

CANDIDATE NAME: _____

INDEX NUMBER _____



SERANGOON JUNIOR COLLEGE
JC2 PRELIM EXAMINATION 2016

BIOLOGY PAPER 1
Higher 1

CG _____

Thursday
22 September 2016

1 hour

Additional materials:
OTAS Sheet

READ THESE INSTRUCTIONS FIRST

Write your name and index number in the spaces at the top of this page and on all the work you hand in.

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

Answer **all** questions in this paper. Record your choice in **2B pencil** on the OTAS sheet provided.

At the end of examination, submit the question paper and MCQ OTAS sheet separately.

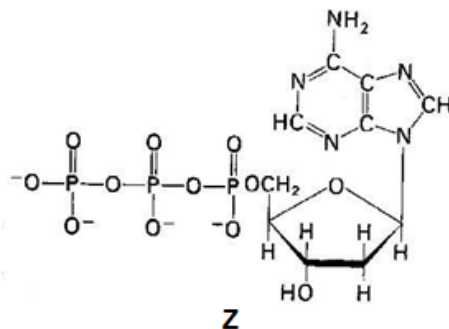
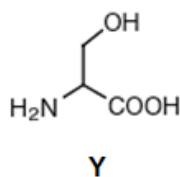
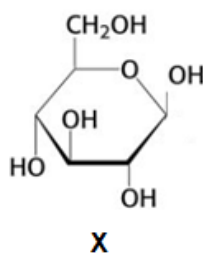
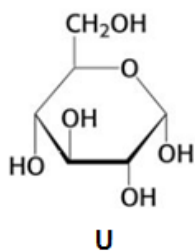
This question paper consists of 20 printed pages excluding this cover page.

Section A [30 marks]

Answer all questions on the OTAS provided.

1. Which of the following best accounts for the difference in structure between amylose which is helical and cellulose which is fibrous?
 - A** Presence or absence of 180° rotation of alternate subunits.
 - B** Presence or absence of branching in the macromolecule
 - C** Subunits are either monosaccharides or amino acids.
 - D** Different tendency of macromolecule to form hydrogen bonds with water.

2. Which of the following combination of polymer, monomer and bond formed between monomers is correct?



	<i>starch</i>	<i>cellulose</i>	<i>polypeptide</i>	<i>polynucleotide</i>
A	X , β -1,4 glycosidic bond	U , α -1,4 glycosidic bond	Z , ester linkage	Y , disulphide linkage
B	U , α -1,4 glycosidic bond	X , β -1,4 glycosidic bond	Y , peptide bond	Z , phosphodiester linkage
C	Z , peptide bond	X , hydrogen bond	Z , ionic bond	U , hydrogen bond
D	X , ionic bonds	Y , peptide bond	U , hydrogen bond	Z , α -1,6 glycosidic bond

3. Most wild plants contain toxins that deter animals from eating them. A scientist discovered that a toxin produced by a certain plant was also toxic to the same plant if it was applied to the roots of the plant. As the first step on finding out why the plant was not normally killed by its own toxin, he fractionated some plant cells and found that the toxin was in the fraction that contained the largest cell organelle. He also found that the toxin was no longer toxic after it was heated. Which of the following statements are consistent with the scientist's observations?

- I. The toxin was stored in the central vacuole.
- II. The toxin cannot cross the membrane of the organelle in which it is stored.
- III. The toxin was stored in chloroplast.
- IV. The toxin is likely to be lipid-soluble.
- V. The toxin may be an enzyme.

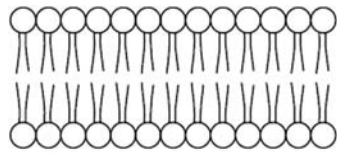
- A I, II and V
- B I, IV and V
- C II, III and IV
- D III, IV and V

4. Which of the following is/are the most likely consequence/(s) for a cell lacking functional lysosomes?

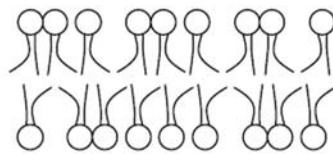
- (i) The cell becomes crowded with undegraded wastes.
- (ii) The cell dies because its ATP-synthesizing mechanisms are missing.
- (iii) The cell dies from a lack of enzymes to catalyze metabolic reactions.
- (iv) The cell is unable to reproduce itself.
- (v) The cell is unable to grow to a mature size and always remains small.

- A (i) only
- B (i) and (v)
- C (ii) and (iv)
- D (iii) and (iv)

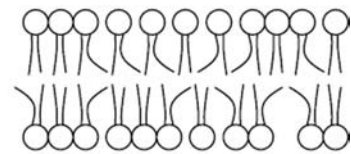
5. A mutated strain of the bacterium *Escherichia coli* was found to be incapable of incorporating unsaturated phospholipids into its plasma membrane. Which of the following correctly depicts and describes the membrane of such a bacteria?



