

NANYANG JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 1

CANDIDATE
NAME

CLASS

BIOLOGY

8876/01

Paper 1 Multiple Choice

25 September 2018

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name and CT on the Answer Sheet in the spaces provided unless this has been done for you.

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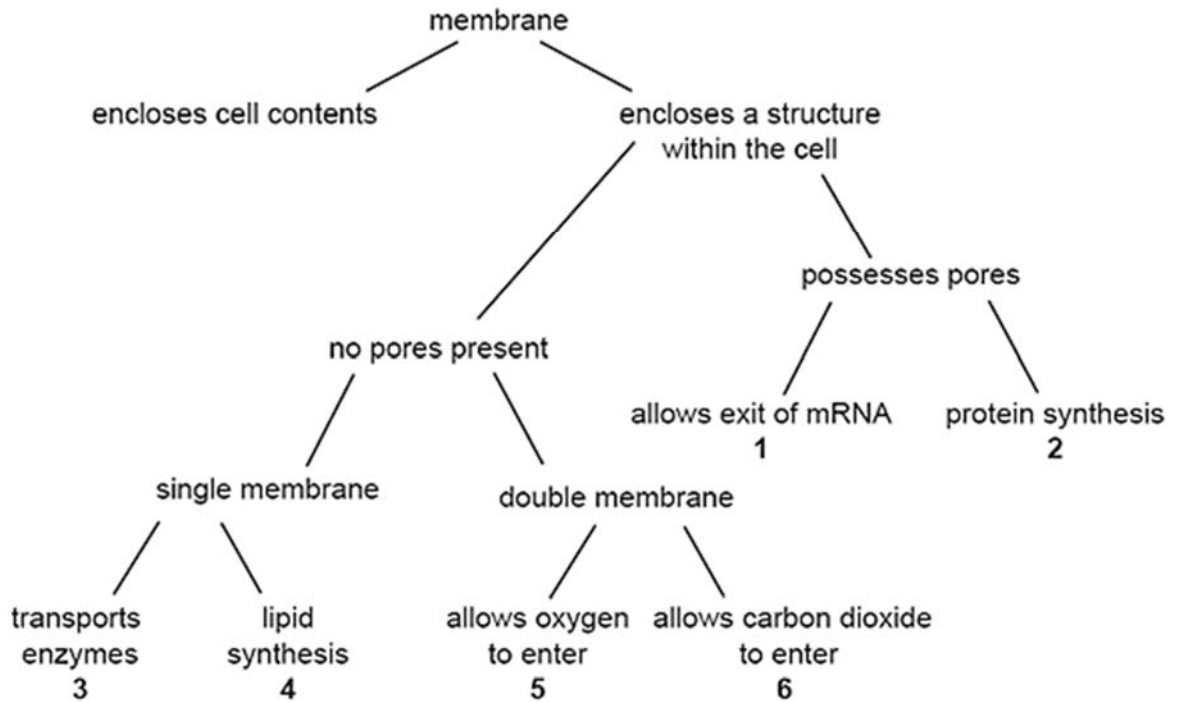
Calculators may be used.

This document consists of **20** printed pages and **0** blank page.

[Turn over

1 Membranes within and at the surface of cells have different roles.

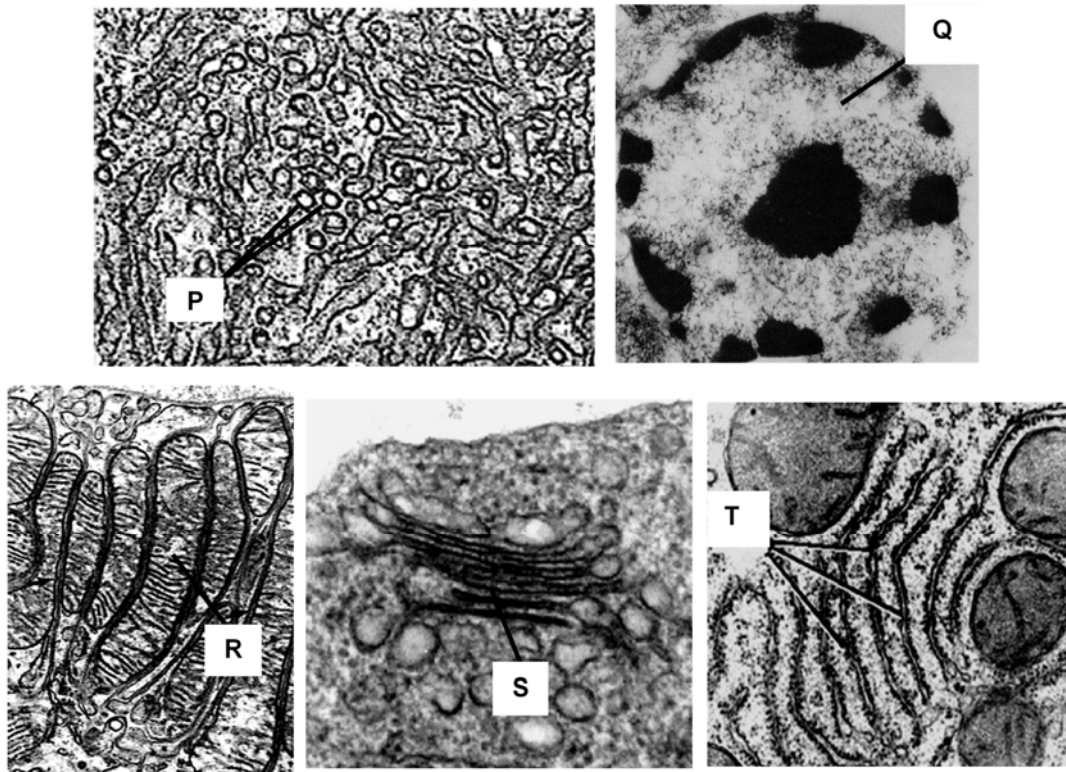
The diagram allows the identification of the various organelles within the cell, by describing the membrane structure and function.



Which of the outcomes shown below correctly identifies the organelles that possess the membrane and function concerned?

	1	2	3	4	5	6
A	nucleus	ribosome	vesicle	smooth ER	mitochondrion	chloroplast
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2 The following electron micrographs show various organelles **P** to **T** present in a liver cell.



Radioactive amino acids are supplied to the liver cell to synthesise insulin receptors.

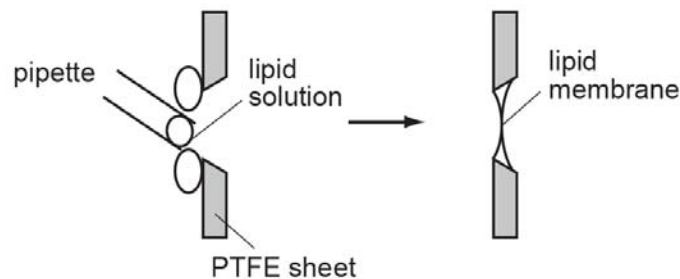
Which sequence shows the correct order in which these amino acids would be detected in the organelles during the synthesis of insulin receptors?

- A Q → T → R → P → S
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- 3 A symbiont may be defined as a species in which individuals live in a long-term, intimate and beneficial relationship with hosts of a different species. As the name suggests, endosymbionts live within their hosts.

Which statement provides evidence that mitochondria and chloroplasts are endosymbionts?

- A Proteins encoded by the nucleus are exported to these organelles.
 - B Their inner membrane has different structure from other intracellular membranes.
 - C They are surrounded by double membrane.
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Such a lipid membrane is impermeable to water soluble materials including charged ions such as Na^+ or K^+ .

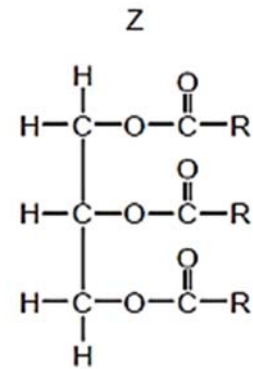
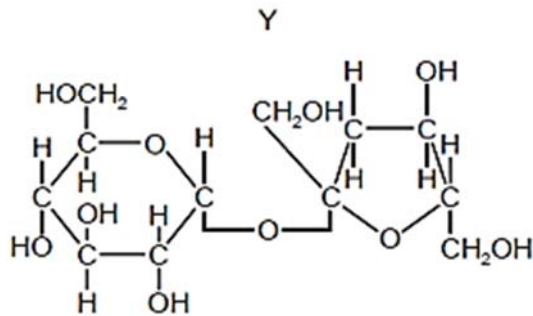
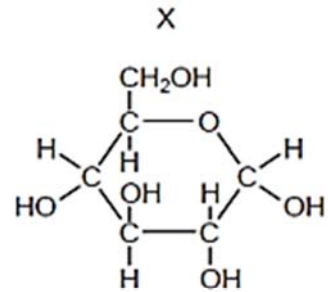
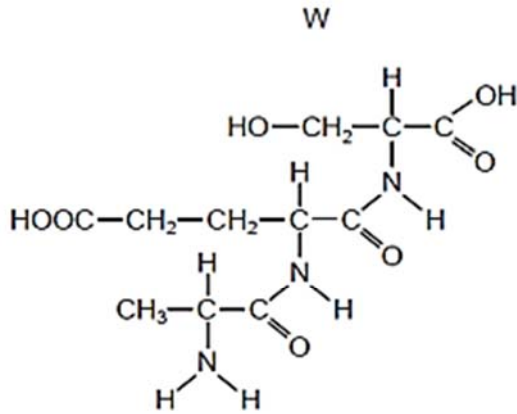
In one experiment with Na^+ ions, no current flowed across the membrane until a substance called gramicidin was added to the membrane, at which time current flowed.

What kind of molecule is gramicidin?

- A A carbohydrate molecule found only on the outside of the membrane.
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- 5 Samples of a mixture of biological molecules were tested using Benedict's reagent, biuret solution and ethanol. After testing, the solutions were blue with Benedict's reagent, purple with biuret solution and cloudy with ethanol emulsion test.

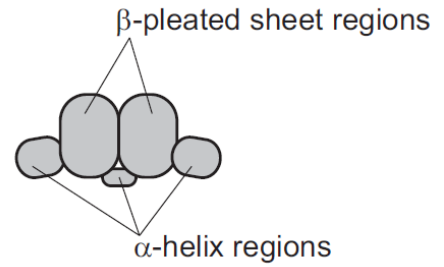
Which molecules could the mixture contain?



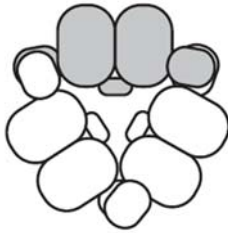
- A W, X and Y
 B W, X and Z
 C W, Y and Z
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6 Approximately half of the total protein in a pea seed consists of the storage protein vicilin.

- Each molecule of vicilin is made up of three identical polypeptides.
- Each polypeptide is made up of two β -pleated sheet regions with linking α -helix regions, folded into the shape shown to the right.



- This allows the three polypeptides to pack together into a compact, flat storage molecule, as shown below.

