VICTORIA JUNIOR COLLEGE

JC 2 PRELIMINARY EXAMINATION 2018

NAME: _____

CT CLASS : _____

H2 BIOLOGY **9744/1**

Paper 1 Multiple Choice **1 hour**

Additional material: Multiple choice answer sheet

READ THESE INSTRUCTIONS FIRST

Write your name, exam number on the answer sheet provided.
Do not use any staples, paper clips, highlighters, glue or correction fluid.

There are **30** 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 answer sheet.

Read the instructions on the answer sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this paper.

The use of an approved scientific calculator is expected, where appropriate.

1 Which of the following is/are the most likely consequence(s) for an animal cell lacking functional Golgi bodies?

1. The cell dies because it is unable to make glycoproteins to detect stimuli from its environment.
2. The cell dies from a lack of enzymes to digest food taken in by endocytosis.
3. The cell dies because of the accumulation of worn-out organelles within itself.
4. The cell is unable to synthesise centrioles for cell division.
5. The cell is unable to export its enzymes or peptide hormones.

A 1 and 5 only

B 2, 3 and 4 only

C All except 4

D All of the above

2 Which of the following options correctly matches the functional and structural features of cellulose, collagen, glycogen and triglycerides?

		Function	Structure		
			Linear/ Fibrous	Molecule held together by hydrogen bonds	Branched chains
A	Cellulose	Support	✓	×	✓
	Collagen	Strengthening	✓	✓	×
B	Cellulose	Support	✓	✓	×
	Triglyceride	Storage	×	×	×
C	Collagen	Strengthening	✓	✓	✓
	Glycogen	Storage	×	×	✓
D	Glycogen	Storage	×	✓	✓
	Triglyceride	Storage	×	✓	×

3 Influenza virus has an enzyme called neuraminidase which breaks down glycoproteins in the membrane of the cell that the virus will infect. The glycoprotein binds to the active site of neuraminidase by induced fit.

Which statements about the induced fit hypothesis of enzyme action are correct?

1. The active site must have a complementary shape to the substrate for them to bind together.
2. This enzyme is less likely to be affected by non-competitive inhibitors than an enzyme working by the lock and key mechanism.
3. The substrate is converted to product by specific R-groups in the active site just like the lock and key mechanism.

A 1 and 2

B 2 and 3

C 2 only

D 3 only

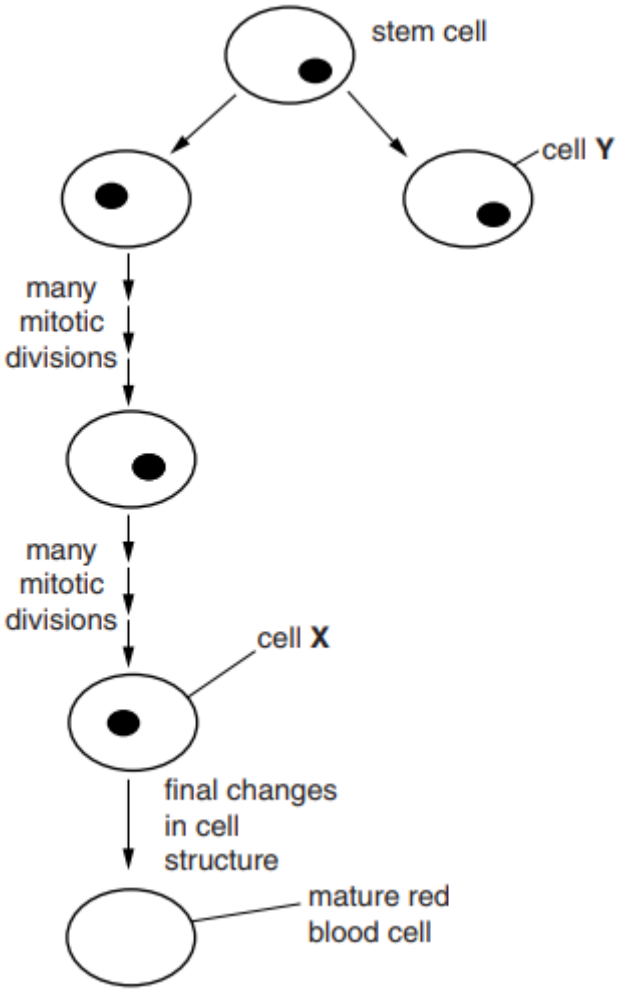
4 An unusual enzyme has been found in a tropical grass.

- It catalyses the hydrolysis of the fungal polysaccharide, chitin, into amino sugars.
- It also inhibits the activity of an enzyme in locust guts which catalyses the digestion of amylose.