Type I



Type II



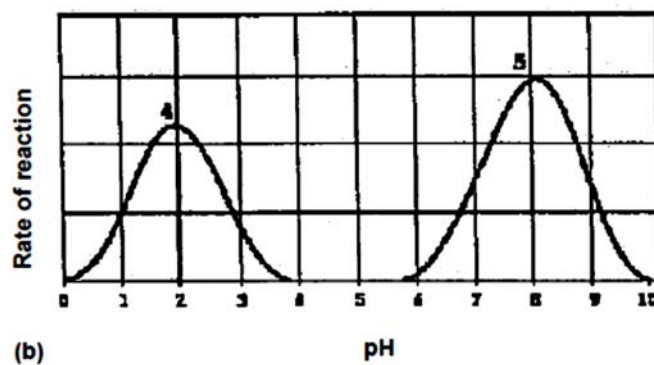
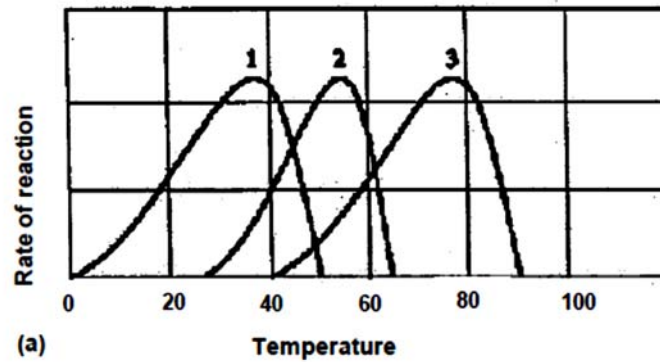
Type III

- A** The membrane would appear as Type I and would be more fluid at low temperatures.
- B** The membrane would appear as Type I and would be less fluid at low temperatures.
- C** The membrane would appear as Type II and would be more fluid at low temperatures.
- D** The membrane would appear as Type III and would be no different from normal bacterial membranes.
6. When mucus is secreted from a goblet cell in the trachea, these events take place.
- (i) addition of carbohydrate to protein
 - (ii) fusion of the vesicle with the plasma membrane
 - (iii) secretion of a glycoprotein
 - (vi) separation of a vesicle from the Golgi apparatus

What is the sequence in which these events take place?

- A** (i), (vi), (ii), (iii)
- B** (i), (vi), (iii), (ii)
- C** (vi), (i), (ii), (iii)
- D** (vi), (i), (iii), (ii)

7. The following graphs show the activities of different enzymes (1-5) under different conditions:

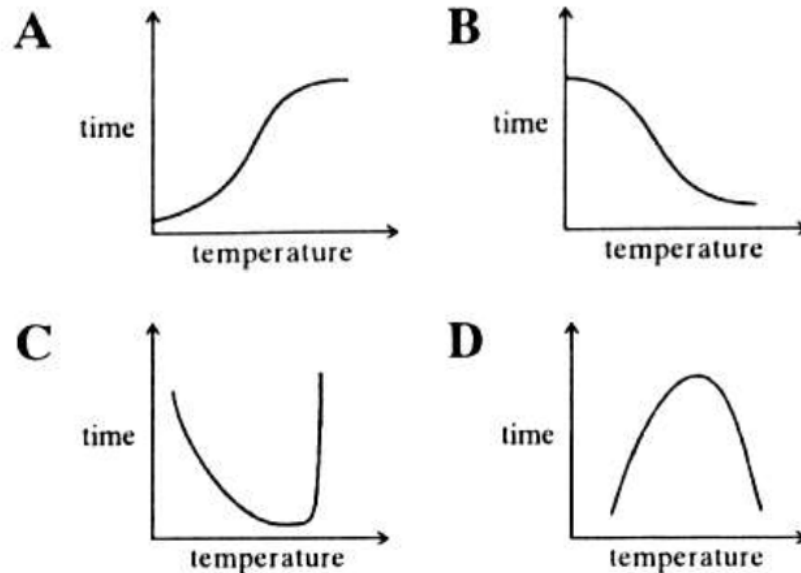


Which statement is a correct explanation for the rate of reaction of different enzymes?

- A** Kinetic energy of enzyme 3 and its substrate is fastest at 75°C.
- B** At pH 2, most of the R groups at the active site of enzyme 4 are all negatively charged.
- C** At pH 8.1, substrate is bonded to the active site of enzyme 5 by hydrogen bonds only.
- D** At 60°C, several hydrogen bonds between R groups of enzyme 2 are broken.