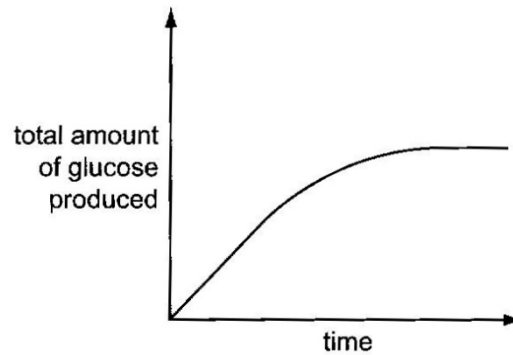


Which row correctly describes the structure of vicilin?

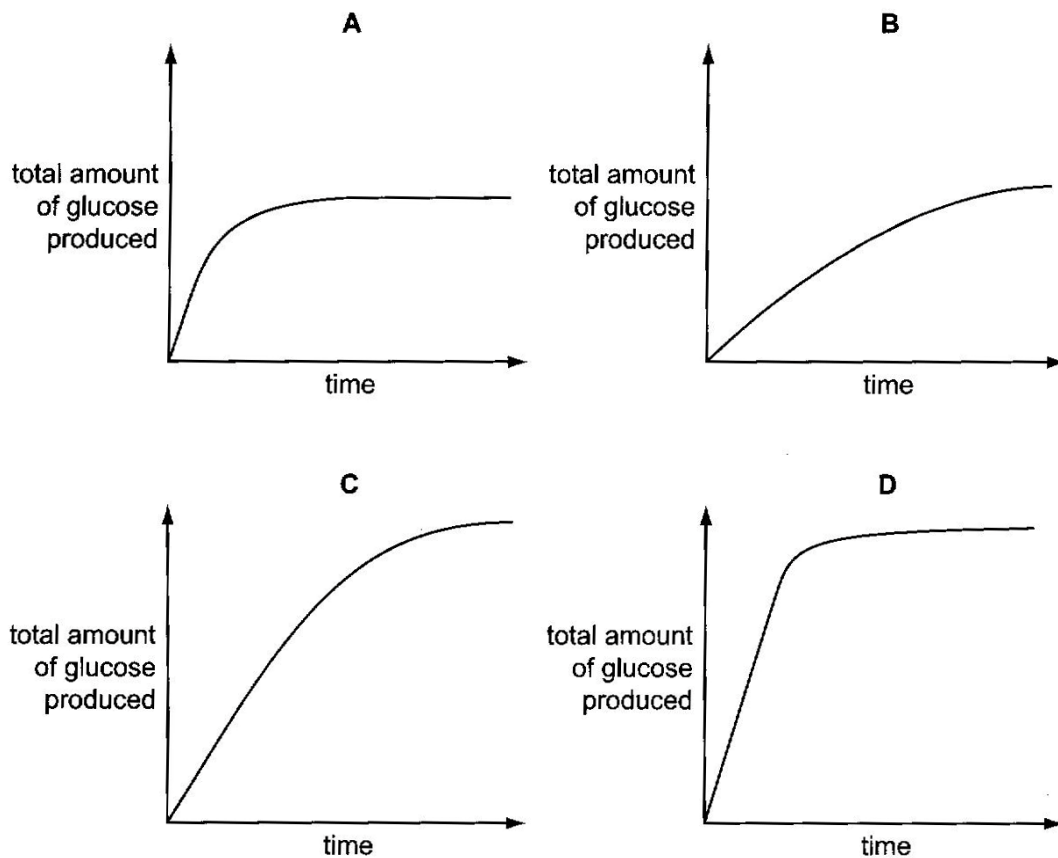
	primary structure	secondary structure	tertiary structure	quaternary structure
A	amino acid sequence of one polypeptide	α -helix and β -pleated sheet regions of each polypeptide	association of three polypeptides	folding of each polypeptide
B	amino acid sequence of one polypeptide	α -helix and β -pleated sheet regions of each polypeptide	folding of each polypeptide	association of three polypeptides
C	association of three polypeptides	amino acid sequence of one polypeptide	α -helix and β -pleated sheet regions of each polypeptide	folding of each polypeptide
D	association of three polypeptides	amino acid sequence of one polypeptide	folding of each polypeptide	α -helix and β -pleated sheet regions of each polypeptide

- 7 Lactose is a disaccharide present in milk. The enzyme β -galactosidase catalyses the conversion of lactose to glucose and galactose.

10 cm³ of a 1% β -galactosidase solution was added to 10 cm³ of milk. The graph shows the total amount of glucose produced over the next ten minutes.



Then, 10 cm³ of a 2% β -galactosidase solution was added to 10 cm³ of milk. Which graph shows the results that would be obtained?



- 8** Serine proteases, such as chymotrypsin and trypsin, are enzymes that cleave peptide bonds in proteins. Three specific amino acids (aspartic acid, histidine, serine) arranged in a special alignment, are found conserved in all serine proteases. This conserved alignment is often referred to as "the catalytic triad". At the active site, scientists also found a variable region between different members in this class of enzymes.

Which feature allows different serine proteases to bind to different substrates?

- A** Different R-group properties of amino acids lining the variable region
 - B** Specific spatial arrangement of aspartic acid, histidine, and serine at the active site
 - C** Presence of a specific cofactor required for catalysis
 - D** Different R-group properties of amino acids in the catalytic triad
- 9** Some RNA molecules, called ribozymes, can catalyse reactions in a similar way to protein enzymes. Most of these ribozymes have other RNA molecules as their substrates and catalyse reactions that break specific sugar phosphate bonds in the substrate molecules.

Which statements about these ribozymes are correct?

- 1** Hydrogen, ionic and disulfide bonds will be involved in the ribozyme structure.
- 2** The active site of a ribozyme is formed from a specific sequence of nucleotides
- 3** Ribozymes can form because RNA can have a specific secondary and tertiary structure.

- A** 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

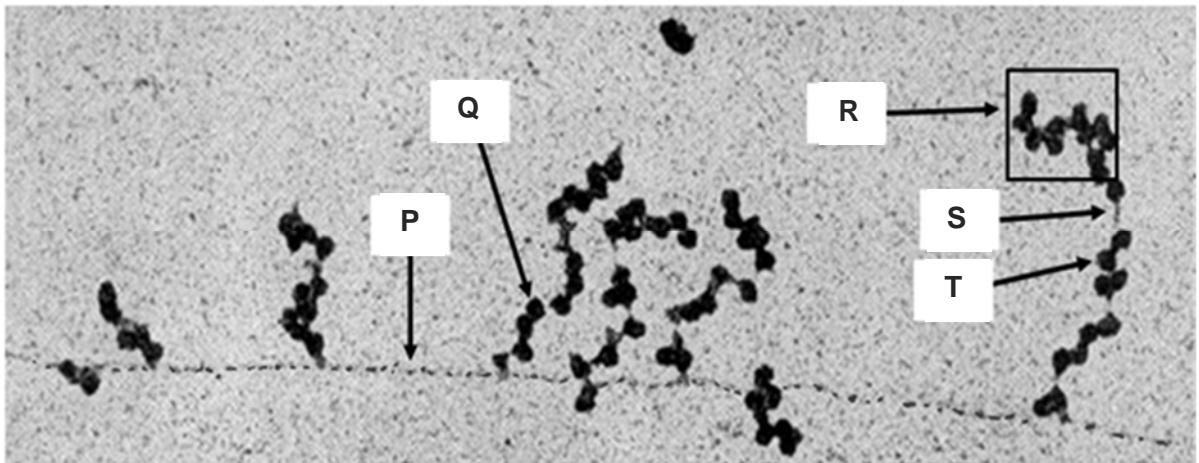
- 10** What is the role of stem cells with regards to the function of adult tissues and organs?

- A** Stem cells are fully differentiated cells that reside under the surface of epithelial tissue, in position to take over the function of the tissue when the overlying cells become damaged or worn out
- B** Stem cells are totipotent cells that divide asymmetrically, giving rise to one daughter cell that remains a stem cell and one daughter cell that will differentiate to replace damaged and worn out cells in the adult tissue or organ.
- C** Stem cells are embryonic cells that persist in the adult, and can give rise to all of the cell types in the body.
- D** Stem cells are cells that have yet to express the genes and produce proteins characteristic of their differentiated state, but do so when needed for repair of tissues and organs.

- 11 The table below shows the percentage of nitrogenous base in four samples of nucleic acids. Which base is adenine?

Sample	Bases				
	A	B	C	D	Uracil
1	19	31	30	19	Nil
2	27	23	24	26	Nil
3	25	25	Nil	25	25
4	17	32	33	18	Nil

- 12 The electron micrograph shows 5 structural components **P**, **Q**, **R**, **S** and **T** involved in the expression of a particular gene in a prokaryotic cell.



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

- 1 RNA polymerase adds incoming nucleotides to form **P**.
 - 2 The products synthesized by **Q** and **T** are identical.
 - 3 Structure **R** can also be found in eukaryotes.
 - 4 **T** is involved in forming **S**.
- A** 3 only
B 2 and 3 only
C 1, 2 and 4 only
D All of the above

- 13** In a genetic engineering experiment, a piece of double-stranded DNA containing 6000 nucleotides is transcribed and translated into a polypeptide consisting of amino acids of fifteen different kinds.

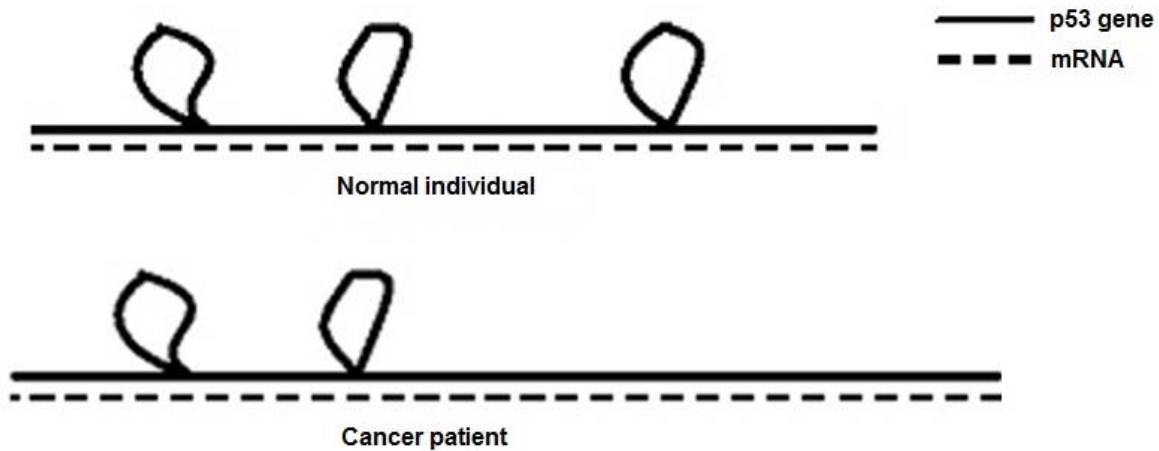
What is the total number of amino acids used and the theoretical minimum number of different tRNA molecules required to translate the mRNA for this peptide?

