

**VICTORIA JUNIOR COLLEGE****JC 2 PRELIMINARY EXAMINATION 2017****NAME** : _____**CT CLASS** : _____**H1 BIOLOGY****8875/1****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.

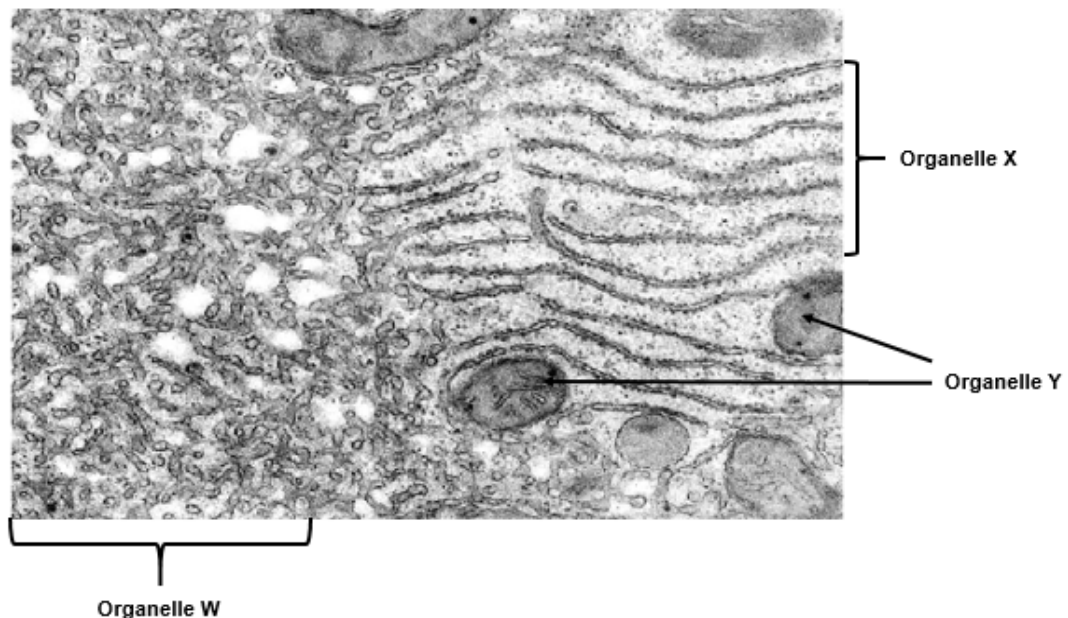
Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this paper.

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

1 Which of the following is a false statement regarding centrioles and ribosomes?

- A Both are non-membrane bound organelles.
- B Only centrioles are present in a cell undergoing mitosis.
- C Both are present in dividing and non-dividing animal cells.
- D Under high temperature, both will be denatured as they have a proteinaceous component.

2 Fig 2 shows three cell organelles W, X and Y.



Which of the following statements about these organelles is true?

- A Only organelle Y contains RNA.
- B Only organelle W contains carbohydrates and phospholipids.
- C Organelle X has 80S ribosomes whereas organelle Y has 70S ribosomes.
- D Organelles X and Y have double membranes whereas organelle W has a single membrane.

- 3 Which set of factors shown below will produce the **least** fluid cell surface membrane?

A	<ul style="list-style-type: none"> • High proportion of cholesterol • High temperature
B	<ul style="list-style-type: none"> • Low proportion of phospholipids with saturated fatty acids • High temperature
C	<ul style="list-style-type: none"> • Low proportion of phospholipids with unsaturated fatty acids • Low temperature
D	<ul style="list-style-type: none"> • High proportion of phospholipids with unsaturated fatty acid • Low temperature

- 4 Fig 4 shows a repeating unit found in a biomolecule.