8. In an investigation to determine the effect of temperature on the activity of an enzyme, the time taken for all the substrates to disappear from a standard solution was recorded.

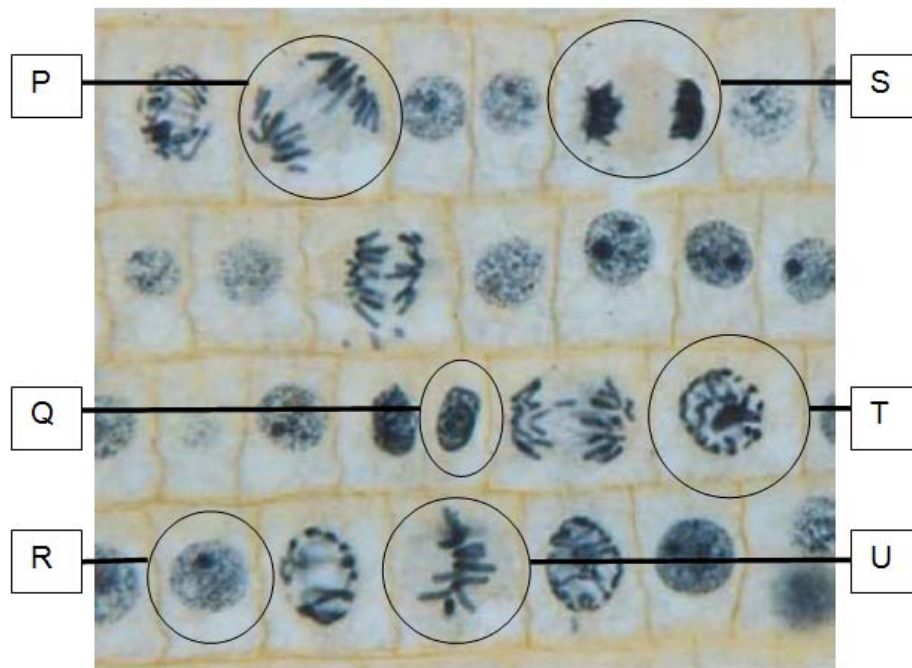
Which graph shows the result of this investigation?



9. Which of the following statements about meiosis is **false**?

- A** Sister chromatids are separated at anaphase II
- B** Homologous chromosomes are separated in anaphase I.
- C** Cells at the beginning of Meiosis II are haploid
- D** Homologous chromosomes are paired on the metaphase plate in metaphase I.

10. The photographs below show a section of the onion root tip. The cells are at different stages of mitosis.



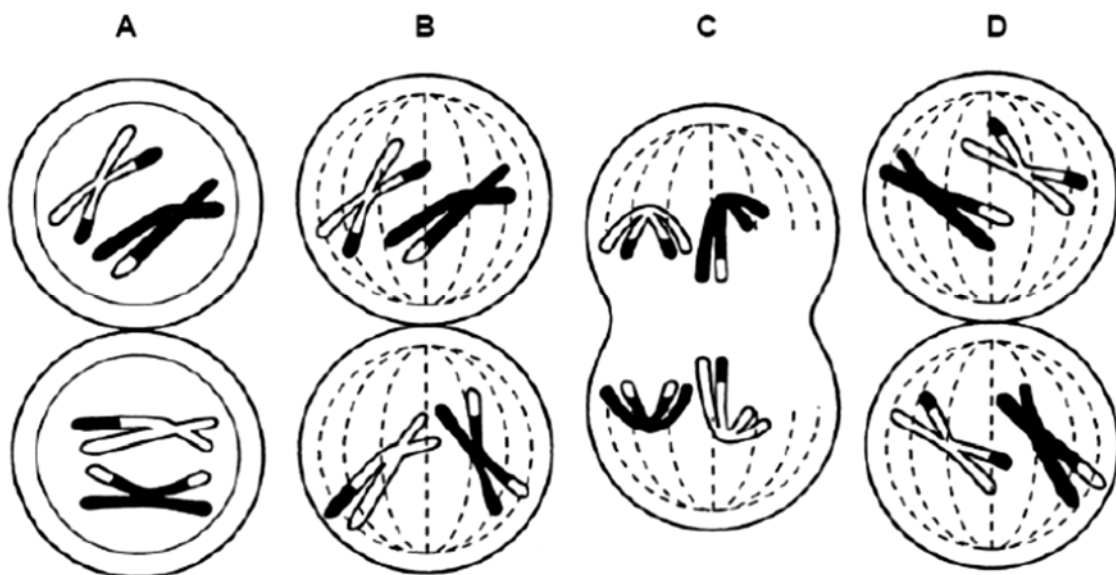
Which of the following shows the correct sequence of events that occurs in these cells?