What describes the actions of this unusual enzyme?

	reaction catalysed	**reaction inhibited**
A	hydrolysis of glycosidic bonds	condensation of glycosidic bonds
B	hydrolysis of glycosidic bonds	hydrolysis of glycosidic bonds
C	hydrolysis of peptide bonds	condensation of glycosidic bonds
D	hydrolysis of peptide bonds	hydrolysis of glycosidic bonds

5 Bone marrow contains many stem cells. Some of these stem cells are responsible for the replacement of red blood cells. During the production of red blood cells, a series of changes occur to the cell structure. The figure below shows the production of a red blood cell from one of these stem cells.



Which of the following correctly describes the changes that occur as cell X becomes a mature biconcave red blood cell?

1. displays cell surface antigens such as ABO, CD4 and CD8
2. becomes multipotent
3. synthesises haemoglobin and carbonic anhydrase
4. loses its nucleus
5. loses organelles such as ribosomes, ER, mitochondria
6. loses telomerase activity

A 1, 2, 4, 6

B 2, 3, 4, 6

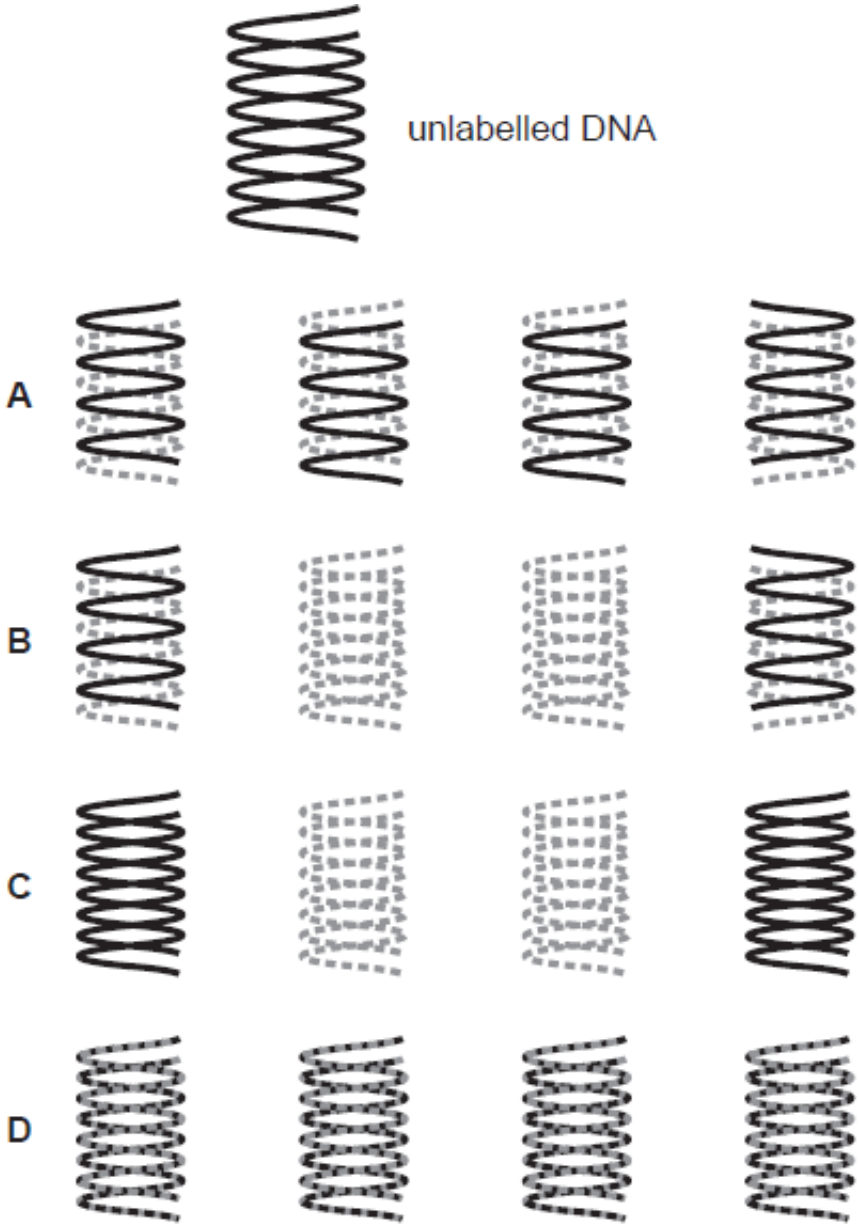
C 1, 3, 4, 5

D 3, 4, 5, 6

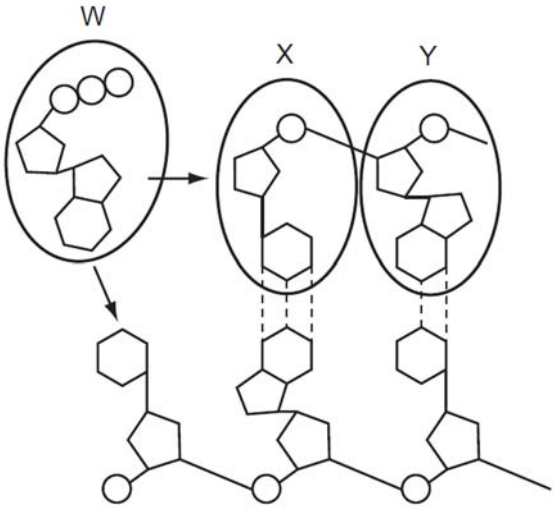
6 The sets of diagrams show four possible outcomes when an unlabelled molecule of DNA is allowed to replicate twice in the presence of ^{15}N-labelled nucleotides.

Labelled sections of DNA are represented by dotted lines.

Which set of diagrams correctly shows the result of DNA replication?



7 The diagram shows the synthesis of a polynucleotide. Molecule W is a nucleoside triphosphate.



- - - - hydrogen bond

Which statements are correct?

1. The base in X could be the pyrimidine, uracil
2. The base in W could be the purine, adenine
3. The base in X is the pyrimidine, cytosine
4. The base in Y is the purine, guanine