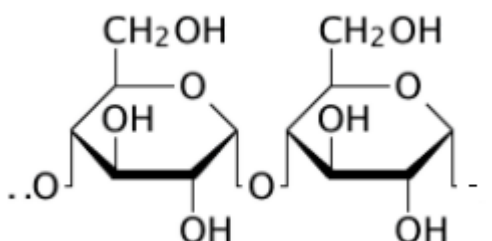


Fig 4

In which of the following biomolecules, would one expect to find the above repeating unit?

X Absent

√ Present

	Cellulose	Glycogen	Amylose	Collagen
A	X	X	√	X
B	√	X	√	X
C	√	X	X	√
D	X	√	√	X

- 5 Fig 5 below is an electron micrograph of a stained fiber of deoxyhemoglobin S (HbS).

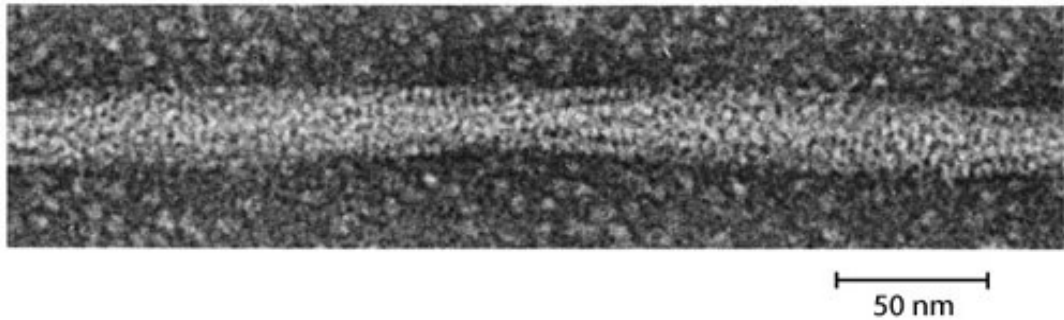


Fig 5

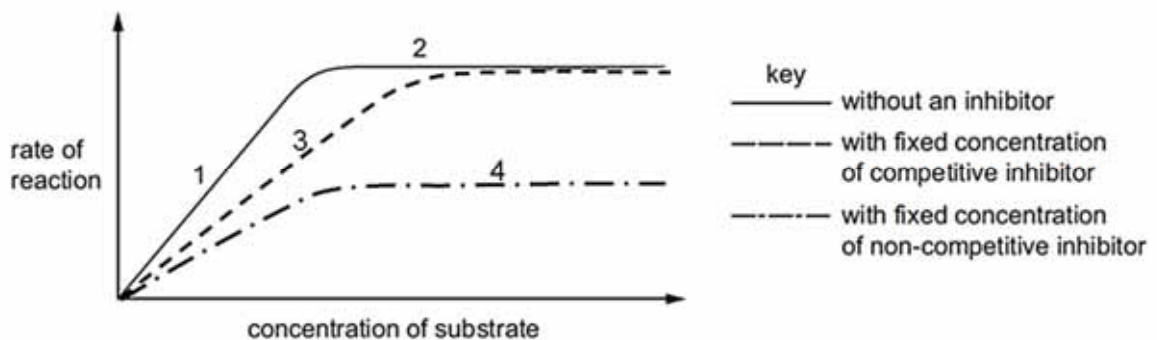
[From G. Rykes, R.H. Crepeau, and S.J. Edelstein. *Nature* 272(1978):509.]

Source: <http://www.nslc.wustl.edu/sicklecell/part2/molecular.html>

Which of the following statements is true?

- A** Mutation in the red blood cell results in the production of HbS which precipitates out as long rigid fibers under low oxygen concentration.
- B** The long HbS molecule is insoluble due to its large molecular size and this results in the sickling of red blood cells.
- C** The aggregation of HbS molecules, under low oxygen concentration, causes the fiber to be precipitated out of solution, resulting in the sickling of red blood cells.
- D** Under low oxygen concentration, HbS molecules form a triplex helix structure, causing the cell membrane of the red blood cells to be more rigid and hence they sickled.

- 6 The graph shows the effect of increasing the concentration of substrate on the rate of enzyme catalysed reaction.