- A** R, T, U, P, S, Q
- B** T, U, P, S, Q, R
- C** Q, T, P, S, U, R
- D** T, R, P, S, U, Q

11. The diagram shows anaphase I of meiosis.



Which diagram shows metaphase II as meiosis continues in this cell?



12. For a double-stranded DNA, which of the following base ratios always equals 1?

- I. $(A + T) / (G + C)$
- II. $(A + G) / (C + T)$
- III. C / G
- IV. $(G + T) / (A + C)$
- V. A / G

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

13. The diagram below is a template strand of a DNA molecule.

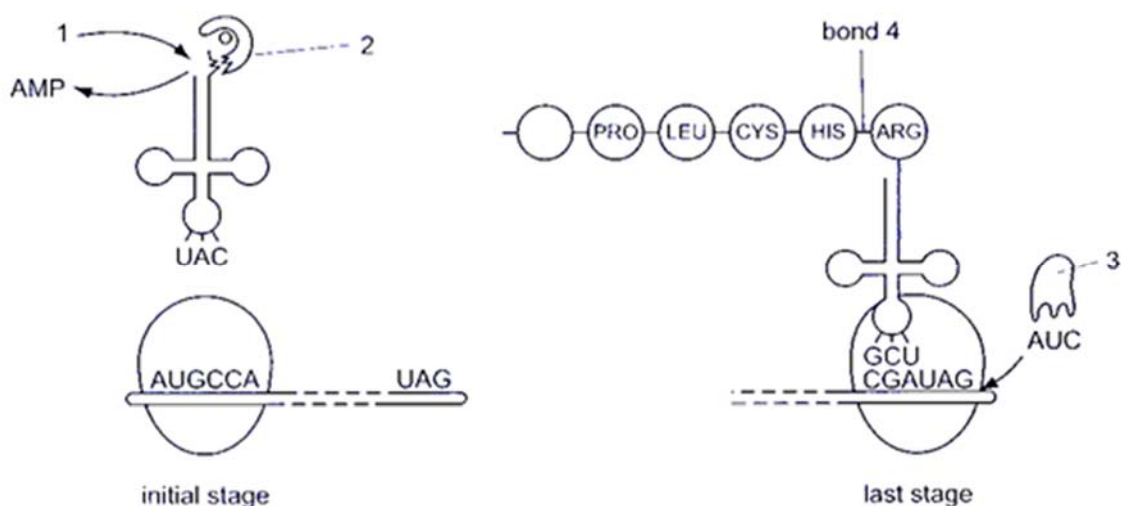
Promoter (18 nucleotides in length)	TAC	DNA sequence of 330 nucleotides	ATC
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The number of amino acids in the protein coded by this template strand is

- A 110
- B 111
- C 112
- D 118

14. A number of molecules other than tRNA and mRNA are involved during translation.

The diagram shows some of these molecules and nucleotides in the codon and anticodon positions.



Which of the following is correct?

	1	2	3	4
A	ADP	Aminoacyl tRNA synthetase	Amino acid	Hydrogen bond
B	ADP	Amino acid	Translation releasing factor	Hydrogen bond
C	ATP	Aminoacyl tRNA synthetase	Aminoacyl tRNA	Peptide bond
D	ATP	Aminoacyl tRNA synthetase	Translation releasing factor	Peptide bond

15. With reference to a single eukaryotic gene, which of the following molecules contains the fewest number of nucleotides?

- A A single strand of the original DNA segment
- B A primary RNA transcript made from the original DNA segment
- C A single strand of the original DNA segment after a point mutation
- D A single strand of the complementary DNA (cDNA) made from the mature mRNA

16. The coat colour of Norwegian cattle is mainly determined by the distribution of two pigments: red and black. Both pigments are made due to the action of the enzyme tyrosinase in cells called melanocytes. A normal level of activity of the enzyme leads to the production of red pigment, whilst a high activity allows only black pigment production. The activity of the enzyme is increased by melanocyte stimulating hormone (MSH), which binds to an MSH receptor.

The receptor is coded for by the **E** locus, which has the three alleles, **E^D**, **E^A** and **e**. **E^D** is insensitive to protein A which blocks MSH receptor. **E^A** is sensitive to protein A which blocks MSH receptor. No receptor is produced by the recessive allele, **e**.

The dominant allele of a second gene, the **A** locus, codes for a protein which binds to and blocks the MSH receptor coded for by **E^A**, thus preventing stimulation of tyrosinase activity in a melanocyte.

