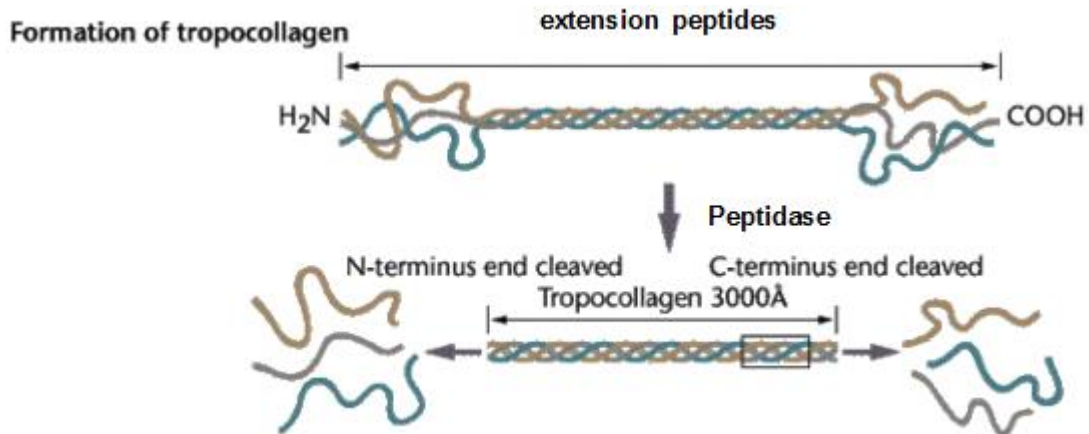


- 1** A plant suspension was prepared by grinding up plant material. The component parts were then separated via centrifugation. At the end of this process, there was a layer of sediment at the bottom of the test tube covered by an aqueous solution. Organelles found in the sediment took up carbon dioxide and produced oxygen when illuminated. The organelles are likely to be
- A** chloroplasts.
 - B** endoplasmic reticulum.
 - C** mitochondria.
 - D** nuclei.
- 2** Phalloidin is a toxin made by the death cap mushroom. The toxin binds to actin subunits and disrupts actin function. Which of the following structures would be most directly affected by phalloidin?
- A** intermediate filaments
 - B** microfilaments
 - C** microtubules
 - D** keratin fibres
- 3** Which of the following are correct statements about triacylglycerols?
- 1 Esterification can occur in a step-wise manner to form non-polar triacylglycerols.
 - 2 Water is necessary to form polar triacylglycerol.
 - 3 H atom from glycerol and OH from fatty acids will combine to form water.
 - 4 Non polar hydroxyl groups from glycerol and polar carboxyl group from fatty acids form non-polar triacylglycerols.
 - 5 Polar hydroxyl groups from glycerol and polar carboxyl group from fatty acids form non-polar triacylglycerols.
- A** 1, 2 and 3
 - B** 2, 3 and 4
 - C** 1, 3 and 5
 - D** 1, 3 and 4

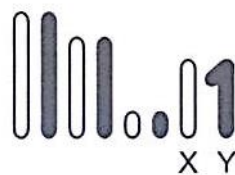
- 4 When collagen polypeptides are synthesised, they have additional amino acids residues on both their N and C termini that are absent in mature collagen. On secretion out of the fibroblast into extracellular space, these extension peptides are cleaved by peptidases.

What is the role of the extension peptides?



- A** Extension peptides are part of the secondary structure that contain glycine residues that can assist in formation of the helical structure for each polypeptide.
- B** Extension peptides contain cysteine residues to form disulfide bonds so as to align the three polypeptides to form a triple helix.
- C** Extension peptides have 4-hydroxyproline residues to stabilise the structure via hydrogen bond formation.
- D** Extension peptides have lysine and allysine to form cross links to hold the triple helix together.
- 5 No crossing over occurs during meiosis in male fruit flies of the species *Drosophila melanogaster*.

The diagram shows the four pairs of homologous chromosomes present in a testis cell of a male fly.



Which set of chromosomes in a gamete nucleus shows the genetic variation resulting from independent assortment?



- 6** It has been suggested that breast cancer cells produce high levels of hydrogen peroxide. This causes connective tissue cells near the cancer cells to digest some of their mitochondria, releasing nutrients which feed the cancer cells.

Which observations made on breast cancer cells and connective tissue cells growing in tissue culture support this view?

- 1 Breast cancer cells grown alone produce hydrogen peroxide.
- 2 Treating breast cancer cells with hydrogen peroxide causes apoptosis.
- 3 Connective tissue cells grown with breast cancer cells have reduced mitochondrial activity.
- 4 Treating breast cancer cells with peroxidase increases cancer cell death.

