-coloured moths can better hide/escape from predators and are selected for to survive and reproduced;
- However, after industrial revolution, it was recorded that most of the moth population were dark coloured/melanic moths;

; for 1 mark, max is 3 marks

- During the industrial revolution, pollution from the burning coal killed off the lichens growing on trees in industrial areas, exposing the darker bark, which was further darkened by soot deposits;
- Therefore, light-coloured peppered moths are no longer as well camouflaged, and it became very conspicuous/obvious to its predators (name one predator) when they rest on the trunks of trees;
- OR
- The dark coloured/melanic form is in turn, now well camouflaged against the dark tree barks;
- This result in the predators (name one example), which acts as the selection pressure, select against the light-coloured peppered moth;

- It reduces the frequency/number of light-coloured peppered moth but increases the dark coloured/melanic form in polluted areas and vice versa for non-polluted areas/OWTTE;
- ; for 1 mark, max is 4 marks

**Example 2**

- The finches living on the Galapagos Islands;
  - Each island had its own kind of finch (14 in all), found nowhere else in the world/OWTTE;
  - The finches are closely related species arising from a common ancestor;
  - Adaptive radiation led to the formation of so many species;
- ; for 1 mark, max is 2 marks
- Each of which specialises in eating a different type of food/diet;
  - There were 3 main groups, ground, warbler, and tree finches, classified according to their beak sizes;
  - This diversification into different ecological niches, is thought to be necessary to permit the coexistence of different species;
  - In different parts of the Galapagos Islands, different types of beak sizes dominate/OWTTE;
  - In this case, the different types of food available act as the selection pressure;
  - Selecting for a particular beak size that favours adaptation and survival in a particular environment with a certain available type of food;
- : for 1 mark, max is 3 marks
- *Name two examples of beaks:*
  - Some had large and heavy beaks adapted for eating large seeds, others for small seeds;
  - Some had parrot-like beaks for feeding on buds and fruits;
  - Some had long and slender/thin beaks for feeding on small insects;
- ; for 1 mark, max is 2 marks

QWC:

Student's chosen example correctly identifies the selection pressure, selective advantage / disadvantage and outcome of natural selection

2.

(a) Contrast between stem cells and cancer cells.

[6]

1. Unlike stem cells, cancer cells do not differentiate;
2. Cancer cells divide indefinitely/ uncontrollably / do not respond to anti-growth signals while stem cell division is determined by molecular signals [that either stimulates cell division or stop it];
3. Cancer cells have self-sufficiency of growth signals, whereas stem cells relies on external growth signals;
4. Cancer cells experience no contact inhibition and is invasive while stem cells experience contact inhibition;
5. Cancer cells have abnormal morphology, whereas stem cells have more regular morphology;
6. Cancer cells metastasize (dislodge from original tumour and form secondary tumours) while stem cells remain in tissue of origin;
7. Cancer cells are able to signal for angiogenesis while stem cells do not;
8. Cancer cells have accumulated loss of function mutation in tumour suppressor genes and gain of function mutations converting proto-oncogenes to oncogenes;
9. Genome of cancer cells are unstable, there is high tendency of genome alteration / mutations where as stem cells have relatively more stable genomes, with mutations occurring at a much lower rate;
10. Cancer cells expresses high levels of telomerase activity whereas only zygotic/totipotent/embryonic/pluripotent expresses high levels of telomerase;
11. Stem cells responds to signal for programmed cell death / apoptosis, whereas cancer cells do not respond / avoids programmed cell death / apoptosis;  
AVP;  
; for 1 mark

(b) Based on data collected over the years on weather patterns and greenhouse gas emissions, researchers have concluded a causal relationship between greenhouse gas emission and enhanced global warming. Biotic factors like coral reefs are sensitive and vulnerable to changes in climate.

Discuss how weather patterns would be affected and the consequences of such changes, along with how corals reefs are impacted by enhanced global warming.

[9]

Weather patterns

1. A warmer climate creates an atmosphere that can collect / retain / drop more water, changing weather patterns;
2. This causes wet areas to become wetter / dry areas become drier;
3. This can lead to heat waves / heavy rain;
4. Heatwaves associated with low humidity may result in wildfire;
5. Heavy rain increases the amount of runoff into rivers and lakes, washing sediment, nutrients, pollutants, trash, animal waste, and other materials into water supplies (any 2), making them unusable/ unsafe/ need of water treatment;
6. Increase rainfall leads to increase breeding sites for mosquitoes, which would lead to an increase in mosquito-borne diseases like dengue;

; for 1 mark, min 2 marks

Coral reefs

7. Heat stress can cause coral bleaching;
8. This is because at higher temperatures, zooxanthellae photosynthesis is disrupted / zooxanthellae produce more toxic compounds;
9. Toxic compounds damages metabolism of coral poly which expels the zooxanthellae, leaving the coral skeleton a stark, "bleached" white;
10. Zooxanthellae and corals have a symbiotic relationship, where zooxanthellae provide corals with food;
11. If temperatures remain above the bleaching threshold for prolonged periods of time, corals will eventually die from starvation and disease /OWTTE;
12. Increase in atmospheric CO<sub>2</sub> cause more CO<sub>2</sub> to be dissolved in the ocean, decreasing the pH,/ resulting in ocean acidification;
13. Ocean acidification affects hard corals as they cannot absorb the calcium carbonate to maintain their skeletons / the stony skeletons that support corals will dissolve;

; for 1 mark, max 6 marks

QWC:

Student's answer cover at least 2 points from each section.

[Total: 15]