- A** 500 amino acids and 20 different tRNA
- B** 1000 amino acids and 15 different tRNA
- C** 2000 amino acids and 20 different tRNA
- D** 3000 amino acids and 15 different tRNA

- 14** Which of the following shows the possible effects of a single nucleotide substitution in each of the following locations in a gene, on the production of the protein it codes for?

	Promoter	Transcription terminator	Start codon	Stop codon	Middle of an intron
A	No protein product is produced	Protein product is shorter than normal	Protein product is longer than normal	Protein product is normal	Too much protein product is produced
B	Too much protein product is produced	Protein product is normal	No protein product is produced	Protein product is longer than normal	Protein product is normal
C	Protein product is normal	Protein product is longer than normal	Protein product is shorter than normal	Too much protein product is produced	Protein product is longer than normal
D	Protein product is longer than normal	Too much protein product is produced	Protein product is normal	Protein product is shorter than normal	No protein product is produced

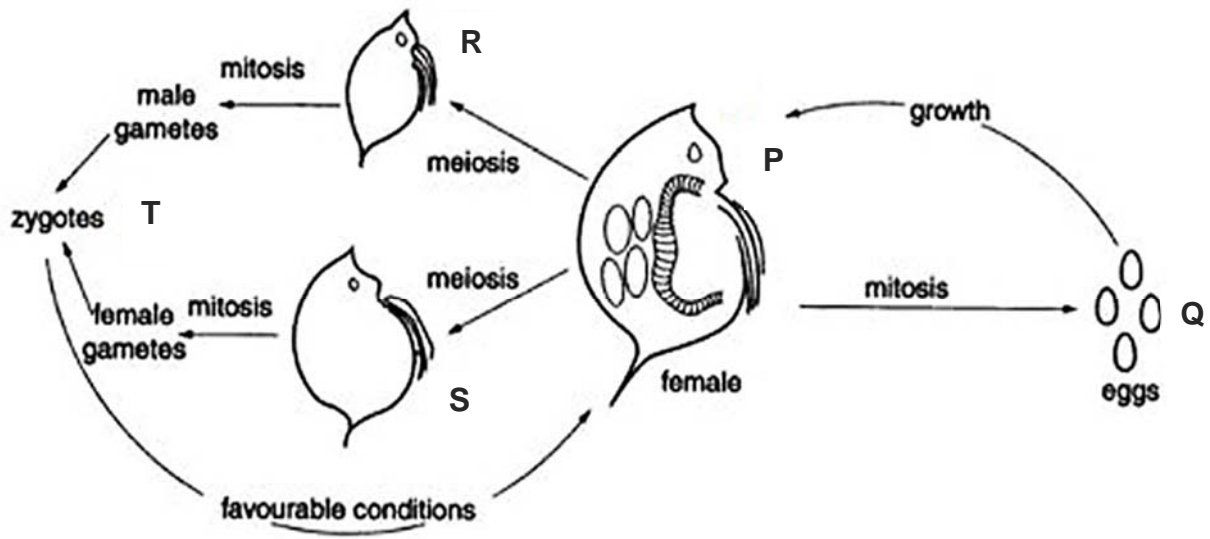
- 15 mRNA was isolated from a normal individual and a patient suffering from cancer. The mRNA was allowed to hybridise with the *p53* gene. The schematic diagram shows the results of the hybridisation process under the electron microscope.



Which of the following could be a possible explanation why the patient is suffering from cancer?

- A A point mutation had occurred in the intron leading to the failure to excise one intron, hence leading to a longer dysfunctional protein being translated.
- B A point mutation had occurred in the intron leading to an exon being excised, hence leading to a shorter dysfunctional protein being translated.
- C A point mutation had occurred leading to the failure of spliceosome to recognise splice sites leading to the excision of the wrong intron, leading to a dysfunctional protein being translated.
- D Gene amplification had occurred leading to the multiple copies of a trinucleotide repeat in an intron, hence causing splice site to be misread due to frameshift mutation, leading to a longer dysfunctional protein being translated.

- 16 The figure shows the life cycle of the water flea, *Daphnia*. The cells of individual **R** contain 10 chromosomes.



Which of the following are correct?

	Individual	Ploidy level	Number of chromosomes	Reason for choice
I	P	2n	20	The cells of P can undergo both mitosis and meiosis.
II	Q	2n	20	P produces eggs by mitosis which develop into females.
III	S	n	10	The gametic cells of P have undergone normal meiosis.
IV	T	2n	20	Random fertilisation of haploid gametes from R and S occurred to form zygote T.

- A I and II only
 B I and III only
 C II and IV only
 D All of the above

- 17** The cells of an organism contain six chromosomes, with an average of 18 units of DNA per chromosome.

The table below shows the results of measuring the amount of DNA in the cells of this organism at different stages of meiosis.

Which of the following shows the amount of DNA in the cell during anaphase I?

	Units of DNA per cell
A	36
B	54
C	108
D	216

- 18** Which pair of statements correctly describes how cellular DNA content and ploidy level change after meiosis I and meiosis II?

- A** Statement 1: Cellular DNA content is halved after both meiosis I and meiosis II.
Statement 2: Ploidy level changes from diploid to haploid only after meiosis II.
- B** Statement 1: Cellular DNA content is halved after both meiosis I and meiosis II.
Statement 2: Ploidy level changes from diploid to haploid after meiosis I, and remains haploid after meiosis II.
- C** Statement 1: Cellular DNA content is halved only after meiosis I.
Statement 2: Ploidy level changes from diploid to haploid only after meiosis II.
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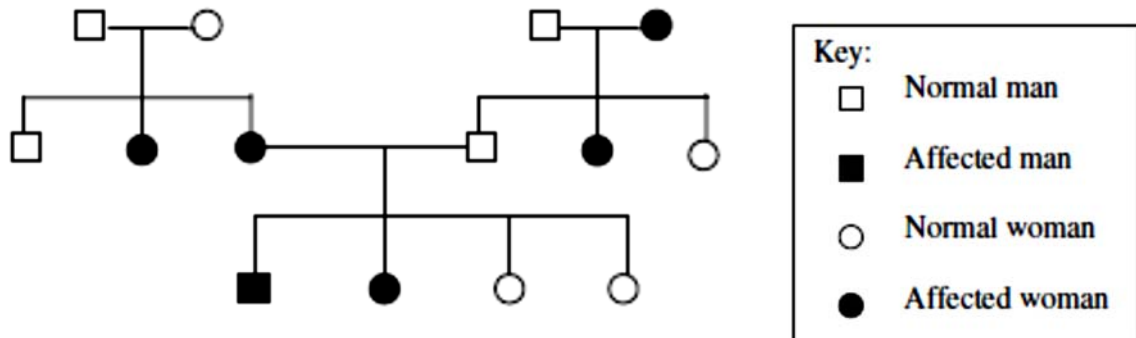
- 19** The sex chromosome combination XYY is found in a small proportion of men. Such a combination is possible if one contributory gamete to the zygote is

- A** a sperm produced by a father whose cells lack an X chromosome
- B** a sperm produced by non-disjunction at meiosis II
- C** an egg containing an X and a Y chromosome
- D** an egg produced by non-disjunction at meiosis I

- 20** A strain of toad has only one nucleolus in the nucleus of each cell instead of the usual two. When toads with one nucleolus per cell are mated, approximately a quarter of the offspring have two nucleoli per nucleus, half have one nucleolus per nucleus and a quarter have no nucleoli.

What is the most likely explanation of these results?

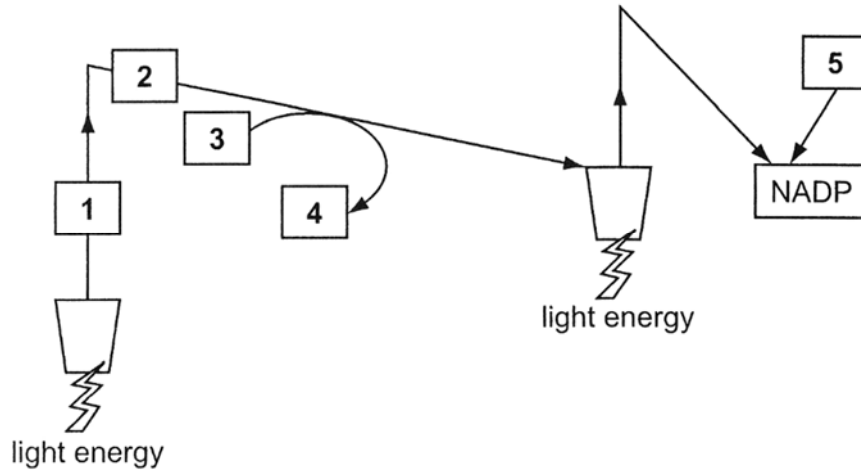
- A** The possession of one nucleolus is due to autosomal linkage.
B The possession of one nucleolus is due to the heterozygous condition.
C The allele for the presence of two nucleoli is recessive.
D The allele for the presence of two nucleoli is dominant.
- 21** The family tree shows the inheritance of a skin condition.



What is the genetic basis of the skin condition?

- A** autosomal dominant
B sex-linked dominant
C autosomal recessive
D sex-linked recessive
- 22** In birds, sex is determined by a ZW chromosome scheme. Males are ZZ and females are ZW. A recessive lethal allele that causes death of the embryo is sometimes present on the Z chromosome in pigeons. What would be the sex ratio in the offspring of a cross between a male that is heterozygous for the lethal allele and a normal female?
- A** 2:1 male to female
B 1:2 male to female
C 1:1 male to female
D 3:1 male to female

23 The diagram represents non-cyclic photophosphorylation.



Which reactants would be present at points 1, 2, 3, 4, and 5?

	1	2	3	4	5
A	Electrons	Electron carrier	ATP	ADP	Hydrogen molecules
B	Electron carrier	Electrons	ADP	ATP	Electrons
C	Electrons	Electron carrier	ADP	ATP	Hydrogen ions
D	Electron carrier	Electrons	ADP	ATP	Electrons and hydrogen ions

24 Dinitrophenol is a compound that can lodge within the thylakoid membranes of chloroplasts. Its presence provides an alternative route for H^+ ions to diffuse across the thylakoid membranes.

In what way would the Calvin cycle be affected in chloroplasts poisoned with dinitrophenol?

- A No effect since Calvin cycle is an enzyme-controlled process.
- B The rate of Calvin cycle would increase as pH in the stroma decreases.
- C The rate of Calvin cycle would decrease with the accumulation of glycerate-3-phosphate.
- D The rate of Calvin cycle would decrease with the accumulation of glyceraldehyde-3-phosphate

25 Six tubes were set up as shown in the table.

tube	contents
1	Glucose + homogenized plant cells
2	Glucose + mitochondria
3	Glucose + cytoplasm lacking organelles
4	Pyruvate + homogenized animal cells
5	Pyruvate + mitochondria
6	Pyruvate + cytoplasm lacking organelles

After incubation, each sample was analysed to determine the presence of carbon dioxide and ethanol.