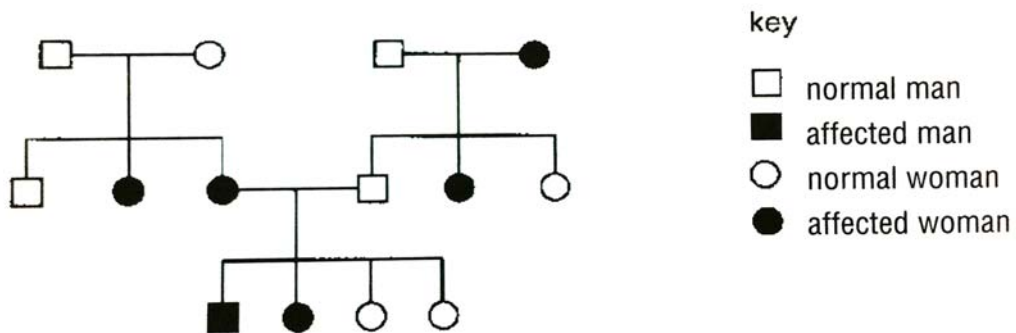
What would be the coat colours of cattle with the following genotypes?

	eeAa	E^Aaaa	E^DeAa	E^AE^AAa
A	Red	Black	Black	Red
B	Red	Black	Red	Red
C	Black	Red	Red	Black
D	Red	Red	Black	Black

17. Two parents have a son who has blood group A and phenylketonuria. One parent has blood group O and the other has blood group AB. Neither parent has phenylketonuria. What is the probability that the second child of these parents will be a girl with blood group B who does not have phenylketonuria?

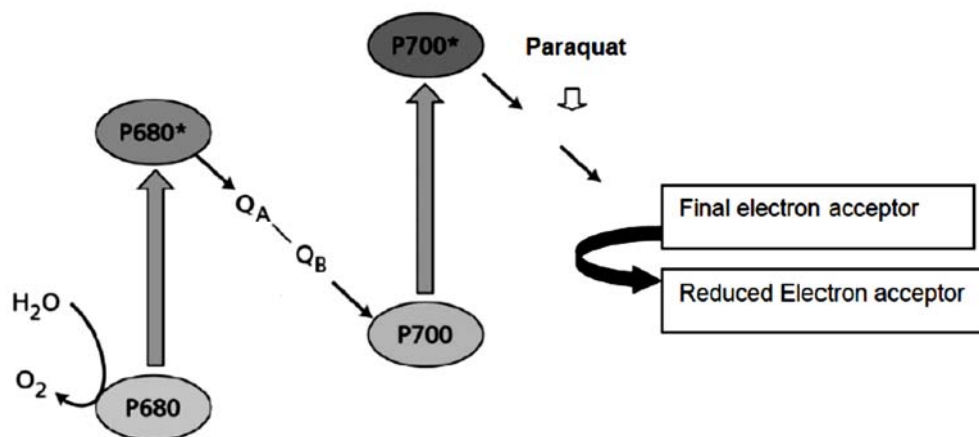
- A** 1 in 16
- B** 1 in 8
- C** 3 in 16
- D** 3 in 8

18. The family tree shows the inheritance of a skin condition.



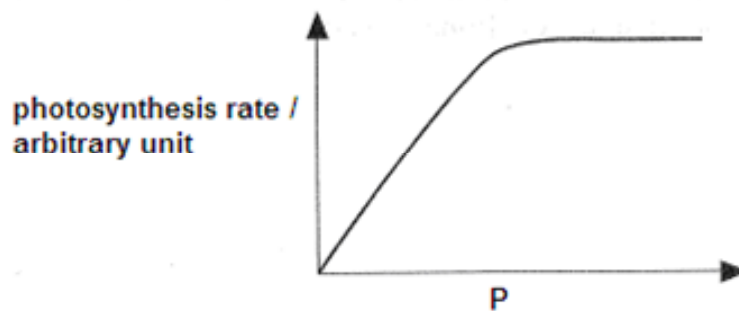
What is the genetic basis of the skin condition?

- A autosomal dominant
 - B sex-linked dominant
 - C autosomal recessive
 - D sex-linked recessive
19. Paraquat is a poison that disrupts electron transport at the position indicated in the diagram. Paraquat was added to isolated chloroplasts. Which of the following correctly represents the outcomes in the presence of paraquat?



- A Both light dependent reactions and Calvin cycle will not be able to proceed.
- B Only Calvin cycle can proceed.
- C Only light dependent reactions can occur.
- D Both light dependent reactions and Calvin cycle can still proceed as per normal.