A 1 and 4 only

B 2 and 3 only

C 3 and 4 only

D 1, 2, 3 and 4

8 Which statements correctly describe the structure and function of prokaryote ribosomes?

1. A prokaryote ribosome can accommodate only one amino acyl-tRNA at a time.
2. Prokaryote ribosomes are smaller than eukaryote ribosomes and sediment at 70 S.
3. In prokaryotes, ribosomes can begin translating mRNA before its synthesis has been completed.
4. In prokaryotes, ribosomes translate mRNA in the same cellular compartment in which it is transcribed.

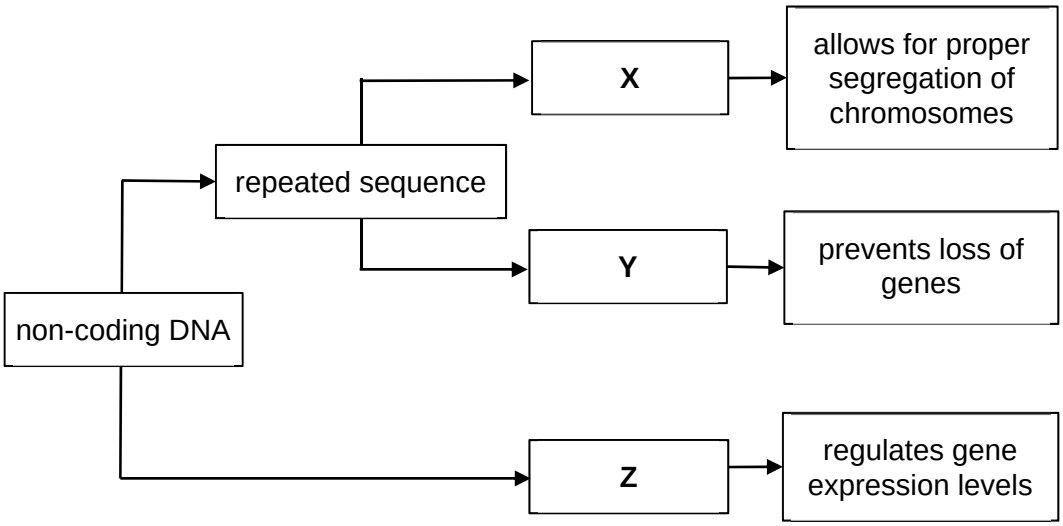
A 1 and 3 only

B 1, 2 and 4 only

C 2, 3 and 4 only

D 1, 2, 3 and 4

9 The flowchart shows the classification of several regions of non-coding eukaryotic DNA, **X**, **Y** and **Z**.



Which statement(s) correctly describes **X**, **Y** and **Z**?

1. Regions **X** and **Y** are made up of transcriptionally active tandem repeats.
2. Regions **X** and **Y** are always associated with proteins, but DNA at region **Z** is only associated with proteins during gene expression.
3. Region **Z** may involve DNA bending but region **Y** shortens during DNA replication.
4. Regions **X**, **Y** and **Z** are conserved throughout the life of the organism.

A 2 only

B 3 only

C 1 and 4 only

D 2 and 3 only

10 Which of the following statement comparing the human immunodeficiency virus (HIV) and lambda phage is **incorrect**?

A The HIV enters by receptor-mediated endocytosis, but the lambda phage infects bacterial cells by injecting its DNA.

B The capsid of the HIV enters the host cell, but the capsid of the lambda virus does not.

C The genome of the HIV must be processed before it is integrated into the host chromosome, but the genome of the lambda virus can be directly integrated.