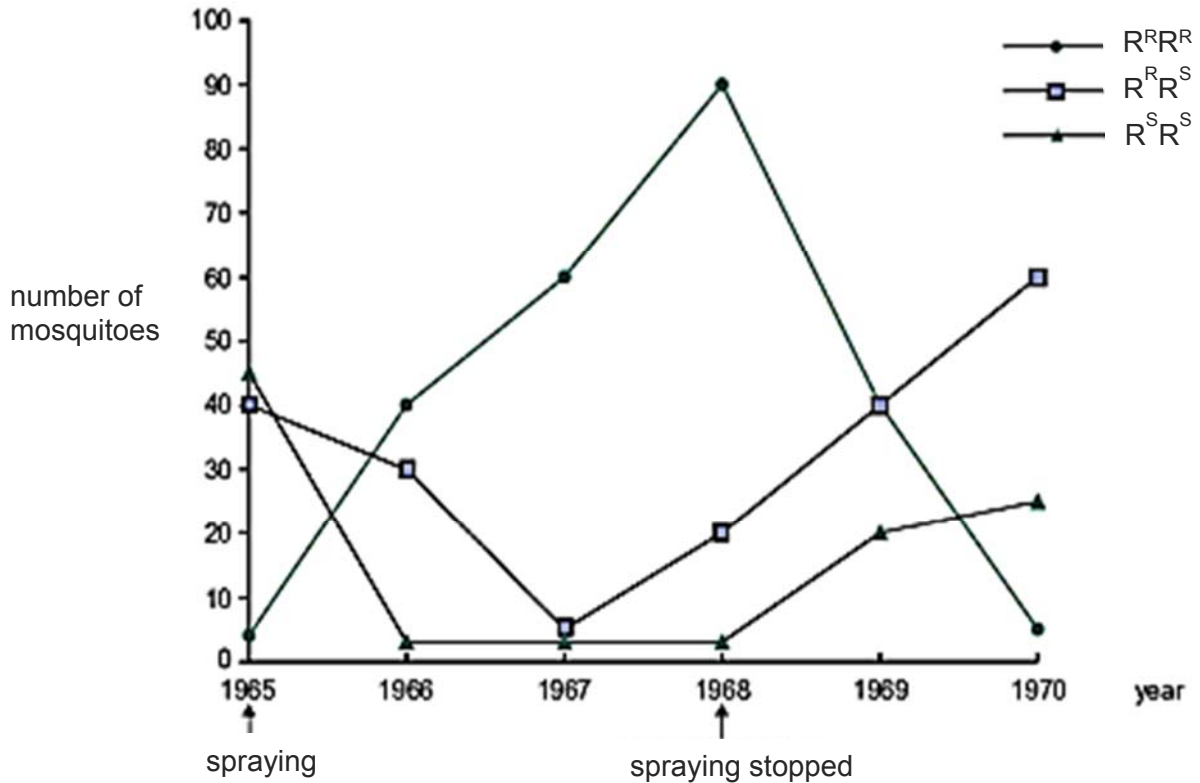
In which tube(s) is lactate most likely to be present?

- A 1 and 3 only
- B 2, 3, 5 and 6 only
- C 4, 5, and 6 only
- D 3 and 6 only

26 Which effect of natural selection is likely to lead to speciation?

- A Differences between populations are increased.
- B Favourable genotypes are maintained in the population.
- C Genetic diversity is reduced.
- D Selection pressure on some alleles reduces reproductive success.

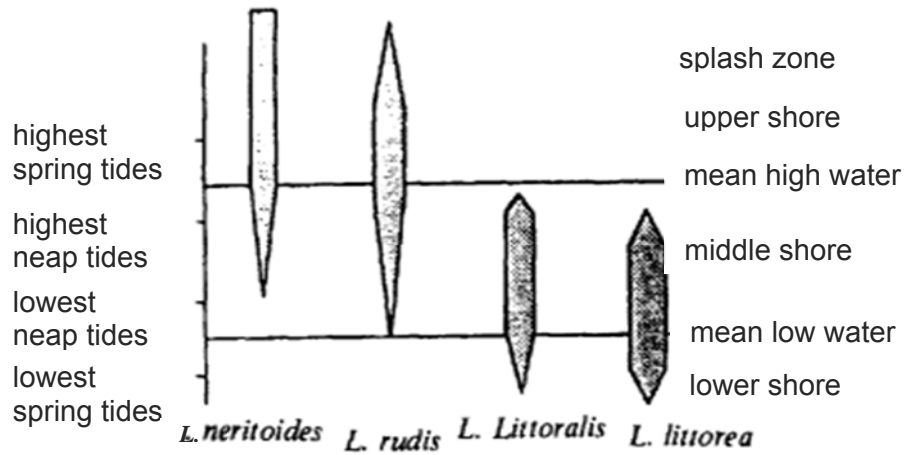
- 27 In the mosquito, there is a gene locus which has two alleles, R^R and R^S , involved in resistance to the insecticide DDT. R^R represents the allele for DDT resistance and R^S represents the allele for DDT sensitivity. The graph shows the number of mosquitoes of three genotypes collected from 1965, when DDT was first used, through to 1970, two years after the spraying of DDT stopped.



From the data, it is possible to conclude that

- A the frequency of the R^S allele is greater than the frequency of the R^R allele in 1968.
- B many generations after the removal of DDT, the R^R allele would disappear from the population.
- C after removal of DDT from the environment in 1968, having the $R^R R^R$ genotype reduces the chance of survival.
- D in the presence of DDT in the environment between 1967 and 1968, mosquitoes with the $R^R R^S$ genotype are most likely to survive.

- 28 The diagram below shows the frequency and distribution of four *Littorina* species on a rocky shore. All feed in a snail-like manner by grazing on algae.



spring tide: Refers to the 'springing forth' of the tide during new and full moon

neap tide: Happens seven days after a spring tide. Refers to a period of moderate tides when the sun and moon are at right angles to each other

Which one of the following factors could **not** directly contribute to this distribution pattern?

- A Variation in the tolerance of each species to desiccation
- B Competition between species for different feeding niches
- C The photoperiod and seasonal change in day length
- D The differential selection of *Littorina* by predators

- 29** Bacteria in the genus *Wolbachia* infect many butterfly species. They are passed from one generation to the next in eggs, but not in sperm, and they selectively kill developing male embryos.

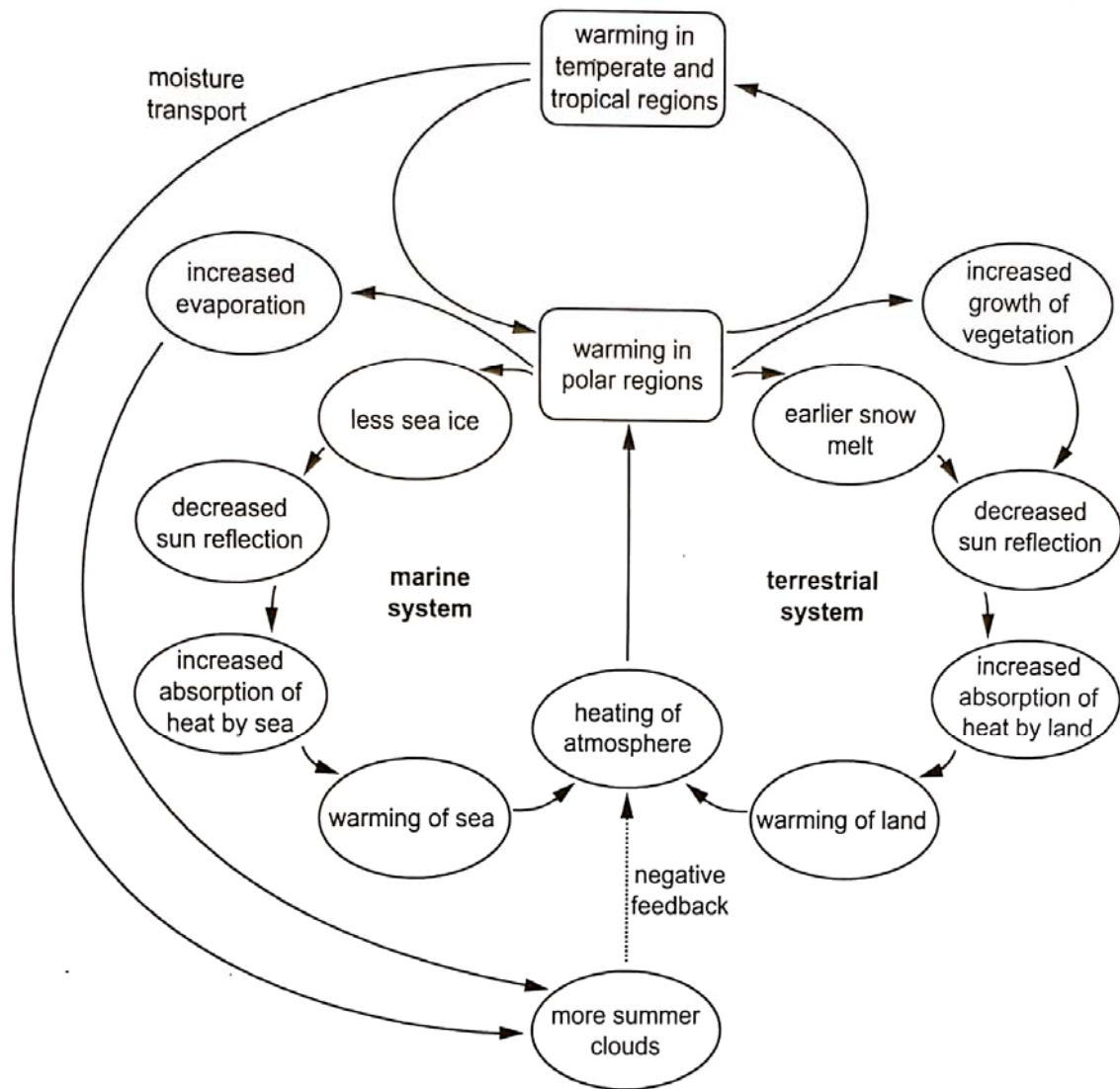
In Samoa in the 1960s, the proportion of male blue moon butterflies fell to less than 1% of the population. However, by 2006, the proportion of males was almost 50% of the population.

Resistance to *Wolbachia* is the result of the dominant allele of a suppressor gene.

Which statements correctly describe the evolution of resistance to *Wolbachia* in the blue moon butterfly population?

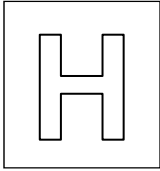
- 1 *Wolbachia* acts as a selective agent.
 - 2 The selective killing of male embryos is an example of artificial selection.
 - 3 When infected with *Wolbachia*, male embryos that are homozygous for the recessive allele of the suppressor gene die.
 - 4 All male embryos that carry the dominant allele of the suppressor gene pass that allele to their offspring.
 - 5 The frequency of the dominant allele of the suppressor gene rises in the butterfly population.
- A** 1 and 4 only
B 2 and 3 only
C 1, 3 and 5
D 2, 4 and 5

- 30 The diagram shows the effect of increasing temperatures on the ice and snow cover at the polar regions.