20. The following graph shows the relationship between the rates of photosynthesis with environmental factor **P**.

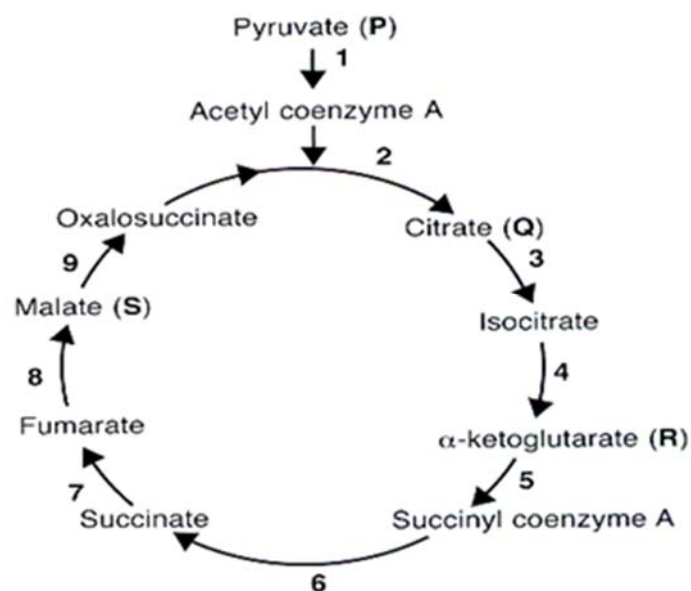


P most probably represents

1. carbon dioxide concentration.
2. oxygen concentration.
3. light intensity.
4. temperature.

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

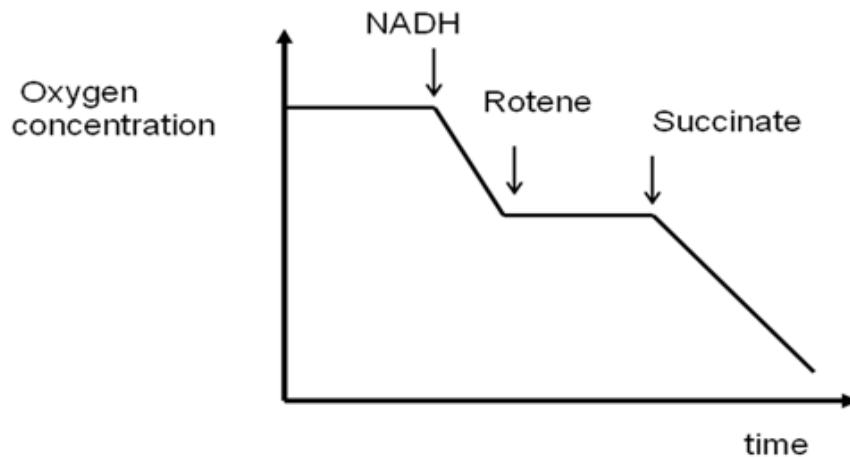
21. The diagram below shows the Krebs Cycle.



At which stages are carbon atoms removed?

- A** 1, 4 and 7
B 1, 4 and 5
C 2, 4 and 5
D 4, 5 and 8

22. A suspension of mitochondria was prepared in a buffer containing ADP and inorganic phosphate (Pi). The oxygen concentration in the buffer was monitored carefully and recorded as shown below. At the times indicated, a specific reagent was added to the buffer. Throughout the experiment, the concentrations of ADP and Pi were in excess.

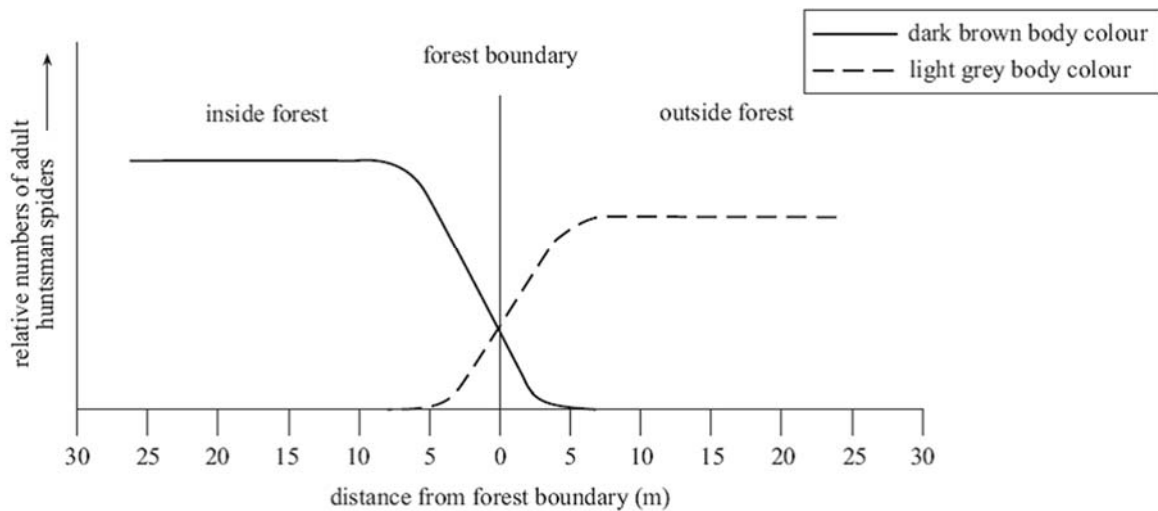


Which one of the following shows correctly from the highest to the lowest, the rate of ATP production after the addition of the three chemicals?