D New HIV are released from the host cell via budding, but new lambda virus are released via cell lysis.

11 The bacterium, *Pneumococcus pneumoniae*, forms two types of colonies whose cells are structurally different. Smooth (S) cells have thick outer capsules, but rough (R) cells lack this capsule. S cells cause the disease pneumonia.

In 1928, Frederick Griffith found that:

- when R cells were mixed with heat-killed S cells and the mixture injected into mice, some of the mice became infected and died.
- living S cells with capsules could be isolated from these dead mice.
- injection of heat-killed S cells alone or of living R cells alone did not cause disease in mice.

What can be concluded from these three observations to explain what happened when R cells were mixed with heat-killed S cells?

A A heritable genetic change occurred in the R cells.

B R and S cells conjugated when mixed.

C R cells were changed into S cells by transduction.

D R cells were transformed by DNA from heat-killed S cells.

12 The onset of puberty is triggered when cells in the hypothalamus region of the brain start to produce and secrete gonadotropin-releasing hormone (GnRH), which triggers the production and release of follicle-stimulating hormone and luteinising hormone from the anterior pituitary.

Which of the following statements are true during the onset of puberty?

1. DNA in the region containing the GnRH gene is methylated in cells of the hypothalamus.
2. DNA in the region containing the GnRH gene is methylated in cells of the anterior pituitary.
3. GnRH receptor is only expressed in cells of the anterior pituitary.
4. GnRH triggers the activation of activators in cells of the anterior pituitary via signal transduction.
5. The transcription initiation complex is formed at the enhancer controlling the GnRH gene in cells of the hypothalamus.

A 1 and 4

B 2 and 3

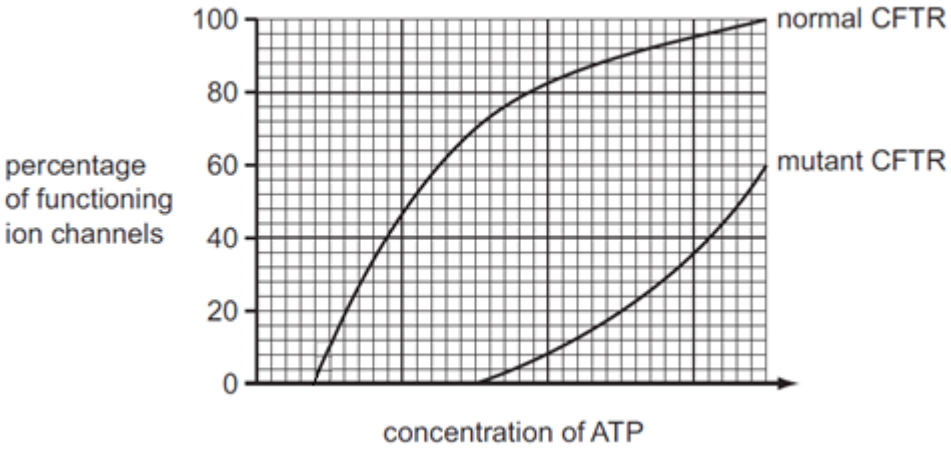
C 1, 4 and 5

D 2, 3 and 4

13 Which of the following correctly describes an advantage and limitation of the polymerase chain reaction (PCR)?

	Advantage	Limitation
A	Only requires a minute amount of template for amplification	Only able to amplify a small fragment of DNA
B	Able to produce 20^2 copies of the target DNA after 20 cycles	Cannot amplify unknown sequences as primers cannot be made
C	Works on DNA from various species and sources	Time consuming and expensive to carry out
D	Highly accurate due to proof-reading function of DNA polymerase	The extent of amplification is limited by the amounts of nucleotides and primers

14 One of the many recessive mutations of the CFTR gene changes one amino acid in the region of the CFTR protein that binds ATP. The graph shows the effect of different concentrations of ATP on normal and mutant CFTR proteins.



Which correctly describes individuals who are homozygous for this mutation?

1. Their CFTR protein cannot bind ATP and cannot act as an ion channel.
2. Their CFTR protein binds ATP less readily than normal CFTR protein.
3. These individuals produce a mutant CFTR protein that can bind ATP to function as an ion channel.
4. These individuals produce a mixture of normal and mutant CFTR protein, both of which can act as an ion channel.