Which effect of higher temperatures in the polar regions could increase global warming?

- A Melting of ice and snow results in less reflection of sunlight and more heat absorption by the Earth.
- B Increased evaporation leads to more rainfall, which absorbs heat from the land and the sea.
- C Melting sea ice causes more cloud formation, which increases absorption of heat in the atmosphere.
- D Earlier melting of snow allows vegetation cover to increase faster, reducing loss of heat from the surface of the Earth.



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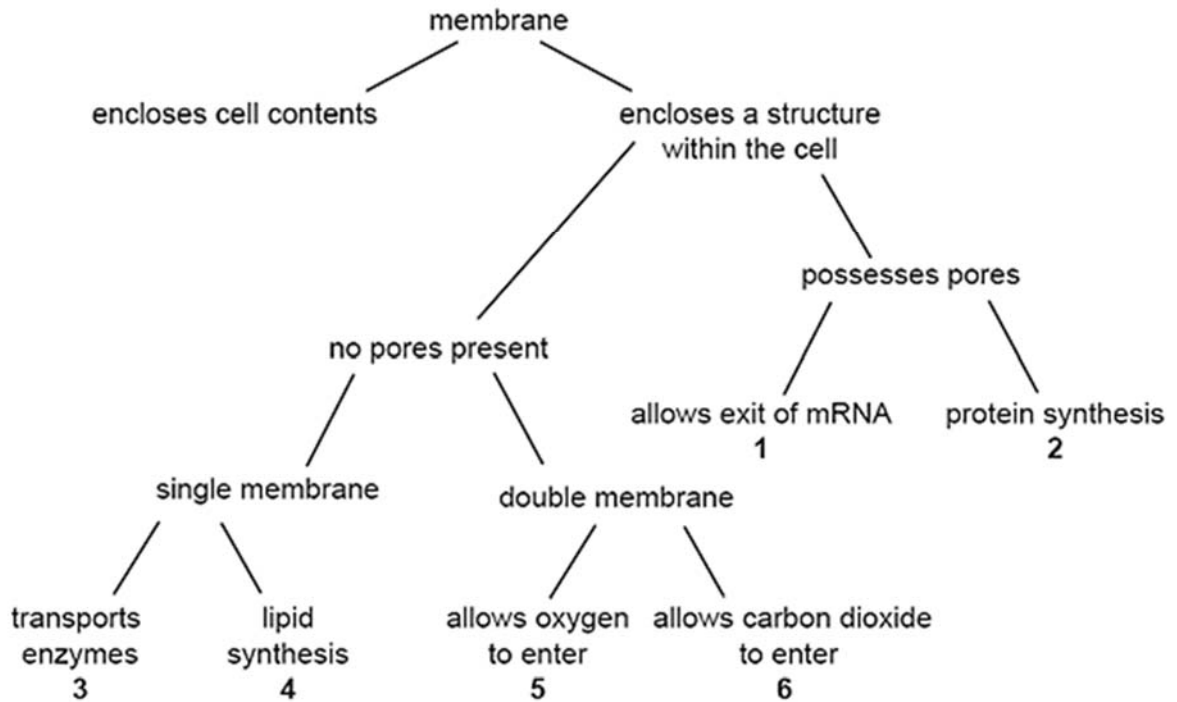
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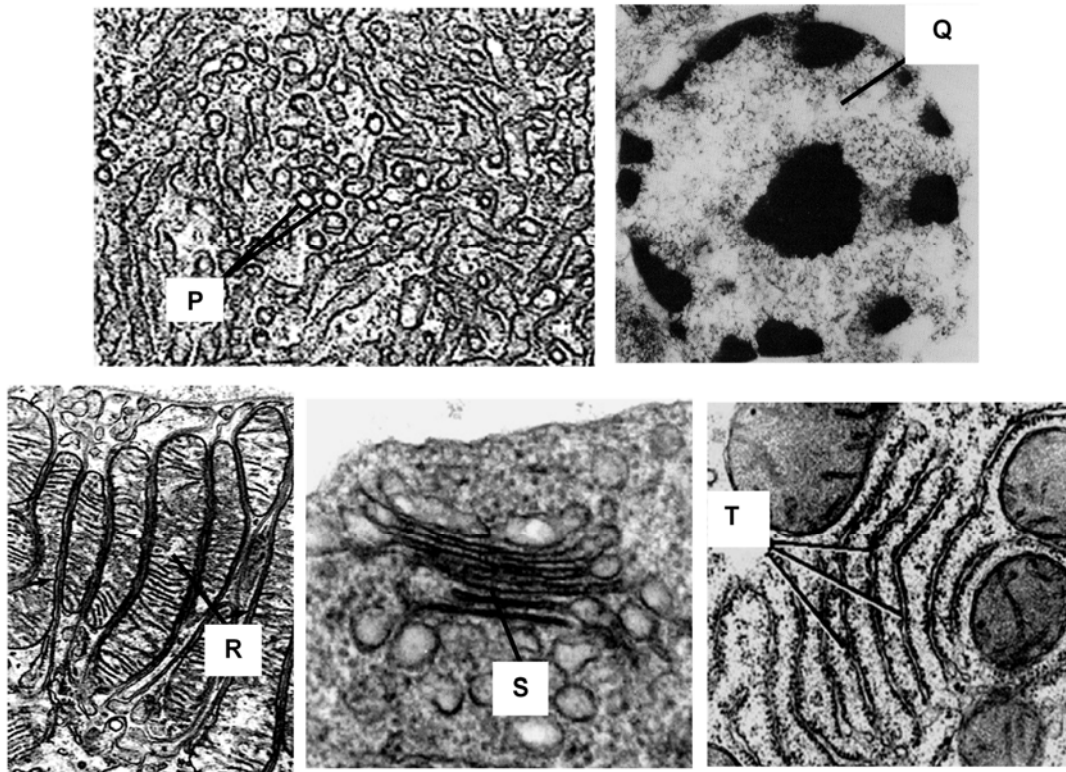
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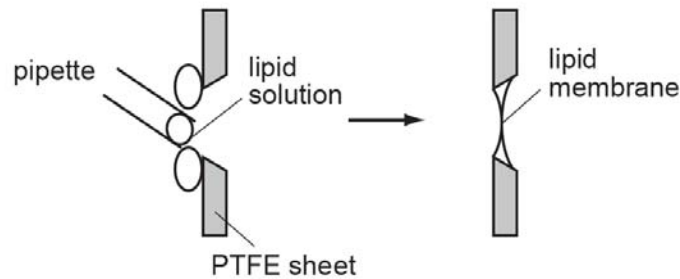
Which sequence shows the correct order in which these amino acids would be detected in the organelles during the synthesis of insulin receptors?

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Such a lipid membrane is impermeable to water soluble materials including charged ions such as Na^+ or K^+ .

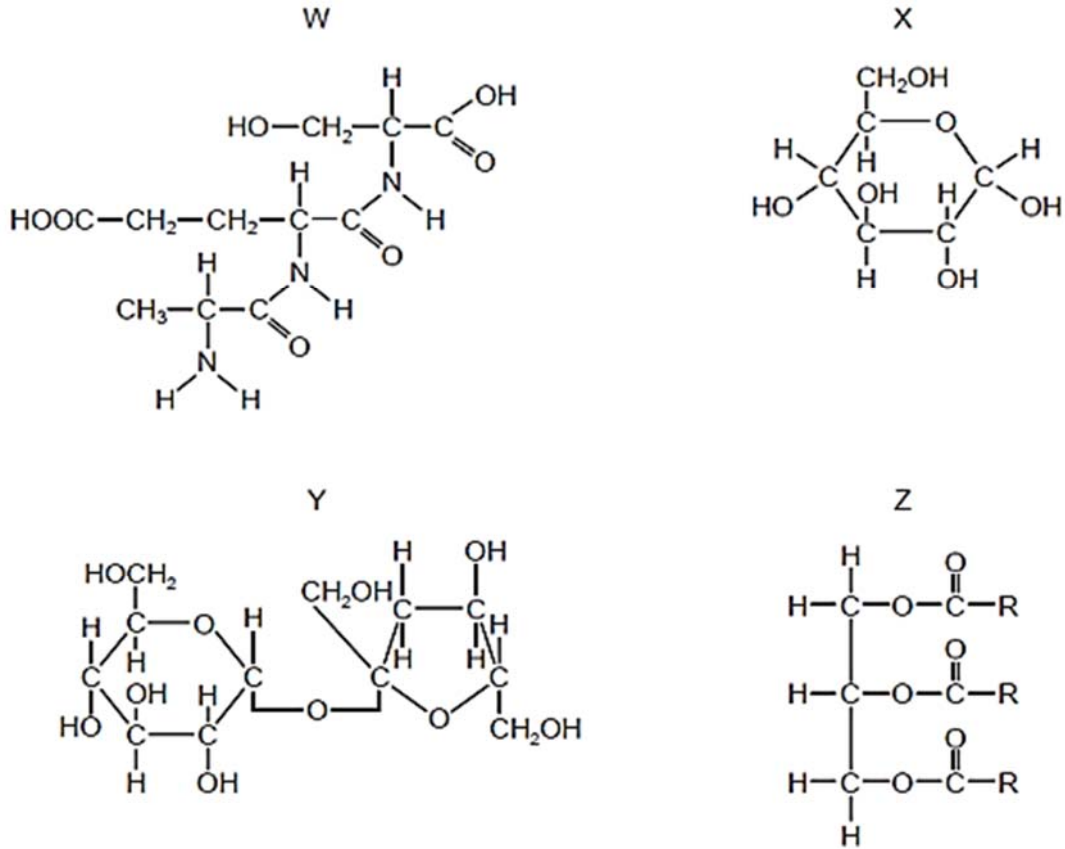
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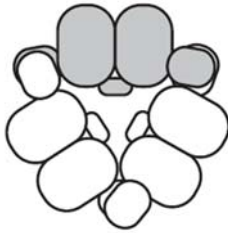
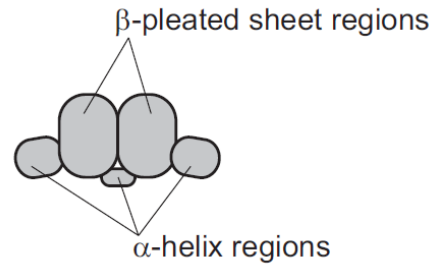
Which molecules could the mixture contain?



- A W, X and Y
 B W, X and Z
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- This allows the three polypeptides to pack together into a compact, flat storage molecule, as shown below.

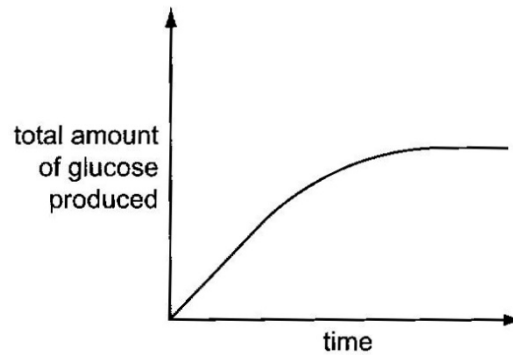


Which row correctly describes the structure of vicilin?