	<i>Highest rate of ATP production</i>	→	<i>Lowest rate of ATP production</i>
A	NADH	Succinate	Rotene
B	Succinate	NADH	Rotene
C	Rotene	NADH	Succinate
D	Rotene	Succinate	NADH

23. Members of two different species possess a similar-looking structure that they use in a similar fashion to perform the same function. Which information would best help distinguish between an explanation based on homology versus one based on convergent evolution?
- A** The two species live at great distance from each other.
 - B** The two species share many proteins in common, and the nucleotide sequences that code for these proteins are almost identical.
 - C** The sizes of the structures in adult members of both species are similar in size.
 - D** Both species are well adapted to their particular environments.

24. The graph below shows the distribution of huntsman spiders at a forest boundary.



One species of huntsman spider (*Isopeda isopedella*) varies in body colour from dark brown to light grey. In one community at the forest boundary, two populations of this species were found. Some were found living in the leaf litter inside the forest and others were found living in the grass just outside the forest. The relative numbers of dark brown adult spiders and light grey adult spiders found at certain distances from the forest boundary are shown in the graph above.

The best explanation for this distribution is that

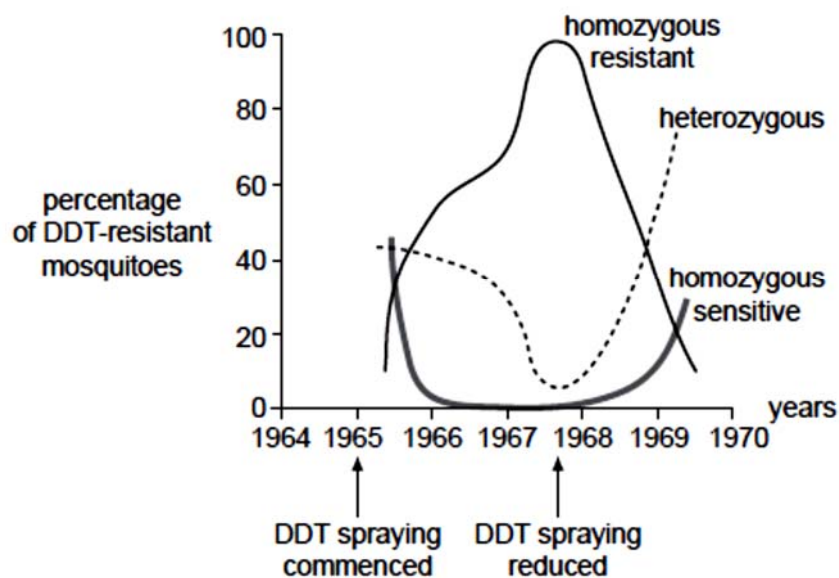
- A** the two populations of spiders were once different species.
- B** the two populations of spiders were unable to interbreed and individuals were adapting to suit their habitats.
- C** the differences in the two habitats had changed the physical appearance of individual spiders.
- D** a particular body colour provided a selective advantage to spiders in a particular habitat.

25. In the mid-1960s, DDT was widely used as an insecticide against mosquitoes. The sensitivity to insecticide in mosquitoes is determined by a single gene that has two alleles.

allele 1 : resistant to DDT

allele 2 : sensitive to DDT

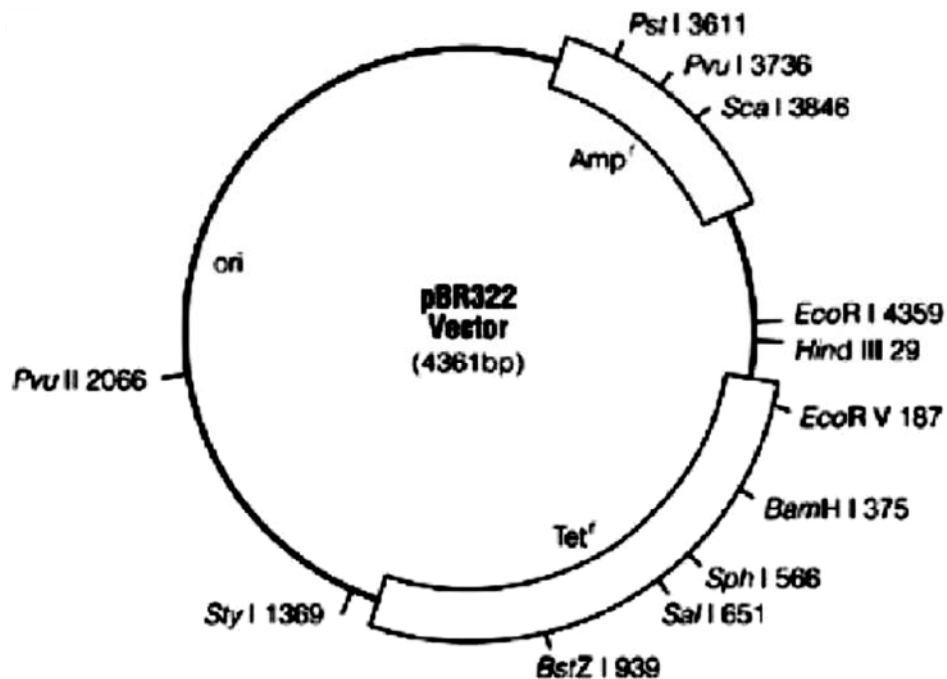
Over several years genotypic frequencies were measured in a population of mosquito larvae. The graph below shows the results.