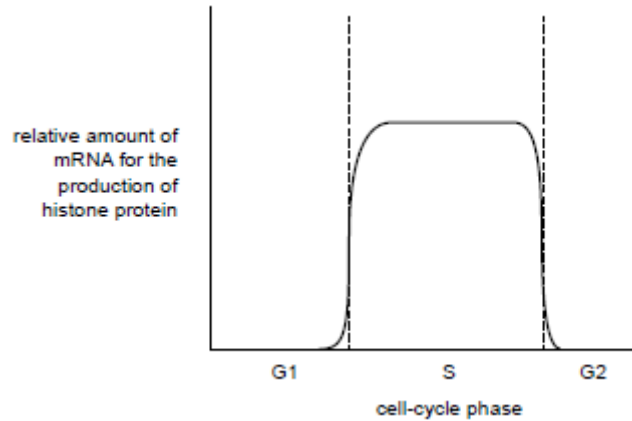
What is limiting the rate of the enzyme-catalysed reaction at 1, 2, 3 and 4 on the graph?

	1	2	3	4
A	enzyme concentration	substrate concentration	competitive inhibitor	non-competitive inhibitor
B	enzyme concentration	substrate concentration	non-competitive inhibitor	competitive inhibitor
C	substrate concentration	enzyme concentration	competitive inhibitor	non-competitive inhibitor
D	substrate concentration	enzyme concentration	non-competitive inhibitor	competitive inhibitor

- 7 What causes genetic variation in gametes during meiosis?

- A Crossing over of sister chromatids during prophase I and random orientation of homologous chromosomes in metaphase II
- B Crossing over in prophase I and random orientation of homologous chromosomes in metaphase I
- C Pairing of maternal and paternal chromosomes during prophase I and crossing over in metaphase I
- D Random orientation and segregation of homologous chromosomes during prophase I and metaphase I

- 8 The graph below shows the relative amount of mRNA for the production of histone protein at different times throughout a cell cycle.



Using your knowledge of the cell cycle and the information in the graph, it is correct to state that

- A DNA replication occurs most actively in the G1 phase.
 - B histone genes are highly active throughout the cell cycle.
 - C histone protein synthesis occurs simultaneously with DNA synthesis.
 - D histone protein is not present in the cell during the G1 and G2 phases.
- 9 The sequence below depicts the template strand of a hypothetical gene. The exons are in bold type.

3' **TAC AAA CCG GCC TTT GCC AAA CCC AAC CTA AAT ATG AAA ATT** 5'

An allele for this gene codes for a polypeptide with only five amino acids. This is caused by a mutation in one of the exons. Which of the following describes the change(s) that results in the formation of the shorter polypeptide?

- A Deletion of one adenine
- B Addition of two cytosines
- C Substitution of thymine with adenine
- D Addition of cytosine and removal of adenine

10 The mechanism of action of four drugs that inhibit DNA replication is stated below:

- Drug 1 inhibits the action of DNA ligase.
- Drug 2 resembles the shape of a DNA nucleotide.
- Drug 3 attaches irreversibly to the DNA molecule.
- Drug 4 binds irreversibly to the active site of DNA polymerase.

Which option correctly matches the drug(s) to the effect on DNA replication?

	Daughter strands of varying lengths are synthesized.	Only fragments are synthesized at the end of replication process.	Phosphodiester bonds cannot be formed.	Template strand becomes inaccessible by the enzyme.
A	4	3	2	1
B	2	4	3	1
C	2	1	4	3
D	3	2	1	4

11 The following events occur during transcription.

- P. Bonds break between complementary bases.
- Q. Bonds form between complementary bases.
- R. Phosphodiester bonds form.
- S. Free nucleotides pair with complementary nucleotides.

Which options correctly depicts the frequency of the events occurring in the nucleus?