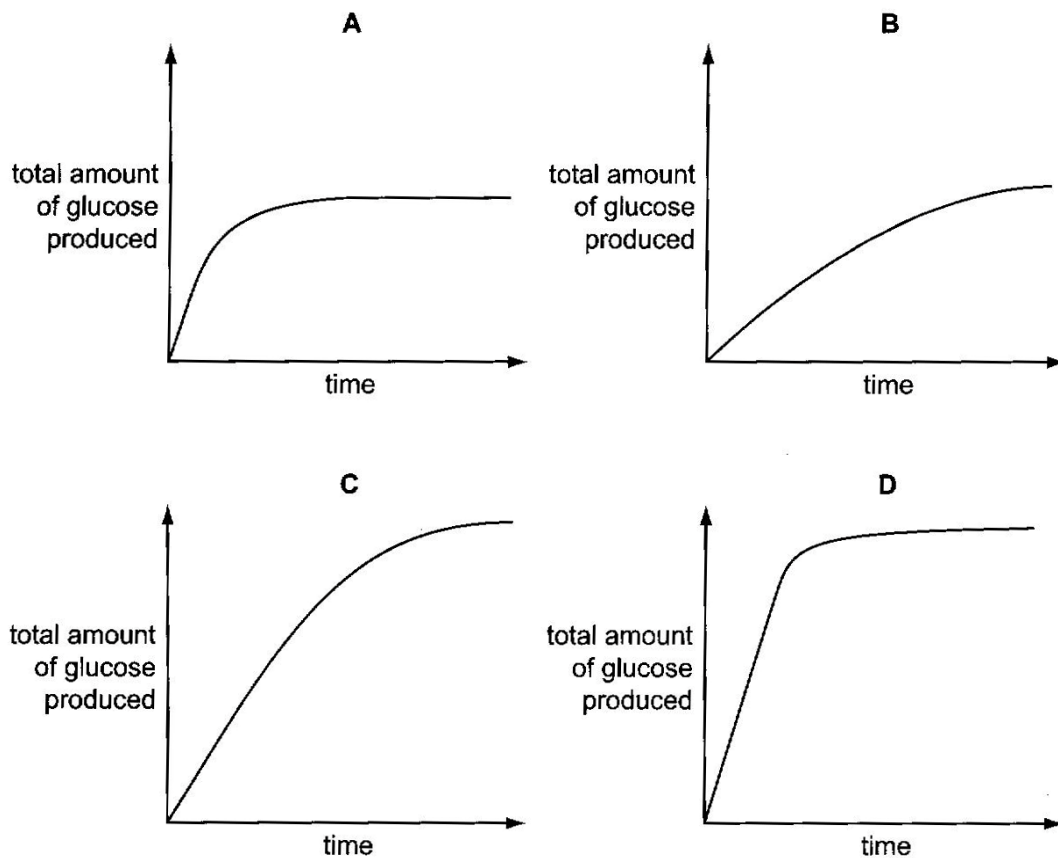
	primary structure	secondary structure	tertiary structure	quaternary structure
A	amino acid sequence of one polypeptide	α -helix and β -pleated sheet regions of each polypeptide	association of three polypeptides	folding of each polypeptide
B	amino acid sequence of one polypeptide	α -helix and β -pleated sheet regions of each polypeptide	folding of each polypeptide	association of three polypeptides
C	association of three polypeptides	amino acid sequence of one polypeptide	α -helix and β -pleated sheet regions of each polypeptide	folding of each polypeptide
D	association of three polypeptides	amino acid sequence of one polypeptide	folding of each polypeptide	α -helix and β -pleated sheet regions of each polypeptide

- 7 Lactose is a disaccharide present in milk. The enzyme β -galactosidase catalyses the conversion of lactose to glucose and galactose.

10 cm³ of a 1% β -galactosidase solution was added to 10 cm³ of milk. The graph shows the total amount of glucose produced over the next ten minutes.



Then, 10 cm³ of a 2% β -galactosidase solution was added to 10 cm³ of milk. Which graph shows the results that would be obtained? **AAAAAAAAAAAAAAAAAAAAAAAAA**



- 8 Serine proteases, such as chymotrypsin and trypsin, are enzymes that cleave peptide bonds in proteins. Three specific amino acids (aspartic acid, histidine, serine) arranged in a special alignment, are found conserved in all serine proteases. This conserved alignment is often referred to as "the catalytic triad". At the active site, scientists also found a variable region between different members in this class of enzymes.

Which feature allows different serine proteases to bind to different substrates?

- A** Different R-group properties of amino acids lining the variable region
- B** Specific spatial arrangement of aspartic acid, histidine, and serine at the active site
- C** Presence of a specific cofactor required for catalysis
- D** Different R-group properties of amino acids in the catalytic triad
- 9 Some RNA molecules, called ribozymes, can catalyse reactions in a similar way to protein enzymes. Most of these ribozymes have other RNA molecules as their substrates and catalyse reactions that break specific sugar phosphate bonds in the substrate molecules.

Which statements about these ribozymes are correct?

- Hydrogen, ionic and disulfide bonds will be involved in the ribozyme structure.
- The active site of a ribozyme is formed from a specific sequence of nucleotides
- Ribozymes can form because RNA can have a specific secondary and tertiary structure.

- A** 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

- 10 What is the role of stem cells with regards to the function of adult tissues and organs?

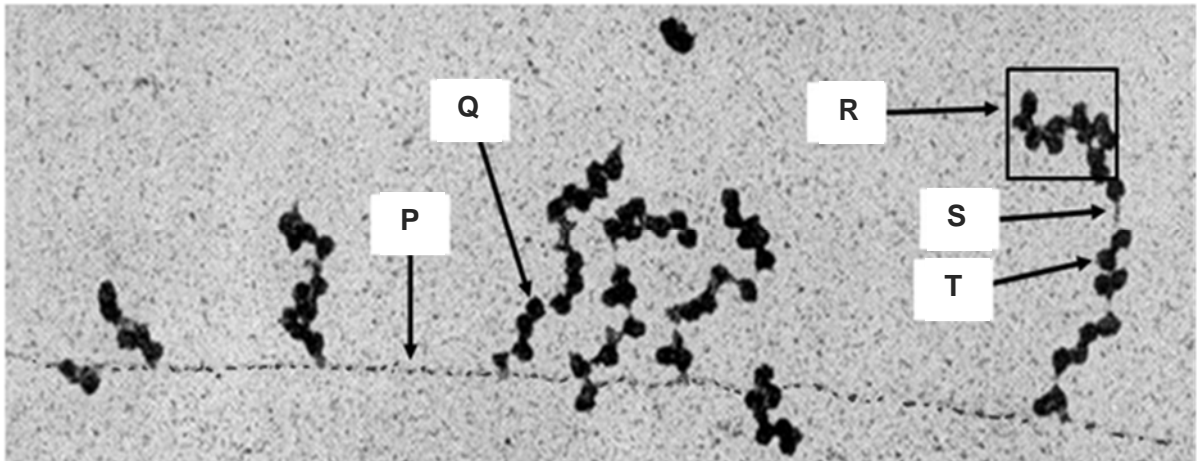
- A** Stem cells are fully differentiated cells that reside under the surface of epithelial tissue, in position to take over the function of the tissue when the overlying cells become damaged or worn out
- B** Stem cells are totipotent cells that divide asymmetrically, giving rise to one daughter cell that remains a stem cell and one daughter cell that will differentiate to replace damaged and worn out cells in the adult tissue or organ.
- C** Stem cells are embryonic cells that persist in the adult, and can give rise to all of the cell types in the body.
- D** Stem cells are cells that have yet to express the genes and produce proteins characteristic of their differentiated state, but do so when needed for repair of tissues and organs.

11 The table shows the percentage of nitrogenous base in four samples of nucleic acids.

Sample	Bases				
	A	B	C	D	Uracil
1	19	31	30	19	Nil
2	27	23	24	26	Nil
3	25	25	Nil	25	25
4	17	32	33	18	Nil

Which base is adenine? **BB**

12 The electron micrograph shows 5 structural components P, Q, R, S and T involved in the expression of a particular gene in a prokaryotic cell.



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

- RNA polymerase adds incoming nucleotides to form P.
- The products synthesized by Q and T are identical.
- Structure R can also be found in eukaryotes.
- T is involved in forming S.

A 3 only

B 2 and 3 only

C 1, 2 and 4 only

D All of the above

- 13 In a genetic engineering experiment a piece of double-stranded DNA containing 6000 nucleotides is transcribed and translated into a polypeptide consisting of amino acids of fifteen different kinds.

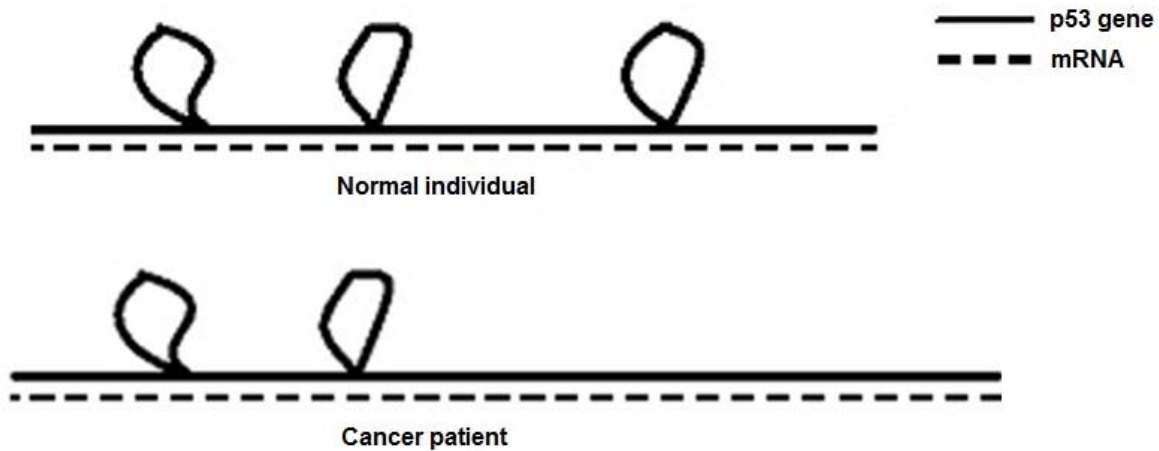
What is the total number of amino acids used and the theoretical minimum number of different tRNA molecules required to translate the mRNA for this peptide?

- A 500 amino acids and 20 different tRNA
- B 1000 amino acids and 15 different tRNA**
- C 2000 amino acids and 20 different tRNA
- D 3000 amino acids and 15 different tRNA

- 14 Which of the following shows the possible effects of a single nucleotide substitution in each of the following locations in a gene on the production of the protein it codes for?