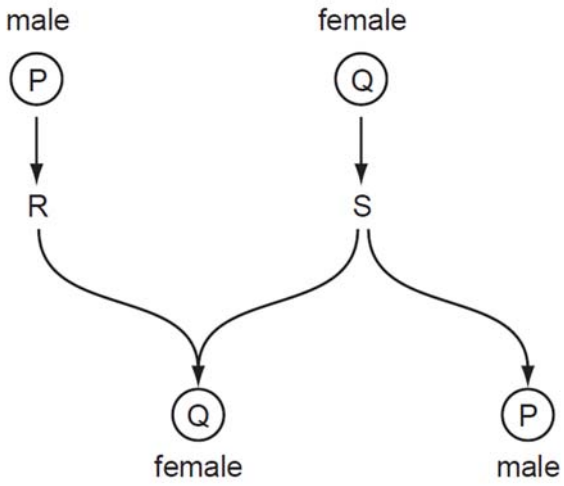
A 1 only

B 2 only

C 2 and 3 only

D 3 and 4 only

15 Sex determination in some insects such as bees and wasps is not controlled by sex chromosomes.



Using the diagram, which row in the table shows how sex is determined in these insects?

	P	Q	R	S
A	n	n	mitosis	mitosis
B	n	2n	mitosis	meiosis
C	2n	n	meiosis	meiosis
D	2n	2n	meiosis	mitosis

16 The protein p53 is produced in a cell in response to DNA damage. This protein stops the cell cycle for a short time just before the DNA is replicated, so that the DNA can be repaired.

At which phase of the cell cycle will this stop occur?

A S

B M

C G1

D G2

17 In cattle, the gene responsible for normal development of hair and teeth, ectodysplasin 1 (*ED1*) is located on the X chromosome. Mutations in the *ED1* gene result in a rare genetic disorder, anhidrotic ectodermal dysplasia. Another character, the presence of horns, is determined by a gene on an autosome. The allele for the absence of horns (**H**) is dominant and the allele for the presence of horns (**h**) is recessive.

A horned bull with anhidrotic ectodermal dysplasia was mated on several occasions to the same female. A large number of offspring consisting of males and females in equal numbers in all combinations of phenotypes are shown in the table.

Offspring phenotypes
No anhidrotic ectodermal dysplasia, horns present
No anhidrotic ectodermal dysplasia, horns absent
Anhidrotic ectodermal dysplasia, horns present
Anhidrotic ectodermal dysplasia, horns absent

If $\mathbf{X^E}$ represents an X chromosome carrying the normal *ED1* allele and $\mathbf{X^e}$ represents an X chromosome carrying the *ED1* allele for anhidrotic ectodermal dysplasia, what is the genotype of the female parent?

A X^EX^EHH

B X^EX^EHh

C X^EX^eHH

D X^EX^eHh

18 Duchenne muscular dystrophy is a condition characterised by progressive muscle wasting. It is caused by a recessive mutation in the DMD gene, located on the X chromosome. The DMD gene codes for a protein known as dystrophin, which, in healthy individuals, prevents damage and weakening of muscle fibres.

Which statement explains why not all affected males inherit the mutation from their mother?

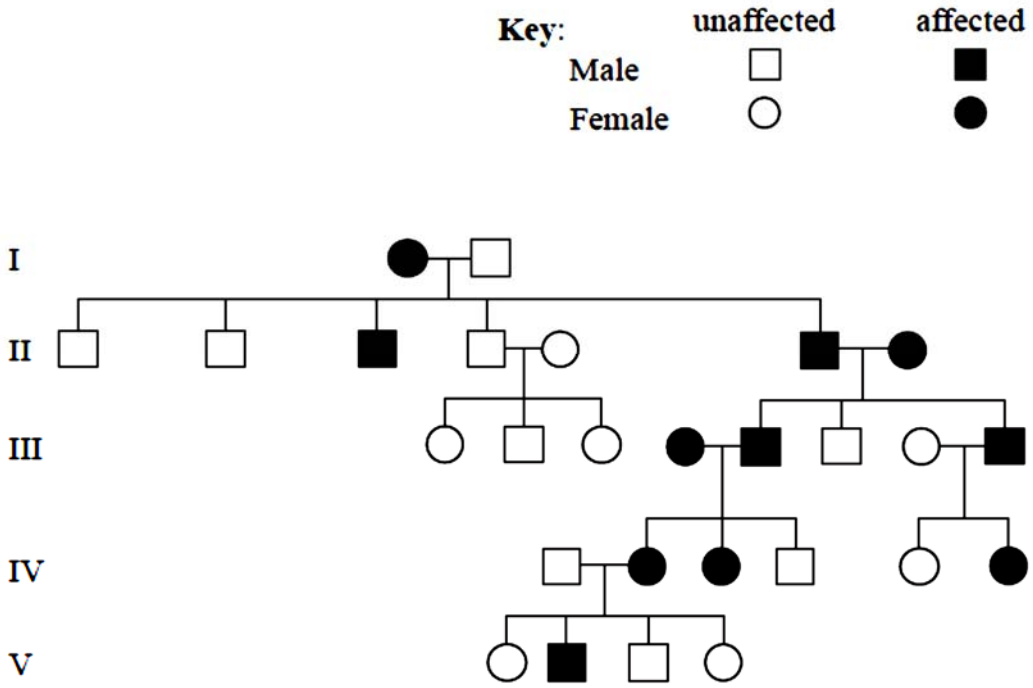
A Some affected males inherit the mutation from their father, who has inherited the mutation from a carrier mother.