	Occurs once	Occurs twice
A	P, R, S	Q
B	Q, R, S	P
C	R, S	P, Q
D	P, S	Q, R

12 The following statements are descriptions of polynucleotides found in eukaryotes.

1. Has catalytic properties
2. Can associate closely with specific proteins
3. Has variable length
4. Has fixed length and can fold into specific shape
5. Can be subjected to degradation by cytoplasmic enzymes

Which row matches the description to its function?

	Stores coded information	Provides a site for amino acid to bind	Forms a ribosome	Serves as a template for translation
A	4	5	1, 3	2
B	3, 5	1	2	4
C	2	4	1	3, 5
D	1, 5	2	4	3

13 The following two examples illustrate the inheritance of a sex-linked gene on the X-chromosome. In the parental generation (*P*), the homogametic sex is homozygous for colour in both examples.

Cat	Magpie Moth
black dominant to yellow	normal colour dominant to pale colour
<i>P</i> Black male x yellow female	<i>P</i> Pale colour male x normal female
<i>F</i> 1 yellow male to 1 black female	<i>F</i> 1 normal male to 1 pale female

In these crosses, the heterogametic sex is...

- A** male in the cat, female in the moth
- B** female in the cat, male in the moth
- C** male in both the cat and moth
- D** female in both the cat and moth

- 14** After pollinating plant 1, which had rough stems and yellow flowers, with plant 2, which had rough stems and white flowers, 80 seeds were obtained. When sown, these seeds grew into plants showing the four combinations of characteristics as follows:

26 with rough stems and yellow flowers.
 12 with smooth stems and yellow flowers.
 33 with rough stems and white flowers.
 9 with smooth stems and white flowers.

Assuming that yellow is the dominant flower colour, which one of the following options is confirmed by these results?

	plant 1 is heterozygous for	plant 2 is heterozygous for
A	stem surface and flower colour	flower colour only
B	stem surface and flower colour	stem surface only
C	flower colour only	flower colour and stem surface
D	stem surface only	flower colour and stem surface

- 15** Flamingos are birds that live by lakes. The feather colour of flamingos may vary from white to pink to red. To investigate the inheritance of feather colour, a scientist performed the following crosses and recorded the feather colour of all the offspring when one year old. The diet of the offspring was also recorded.

Cross	Feather colour of parents	Feather colour of all one-year-old offspring	Diet of offspring
1	white × white	white	aquatic plants
2	red × white	white	aquatic plants
3	white × white	pink	algae and crustaceans
4	red × white	pink	algae and crustaceans

Based on this information, a correct conclusion would be that...

- A** both the parents in cross 1 must be homozygous for white feather colour.
B white feather colour is recessive to red feather colour
C the feather colour of flamingos is influenced by their environment.
D two parents, both with pink feather colour, would produce pink offspring

- 16** Tyrosinase is an enzyme that catalyses the conversion of the amino acid tyrosine into the black pigment melanin. It is responsible for the black fur colour of some rabbits.

A group of rabbits kept at 30 °C resulted in 90% of the rabbits with light fur colour. A second group of rabbits kept at 10 °C resulted in 90% of the rabbits with black fur colour.

Which hypothesis is supported by these results?

A	An inhibitor is present in rabbit skin cells that can bind strongly to tyrosinase when the external temperature is 30 °C.
B	At 10 °C external temperature there are fewer tyrosinase-tyrosine complexes formed and less melanin is produced.
C	Tyrosinase is an enzyme that is coded for by a gene that is switched off when the external temperature is 10 °C.
D	Tyrosinase is a temperature-sensitive molecule that is only activated when the external temperature is 30 °C.

- 17** In a common genetic condition afflicts children, the mutant allele differs from the wild-type allele by a single nucleotide substitution. This substitution eliminates a *NheI* restriction site so that the mutant allele is not cut by the restriction enzyme, *NheI*. A pedigree of a family exhibiting this condition is shown in Fig. 17.1.