	Promoter	Transcription terminator	Start codon	Stop codon	Middle of an intron
A	No protein product is produced	Protein product is shorter than normal	Protein product is longer than normal	Protein product is normal	Too much protein product is produced
B	Too much protein product is produced	Protein product is normal	No protein product is produced	Protein product is longer than normal	Protein product is normal
C	Protein product is normal	Protein product is longer than normal	Protein product is shorter than normal	Too much protein product is produced	Protein product is longer than normal
D	Protein product is longer than normal	Too much protein product is produced	Protein product is normal	Protein product is shorter than normal	No protein product is produced

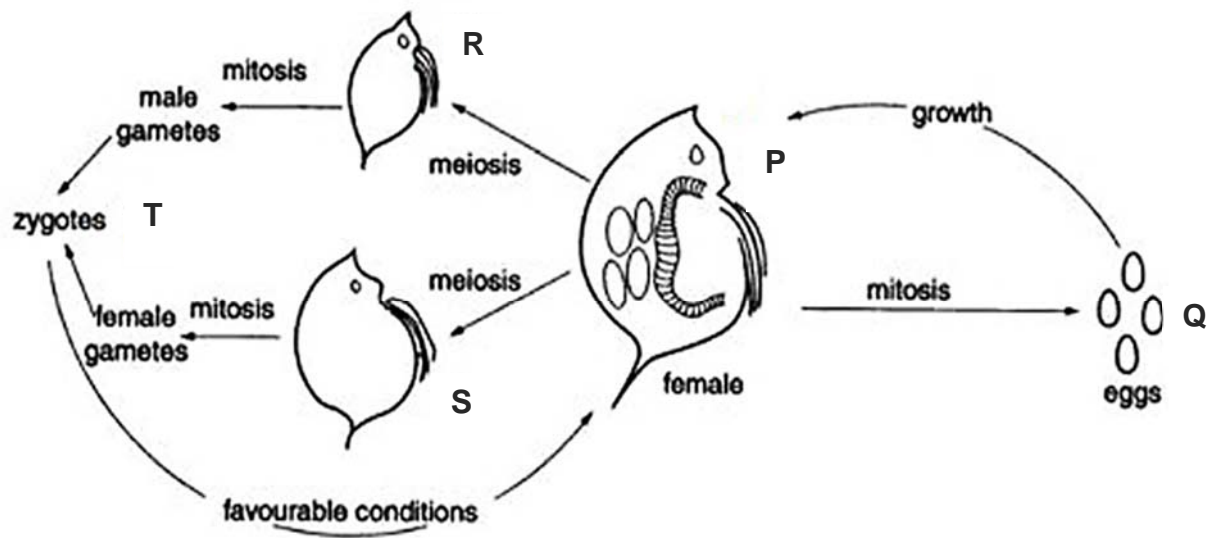
- 15 mRNA was isolated from a normal individual and a patient suffering from cancer. The mRNA was allowed to hybridise with the *p53* gene. The schematic diagram shows the results of the hybridisation process under the electron microscope.



Which of the following could be a possible explanation why the patient is suffering from cancer?

- A** A point mutation had occurred in the intron leading to the failure to excise one intron, hence leading to a longer dysfunctional protein being translated.
- B** A point mutation had occurred in the intron leading to an exon being excised, hence leading to a shorter dysfunctional protein being translated.
- C** A point mutation had occurred leading to the failure of spliceosome to recognise splice sites leading to the excision of the wrong intron, leading to a dysfunctional protein being translated.
- D** Gene amplification had occurred leading to the multiple copies of a trinucleotide repeat in an intron, hence causing splice site to be misread due to frameshift mutation, leading to a longer dysfunctional protein being translated.

- 16 The figure shows the life cycle of the water flea, *Daphnia*. The cells of individual **R** contain 10 chromosomes.



Which of the following are correct?

	Individual	Ploidy level	Number of chromosomes	Reason for choice
I	P	2n	20	The cells of P can undergo both mitosis and meiosis.
II	Q	2n	20	P produces eggs by mitosis which develop into females.
III	S	n	10	The gametic cells of P have undergone normal meiosis.
IV	T	2n	20	Random fertilisation of haploid gametes from R and S occurred to form zygote T.

- A I and II only
 B I and III only
 C II and IV only
 D All of the above

- 17 The cells of an organism contain six chromosomes, with an average of 18 units of DNA per chromosome.

The table below shows the results of measuring the amount of DNA in the cells of this organism at different stages of meiosis.

Which of the following shows the amount of DNA in the cell during anaphase I?

	Units of DNA per cell
A	36
B	54
C	108
D	216

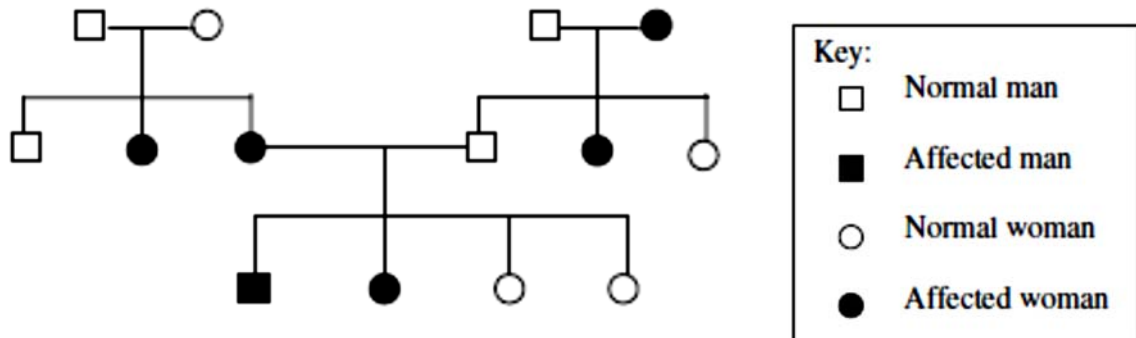
- 18 Which pair of statements correctly describes how cellular DNA content and ploidy level change after meiosis I and meiosis II?
- A Cellular DNA content is halved after both meiosis I and meiosis II.
Ploidy level changes from diploid to haploid only after meiosis II.
- B Cellular DNA content is halved after both meiosis I and meiosis II.
Ploidy level changes from diploid to haploid after meiosis I, and remains haploid after meiosis II.**
- C Cellular DNA content is halved only after meiosis I.
Ploidy level changes from diploid to haploid only after meiosis II.
- D Cellular DNA content is halved only after meiosis I.
Ploidy level changes from diploid to haploid after meiosis I, and remains haploid after meiosis II.
- 19 The sex chromosome combination XYY is found in a small proportion of men. Such a combination is possible if one contributory gamete to the zygote is
- A a sperm produced by a father whose cells lack an X chromosome
- B a sperm produced by non-disjunction at meiosis II**
- C an egg containing an X and a Y chromosome
- D an egg produced by non-disjunction at meiosis I

- 20 A strain of toad has only one nucleolus in the nucleus of each cell instead of the usual two. When toads with one nucleolus per cell are mated, approximately a quarter of the offspring have two nucleoli per nucleus, half have one nucleolus per nucleus and a quarter have no nucleoli.

What is the most likely explanation of these results?

- A The possession of one nucleolus is due to autosomal linkage.
- B The possession of one nucleolus is due to the heterozygous condition.**
- C The allele for the presence of two nucleoli is recessive.
- D The allele for the presence of two nucleoli is dominant.

- 21 The family tree shows the inheritance of a skin condition.

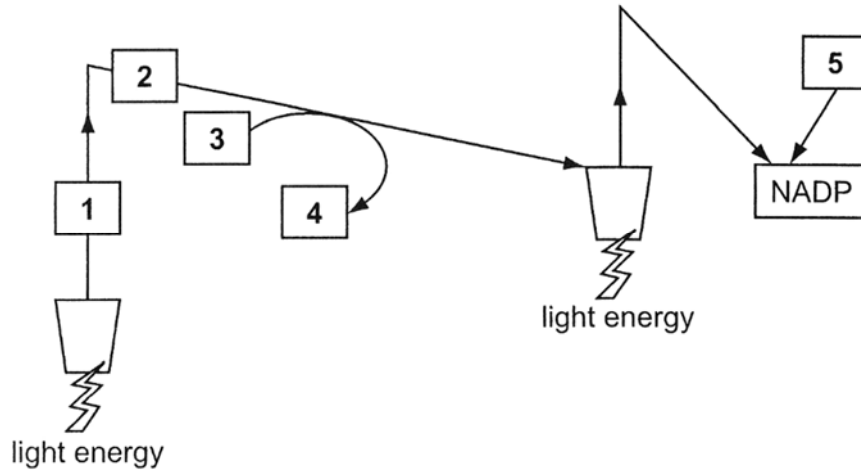


What is the genetic basis of the skin condition?

- A autosomal dominant
 - B sex-linked dominant
 - C autosomal recessive**
 - D sex-linked recessive
- 22 In birds, sex is determined by a ZW chromosome scheme. Males are ZZ and females are ZW. A recessive lethal allele that causes death of the embryo is sometimes present on the Z chromosome in pigeons. What would be the sex ratio in the offspring of a cross between a male that is heterozygous for the lethal allele and a normal female?

- A 2:1 male to female**
- B 1:2 male to female
- C 1:1 male to female
- D 3:1 male to female

23 The diagram represents non-cyclic photophosphorylation.



Which reactants would be present at points 1, 2, 3, 4, and 5?

	1	2	3	4	5
A	Electrons	Electron carrier	ATP	ADP	Hydrogen molecules
B	Electron carrier	Electrons	ADP	ATP	Electrons
C	Electrons	Electron carrier	ADP	ATP	Hydrogen ions
D	Electron carrier	Electrons	ADP	ATP	Electrons and hydrogen ions

24 Dinitrophenol is a compound that can lodge within the thylakoid membranes of chloroplasts. Its presence provides an alternative route for H^+ ions to diffuse across the thylakoid membranes.

In what way would the Calvin cycle be affected in chloroplasts poisoned with dinitrophenol?

- A No effect since Calvin cycle is an enzyme-controlled process.
- B The rate of Calvin cycle would increase as pH in the stroma decreases.
- C The rate of Calvin cycle would decrease with the accumulation of glycerate-3-phosphate.
- D The rate of Calvin cycle would decrease with the accumulation of glyceraldehyde-3-phosphate

25 Six tubes were set up as shown in the table.

tube	contents
1	Glucose + homogenized plant cells
2	Glucose + mitochondria
3	Glucose + cytoplasm lacking organelles
4	Pyruvate + homogenized animal cells
5	Pyruvate + mitochondria
6	Pyruvate + cytoplasm lacking organelles

After incubation, each sample was analysed to determine the presence of carbon dioxide and ethanol.