B Some affected males inherit the normal allele of a carrier mother but synthesise dystrophin molecules that have an altered tertiary structure.

C Some males with mothers who are not carriers of the mutated allele are affected as a result of a new mutation in the DMD gene.

D The single X chromosome of some affected males become inactivated and no dystrophin is synthesised.

19 The pedigree chart below shows the inheritance of a genetic disease in a family. What is the nature of the allele that causes this disease?



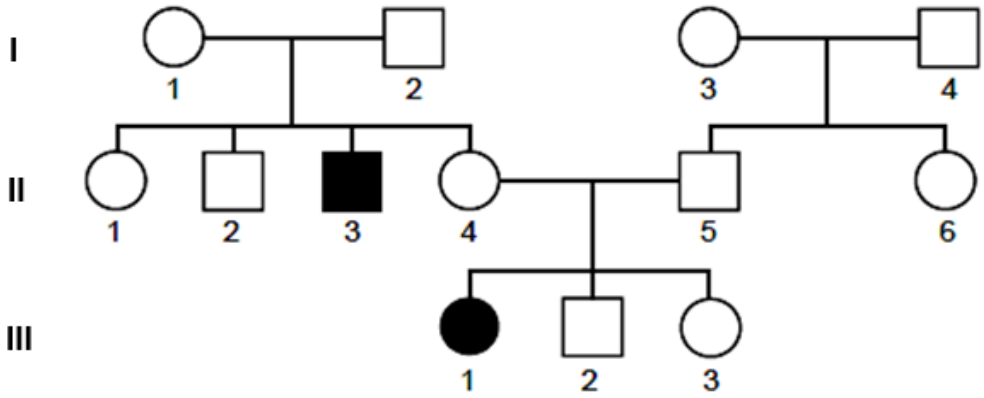
A Dominant and sex-linked

B Dominant and autosomal

C Recessive and sex-linked

D Recessive and autosomal

20 ALDOA deficiency is a genetic condition in which affected individuals fail to produce the enzyme aldolase A, leading to haemolytic anaemia. The pedigree shows a family where two members have ALDOA deficiency.



If individual **III–3** was to marry an affected man, what is the probability that their first child is an affected boy?

A 2/3 **B** 1/4 **C** 1/3 **D** 1/6

21 The action spectrum and absorption spectrum of photosynthetic pigments are similar because

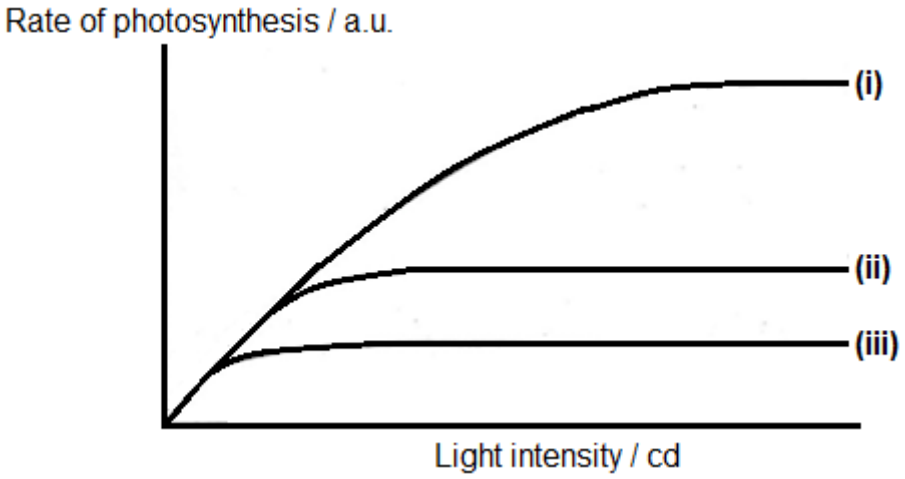
A the amount of energy absorbed by the pigments is the activation energy needed for photosynthesis.

B only certain wavelengths of light provide enough energy to make ATP during the light reaction.

C photosynthesis occurs when the whole spectrum is absorbed.

D wavelengths of light absorbed by the pigments are the ones used in photosynthesis.

22 Cuttings of the same plant were kept in different conditions and the rates of photosynthesis were measured. The results were shown in the graph below.



Which of the following best explains the results shown?

A The leaves in (i) are bigger than those in (iii) and thus are able to absorb more light for photosynthesis.