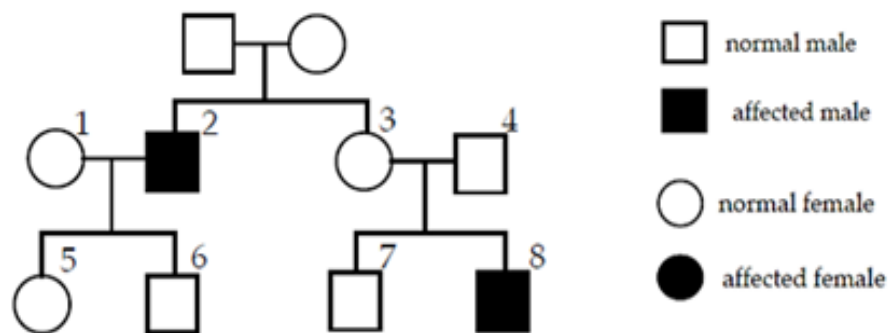


Fig 17.1

The DNA from four individuals in the pedigree were isolated and subjected to polymerase chain (PCR) reaction. This technique amplifies a 1000 bp portion of their DNA that includes the *NheI* site that is affected by the mutation. The PCR products are then digested with *NheI* and analysed.

The DNA fragments from the digest are run on an agarose gel and the results are shown in Fig. 17.2.

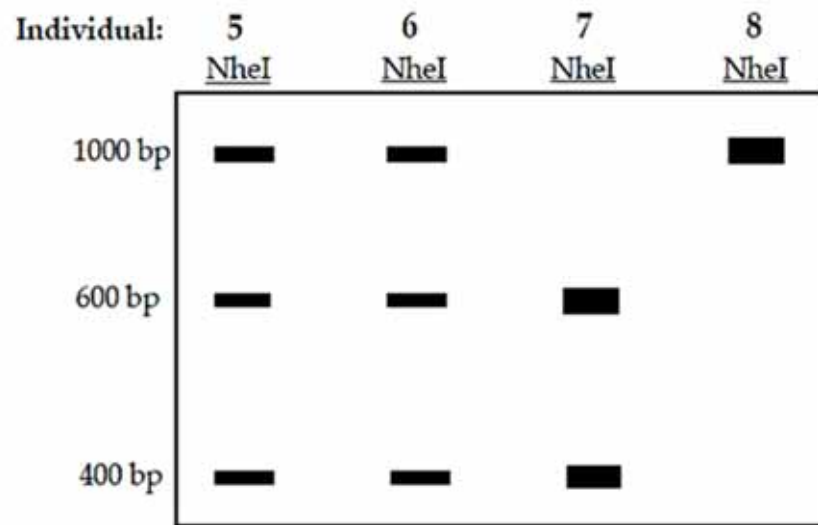
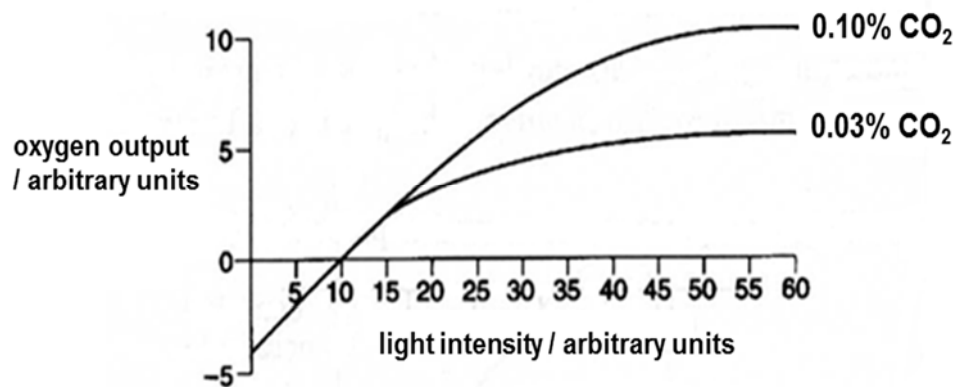


Fig. 17.2

Based on the data in Fig. 17.1 and Fig. 17.2, identify the correct mode of inheritance, and the probability of Individuals 3 and 4 of having a daughter who will be affected.