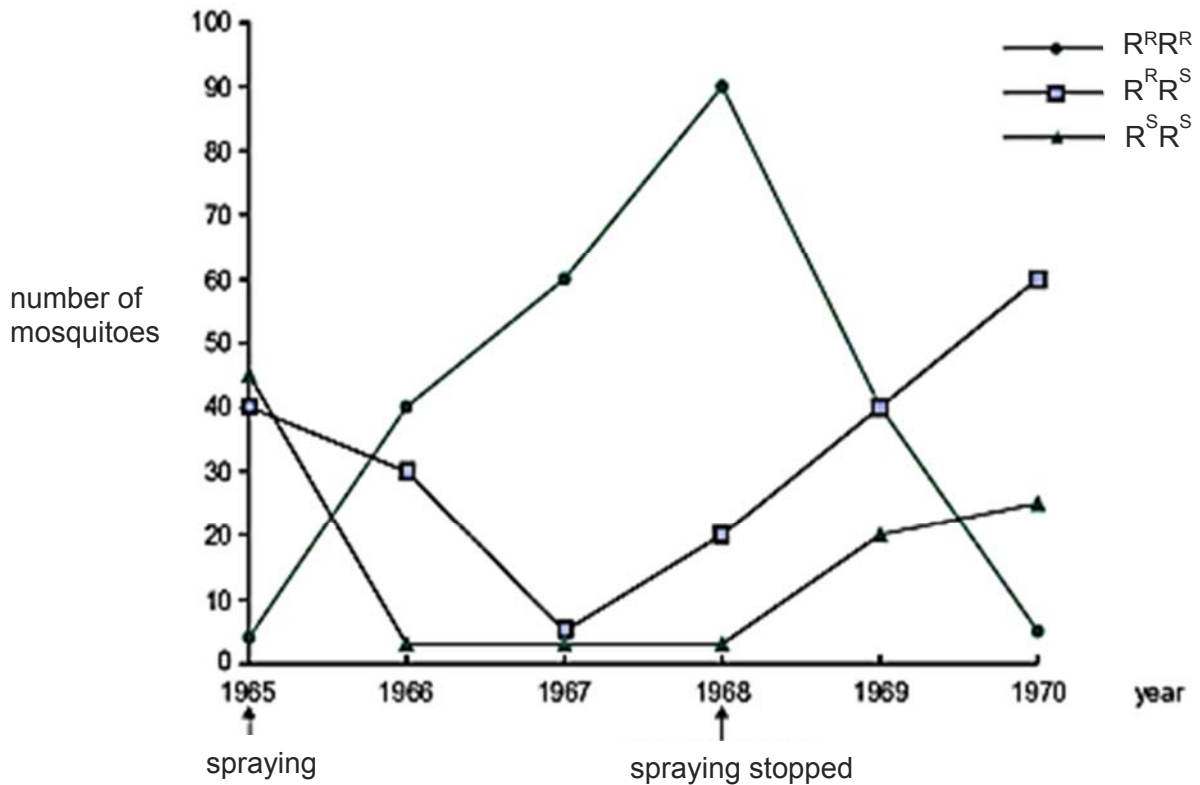
In which tube(s) is lactate most likely to be present?

- A 1 and 3 only
- B 2, 3, 5 and 6 only
- C 4, 5, and 6 only
- D 3 and 6 only**

26 Which effect of natural selection is likely to lead to speciation?

- A Differences between populations are increased.**
- B Favourable genotypes are maintained in the population.
- C Genetic diversity is reduced.
- D Selection pressure on some alleles reduces reproductive success.

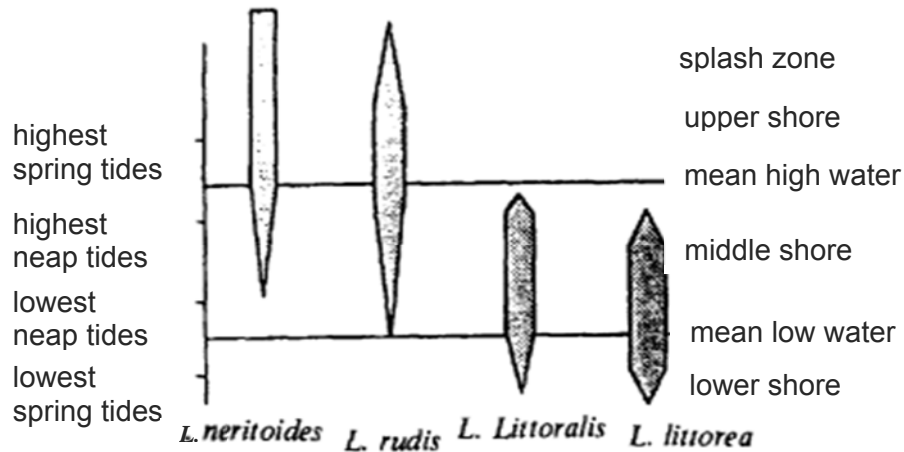
- 27 In the mosquito, there is a gene locus which has two alleles, R^R and R^S , involved in resistance to the insecticide DDT. R^R represents the allele for DDT resistance and R^S represents the allele for DDT sensitivity. The graph shows the number of mosquitoes of three genotypes collected from 1965, when DDT was first used, through to 1970, two years after the spraying of DDT stopped.



From the data, it is possible to conclude that

- A the frequency of the R^S allele is greater than the frequency of the R^R allele in 1968.
- B many generations after the removal of DDT, the R^R allele would disappear from the population.
- C after removal of DDT from the environment in 1968, having the $R^R R^R$ genotype reduces the chance of survival.**
- D in the presence of DDT in the environment between 1967 and 1968, mosquitoes with the $R^R R^S$ genotype are most likely to survive.

- 28 The diagram below shows the frequency and distribution of four *Littorina* species on a rocky shore. All feed in a snail-like manner by grazing on algae.



spring tide: refers to the 'springing forth' of the tide during new and full moon

neap tide: Happens seven days after a spring tide. Refers to a period of moderate tides when the sun and moon are at right angles to each other

Which one of the following factors could **not** directly contribute to this distribution pattern?

- A Variation in the tolerance of each species to desiccation
- B Competition between species for different feeding niches
- C The photoperiod and seasonal change in day length**
- D The differential selection of *Littorina* by predators

- 29** Bacteria in the genus *Wolbachia* infect many butterfly species. They are passed from one generation to the next in eggs, but not in sperm, and they selectively kill developing male embryos.

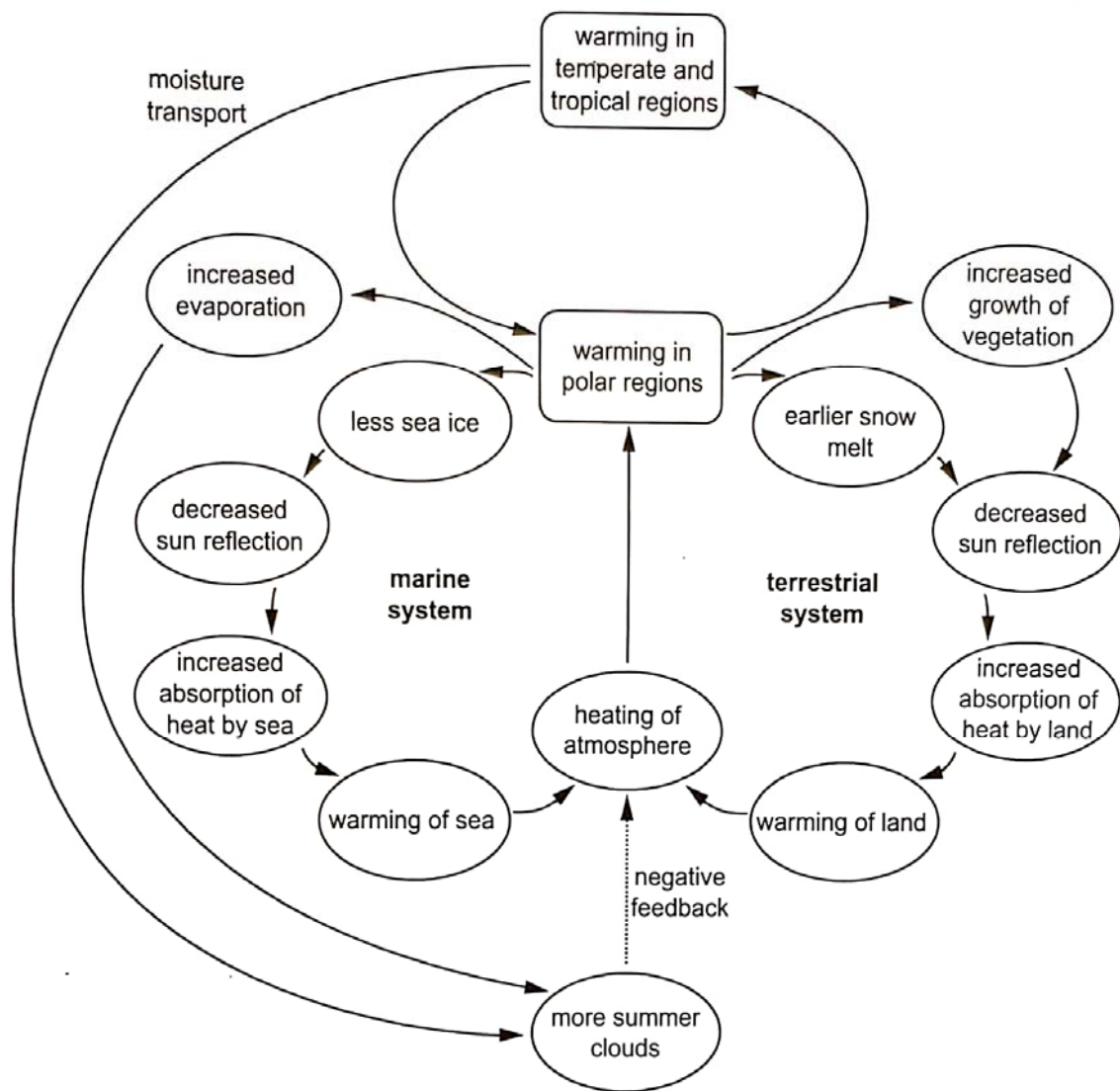
In Samoa in the 1960s, the proportion of male blue moon butterflies fell to less than 1% of the population. However, by 2006, the proportion of males was almost 50% of the population.

Resistance to *Wolbachia* is the result of the dominant allele of a suppressor gene.

Which statements correctly describe the evolution of resistance to *Wolbachia* in the blue moon butterfly population?

- 1 *Wolbachia* acts as a selective agent.
 - 2 The selective killing of male embryos is an example of artificial selection.
 - 3 When infected with *Wolbachia*, male embryos that are homozygous for the recessive allele of the suppressor gene die.
 - 4 All male embryos that carry the dominant allele of the suppressor gene pass that allele to their offspring.
 - 5 The frequency of the dominant allele of the suppressor gene rises in the butterfly population.
- A** 1 and 4 only
- B** 2 and 3 only
- C** 1, 3 and 5
- D** 2, 4 and 5

- 30 The diagram shows the effect of increasing temperatures on the ice and snow cover at the polar regions.



Which effect of higher temperatures in the polar regions could increase global warming?

- A** Melting of ice and snow results in less reflection of sunlight and more heat absorption by the Earth.
- B** Increased evaporation leads to more rainfall, which absorbs heat from the land and the sea.
- C** Melting sea ice causes more cloud formation, which increases absorption of heat in the atmosphere.
- D** Earlier melting of snow allows vegetation cover to increase faster, reducing loss of heat from the surface of the Earth.