B The temperature in (i) is at the optimum temperature of the enzymes in Calvin cycle while the temperature in (ii) is much higher.

C The light compensation point in (ii) is higher than that in (iii).

D The carbon dioxide concentration in (iii) is the lowest, limiting the rate of carbon fixation.

23 The table below shows a description of the activity of three drugs.

Drug	Description
1	Inhibit cAMP synthesis
2	Inhibit phosphatases
3	Inhibit Golgi body function

Which of the following combination shows the consequence for each of the three drugs on muscle cells in relation to blood glucose regulation?

	Drug 1	Drug 2	Drug 3
A	No effect	Decreased signal transduction efficiency	Increased cellular response
B	Decreased activation of signalling pathways	Decreased signal transduction efficiency	Increased cellular response
C	Decreased activation of signalling pathways	Increased signal transduction efficiency	Decreased cellular response
D	No effect	Increased signal transduction efficiency	Decreased cellular response

24 Which of the following **does not** explain why the population is the smallest unit that can evolve?

A Natural selection involves competition between individuals in a population.

B Evolution occurs when allele frequency in a population changes due to selection or chance events like genetic drift.

C Differential reproductive success is observed at the population level due to the phenotypic variations in the population.

D Evolution involves the introduction of advantageous mutations into the gene pool of a population as a result of a selective pressure.

25 Which of the following statements could **not** be used to describe a species?

A A group of organisms showing analogous body structures

B A group of organisms showing distinctly similar genetic sequence

C A group of organisms capable of mating to produce viable offspring

D A group of organisms sharing the same ecological niche

26 The statements refer to the disease tuberculosis (TB).

1. The pathogen lives inside human cells so is not accessible to the immune system.
2. The bacterial pathogen reproduces slowly.
3. The pathogen is not very sensitive to antibiotics.

Which explains why treatment for TB with antibiotics such as penicillin takes a long time?

A 1, 2 and 3

B 1 and 2 only

C 1 and 3 only

D 2 and 3 only

27 Rabies is a viral disease which can be spread to humans by a bite from an infected animal. One method of treatment is to inject the patient with antibodies specific to the rabies virus.

Which statements about this treatment are correct?

1. The patient will have natural passive immunity to rabies.
2. The injected antibodies will be broken down by the patient.
3. The patient's memory cells will be able to produce this antibody more rapidly in the future.
4. The immunity provided will only be of short duration.