	Mode of inheritance of disease	Probability
A	autosomal dominant	0.125
B	autosomal recessive	0.25
C	X-linked dominant	0
D	X-linked recessive	0.5

- 18** The graph shows the oxygen output of a green plant at different light intensities in two separate setups with different concentrations of carbon dioxide in the surrounding air.



What can be deduced from the graph above?

- 1 At 10 arbitrary units of light intensity, the rate of photosynthesis is equivalent to the rate of respiration.
- 2 Concentration of carbon dioxide limits the rate of photosynthesis when light intensity exceeds 15 arbitrary units.
- 3 Enzymes catalysing carbon fixation are saturated at high light intensities (above 30 arbitrary units) in both experiments.
- 4 Oxygen output can be used to quantify the rate of photosynthesis due to their role as final acceptor of protons and electrons.

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

- 19** Which of the following statements show a difference between cyclic and non-cyclic photophosphorylation?
- A** Cyclic photophosphorylation only involves PSI and PSII whereas non-cyclic photophosphorylation only involves PSI, PSII and NADP.
 - B** Light is required to boost electrons cyclic photophosphorylation whereas for non-cyclic photophosphorylation, the energy comes from photolysis of water.
 - C** Only non-cyclic photophosphorylation produces protons which is required for the generation of the proton gradient for ATP synthesis.
 - D** Oxygen is produced in non-cyclic photophosphorylation only.

- 20** Metformin is widely used to reduce high blood sugar levels caused by diabetes.

It exerts its activity through increasing glucose uptake and utilisation by cells. Metformin has also been shown to affect mitochondrial respiration in the following ways:

- Decreases the activity of the enzyme (pyruvate dehydrogenase) that converts pyruvate to acetyl CoA
- Inhibit one of the electron carriers in the electron transport chain

Which of the following are possible observations of cells that have been treated with metformin?

1. An increase in oxygen uptake by the cells.
2. A decrease in the pH of the cytoplasm
3. An increase in the breakdown of glucose.
4. A decrease in the carbon dioxide release.

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

- 21** Two respirometers (one shown in Fig 22) were set up to investigate the rate of respiration in spiders. To one setup, the spiders were fed a diet containing a drug before the experiment. For this setup, the drop of fluid remained stationary after a short distance from the starting position. Distance moved is shorter than the control setup.

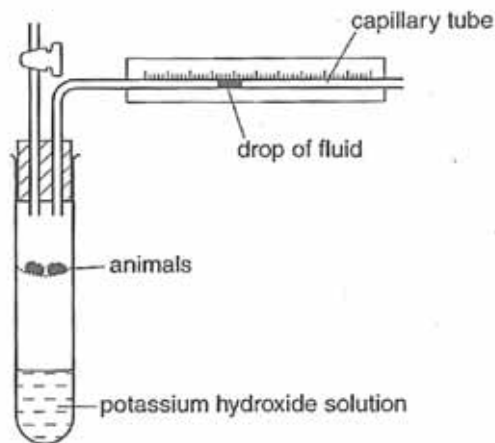


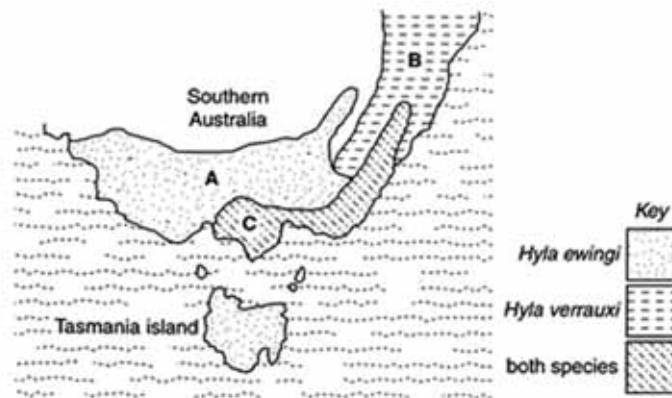
Fig 22

What could be a possible explanation for this observation?