Analysis of the graph reveals that in the population

- A when spraying levels declined, heterozygous advantage occurred.
- B there were no alleles for sensitivity present in the population in 1967.
- C the number of alleles for resistance was equal to the number for sensitivity in 1966.
- D the homozygous resistant genotype was unable to produce offspring at low spraying levels.

26. pBR322 vector is used to clone a eukaryotic gene which has been digested by the restriction endonuclease BamHI.



Following transformation, bacterial cells were grown in four different media, as shown below:

- I nutrient broth plus ampicillin
- II nutrient broth plus tetracycline
- III nutrient broth plus ampicillin and tetracycline
- IV nutrient broth without antibiotics

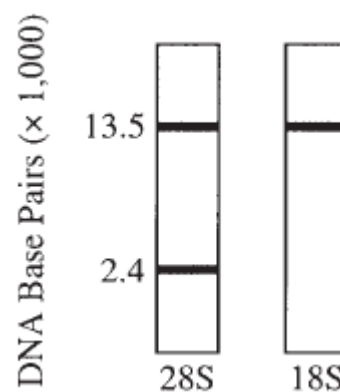
In which media would bacterial cells that contain the recombinant plasmids grow in?

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

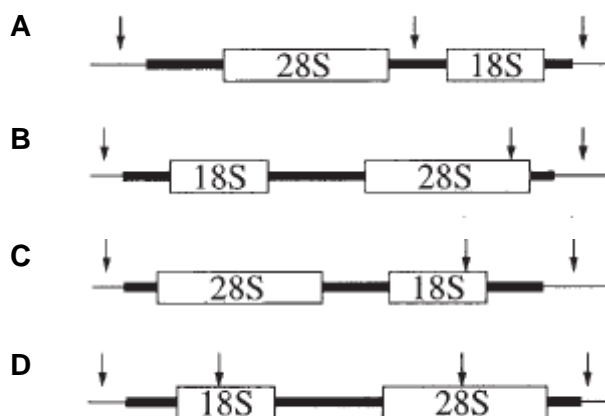
27. Which of the following shows a correct comparison of the various processes?

	Polymerase Chain Reaction	Transcription
A	Occurs in the cytoplasm	Occurs in the nucleus
B	Requires nucleic acid	Does not require nucleic acids
C	Involves hydrogen bonding	Involves hydrogen bonding
D	Replicates the entire template strand	Replicates the entire template strand

28. The autoradiograms obtained below (after electrophoresis and Southern Blotting) show human DNA digested with a specific restriction enzyme and probed with labeled rRNA. In the autoradiogram on the left, the probe was 28S rRNA; at the right, the probe was 18S rRNA.



If the arrows in the following map show the location of the restriction sites of this restriction enzyme, which map *best* explains the results shown above?



29. Which of the following statements are **true** about all stem cells?

- I Stem cells can be induced to differentiate by environmental signals.
- II Stem cells are easily isolated and propagated
- III Stem cells are able to develop into whole organisms if implanted into the womb
- IV Stem cells make more stem cells under appropriate conditions.

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

30. Maize varieties are being developed in which the leaves produce proteins that are toxic to insects. The DNA coding for these toxic proteins was inserted into a maize chromosome via a bacterial plasmid. Many people are opposed to this process.

Which objection is **not** biologically valid?

- A Beneficial insects may be killed if they eat genetically modified maize.
- B Genes for antibiotic resistance are present in plasmids and these genes may be passed to harmful bacteria.
- C Hybridisation may transfer the bacterial genes from maize to weeds, giving the weed species new and harmful characteristics.
- D Mutations may be caused in cattle or humans that eat the genetically modified maize.

End of Paper