A 1 and 3

B 1 and 4

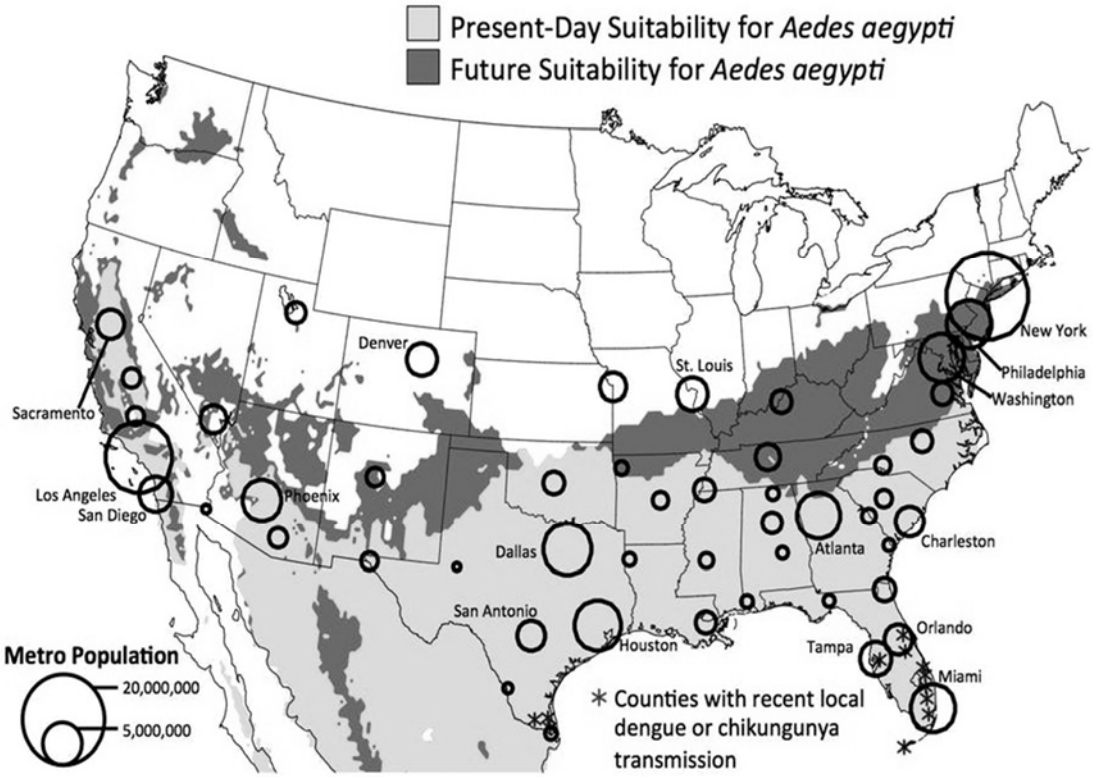
C 2 and 3

D 2 and 4

28 Which row is correct for malaria?

	Nature of disease	Method of transmission	Pathogen	Location
A	infectious	insect vector	species of *Plasmodium*	Can be found in sub-tropical regions due to global warming
B	infectious	water-borne	species of *Anopheles*	Endemic in south east Asia
C	non-infectious	human vector	species of *Anopheles*	Can be found in all regions with high humidity
D	non-infectious	aerosol-borne	species of *Plasmodium*	Endemic in Asia

29 The figure below shows the current and potential spread of dengue and chikungunya across the United States.



Which of the following best explains the current or potential trends in the spread of these diseases as shown in the figure?

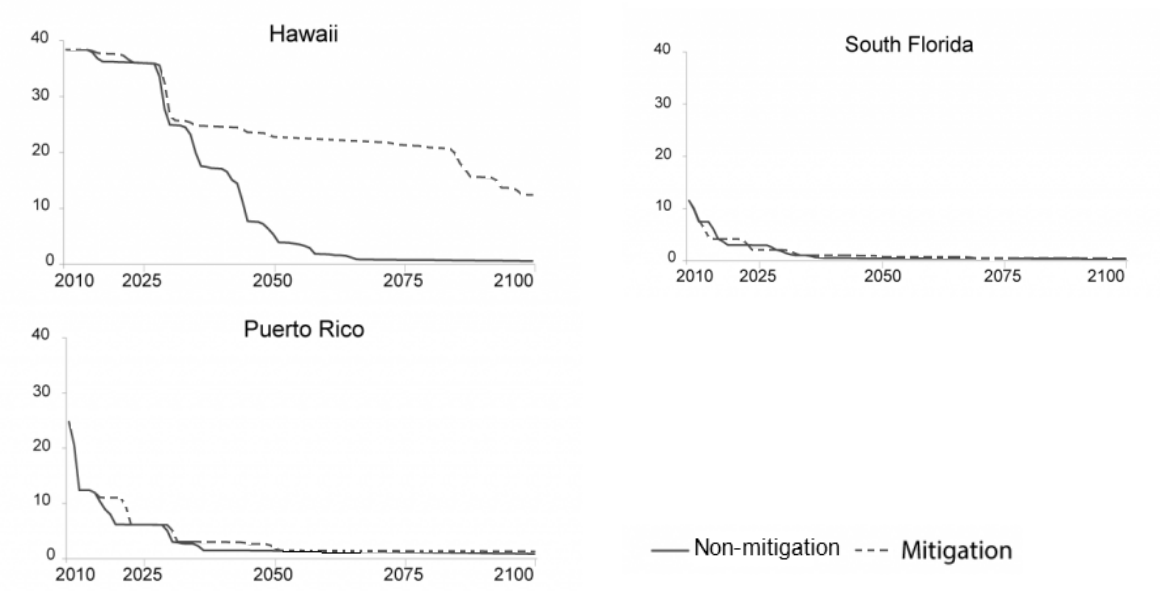
A Most of the regions with recent local dengue or chikungunya transmission are coastal regions possibly because these regions receive more rainfall and provide more suitable breeding grounds for ***Aedes aegypti***.

B The larger the size of the metro population, the higher the chances of mosquitoes transmitting the diseases from person to person.

C These diseases would spread higher in altitude in the future with increased global warming.

D The diseases are unlikely to spread to the northern regions (in white) in the future because they are mostly mountainous regions that are too cold to be affected by global warming.

30 Some studies reveal that mitigating (reducing) global greenhouse gas emissions have varied effectiveness in reducing negative impact on coral growth. The figure below shows the projected coral reef cover (%) over time (year) in Hawaii (latitude 22.2ºN), South Florida (24.5ºN) and Puerto Rico (18.2ºN) under mitigation and non-mitigation scenarios.



Based on the information given above, which of the following are possible explanations for the projected coral reef cover in the various locations after mitigation?

1. The coral reef cover in Hawaii is projected to improve significantly after mitigation because average sea temperatures there may not be significantly higher than the thermal limit of the corals.
2. It is projected that mitigation in South Florida and Puerto Rico would not significantly improve coral reef because these countries are closer to the equator as compared to Hawaii.
3. Recovery of coral cover after mitigation in South Florida is projected to be negligible because the extent of damage is already very high.

A 1 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3