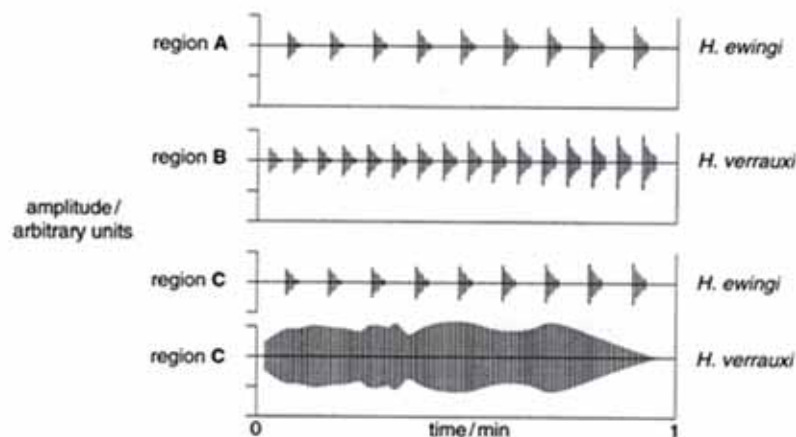
- A** The oxygen content in the boiling tube was depleted.
 - B** A mutation occurred that causes the ATP synthase to become hyperactive.
 - C** A drug was introduced that act as an ion channel on the mitochondrial membrane.
 - D** Inhibitor of the electron carriers in the electron transport chain was added to the animal's diet.
- 22** Which feature does **not** support Darwin's theory of natural selection?
- A** adaptations to the environment, e.g. increased density of fur in bears in cold climates
 - B** homologous molecular structures, e.g. ATP in diverse organisms
 - C** similar anatomy, e.g. same number of neck vertebrae among mammals
 - D** similar structures for specific functions, e.g. fin of whale and shark

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- 23 *Hyla ewingi* and *Hyla verrauxi* are two closely related species of tree frogs from southern Australia.



DNA sequence comparisons show a high level of homology and interbreeding can occur to produce viable offspring. Mate selection is based on females responding to the frequency of mating calls emitted by male frogs. The following data shows the pulse frequency and amplitude in the mating calls of *H. ewingi* and *H. verrauxi* from the regions **A**, **B** and **C**.



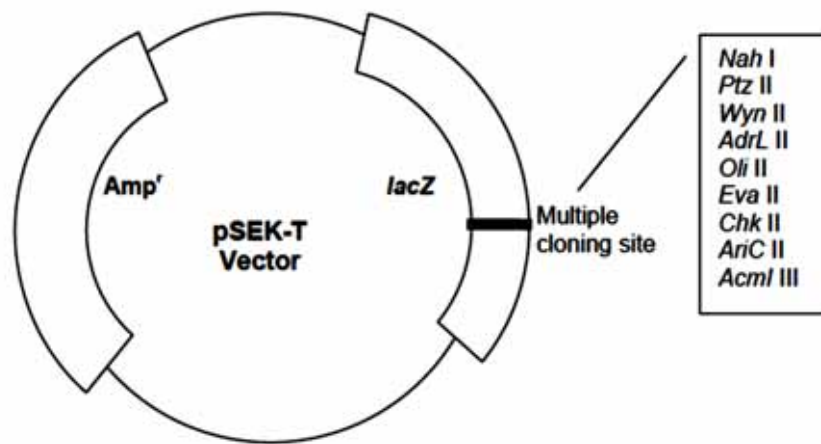
The distinct mating call observed in region C involves events shown below:

- I Sexual selection by females of *Hyla verrauxi* selects for males with a continuous calls over males that emit a discontinuous call.
- II Female *Hyla verrauxi* tree frogs preferred mates that emit calls of higher amplitude.
- III Males of both species in region C compete for mates.
- IV Variations in amplitude occur in male mating calls present in population of *Hyla* frogs.
- V The genes that code for continuous high amplitude calls are passed down to future generations and become established in the population of *H. verrauxi*.

What is the correct sequence of events that leads to the distinct profile of male mating call of *H. verreauxi* in region C?

- A** III → I → IV → II → V
- B** I → II → IV → III → V
- C** IV → I → V → III → II
- D** II → IV → V → I → III

- 24** As part of the procedure to produce recombinant proteins in *E. coli*, you are asked to insert the gene encoding for the D-ONG protein into the pSEK-T vector. The restriction sites and selectable markers on the vector are shown below.



If the gene for D-ONG protein were to be inserted into the multiple cloning site, what should be added to the agar plate in order to screen for recombinant clones and how would the recombinant clones appear?

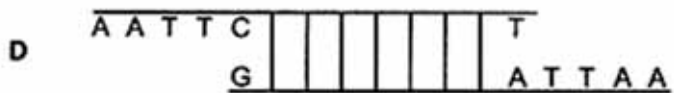
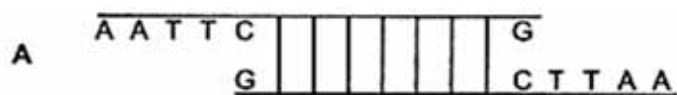
	Chemicals to be added		Colour of colonies
A	Ampicillin	X-gal	Blue
B	β -galactosidase	X-gal	Blue
C	Ampicillin	X-gal	White
D	β -galactosidase	Lactose	White

25 Which of the following does **not** occur during the polymerase chain reaction?

- A Synthesis of a complementary primer
- B Separation of parental DNA strands
- C Formation of strong covalent bonds
- D Involvement of inorganic enzyme co-factors

26 In genetic engineering, a restriction enzyme is used to cut plasmid DNA at a specific target site. The enzyme recognises a sequence of six bases and forms sticky ends.

Which diagram of such a cut section of DNA is correct? A



- 27** One type of GM tilapia that is close to commercial consideration is a hybrid of two tilapia species, with transgene consisting of a tilapia growth hormone cDNA spliced to a viral promoter. Consumers and critics have expressed some concerns about the production of GM tilapia.

- I excessive production of growth hormone in the tilapia
- II GM fish gaining a mating advantage over wild tilapia should they escape
- III production of foreign protein in tilapia
- IV undesirable effects of transgene

Which of their concerns is / are not valid?

- A** I and II
 - B** II and III
 - C** III only
 - D** IV only
- 28** Which combination of properties is true about embryonic stem cells and hematopoietic stem cells?

	embryonic stem cells	hematopoietic stem cells
A	able to form all cell types in the body excluding extra-embryonic tissues	able to form some cell types in the body
B	can self-renew but not differentiate	can self-renew and differentiate
C	cannot perform a specialized function	can perform a specialized function
D	totipotent	multipotent

29 Which of the following is an outcome of the Human Genome Project that has ethical implications?

- A** Screening of the genetic make-up of newborn infants for susceptibility to certain key diseases.
- B** Creation of customised medicines that are potentially more expensive to produce than traditional drugs.
- C** Consideration of a suspect's genetic pre-disposition to violent behaviour in criminal trials
- D** The free availability and accessibility of the complete sequence of the human genome on the Internet.

30 Which of the following is **not** a possible concern of cultivating *Bt* corn?

- A** Toxic effects of *Bt* on non-target insects e.g. monarch butterfly larvae could have predictable ecological consequences.
- B** Transfer of selection marker to bacteria that reside in the human gut thereby conferring upon the bacteria antibiotic resistance
- C** Spread of the *Bt* gene from cultivated corn to wild relative which would then lead to the loss of biodiversity
- D** Transfer of *Bt* gene to the pests thereby increasing their resistance to the *Bt* toxin

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