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

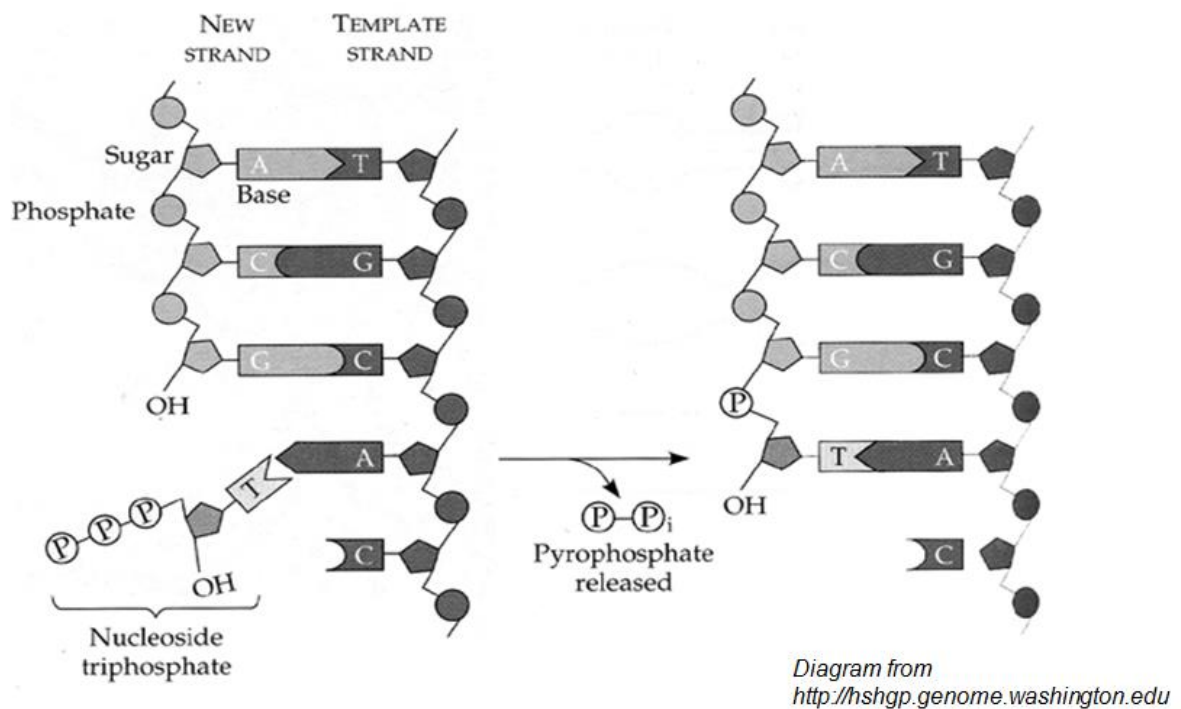
- 7** When DNA replicates, new nucleotides containing the common isotope of nitrogen (^{14}N) are used to build new nucleic acids.

In the laboratory, nucleotides can be synthesised using the heavy isotope of nitrogen (^{15}N). DNA is allowed to replicate once using these ^{15}N nucleotides, then two more times using ^{14}N nucleotides.

What will be the ratio of ^{14}N to ^{15}N nucleotides in the final molecules?

- A** 1:1
- B** 3:1
- C** 5:1
- D** 7:1

- 8 The diagram below shows the synthesis of a new strand of DNA during interphase.



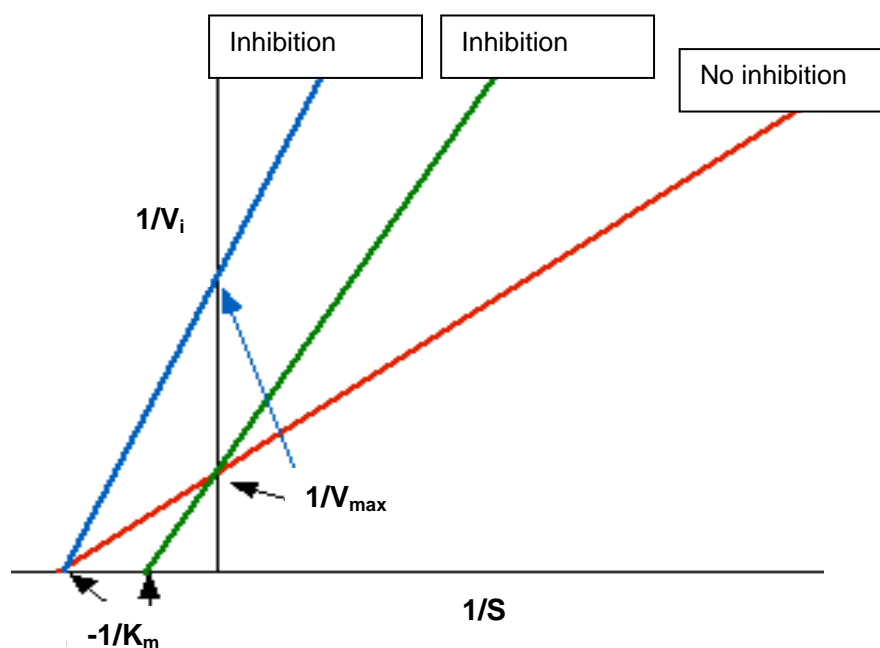
Which of the following shows the correct combination of bond(s) that need to be formed and the kind of reaction that is involved in order for the nucleotide to be added to the DNA chain?

- A hydrogen and condensation
 - B phosphodiester and hydrolysis
 - C covalent bond and hydrolysis
 - D phosphodiester and condensation
- 9 Which statement about the transcription and translation of exons and introns is correct?
- A Exons and introns are both transcribed but only the exons are translated.
 - B Exons and introns are both transcribed but only the introns are translated.
 - C Only the exons are transcribed and translated.
 - D Only the introns are transcribed and translated.

10 Which of the following components are not directly required during translation?

- A aminoacyl-tRNA synthetase
- B small ribosomal subunit
- C peptidyl transferase
- D rRNA

11 The diagram shows two types of inhibition, namely competitive and non-competitive inhibition. Which comparative statements about competitive and non-competitive inhibition are correct?



- 1 Competitive inhibitors compete with substrate and bind to active site while non-competitive inhibitors bind to substrate.
- 2 In non-competitive inhibition, $1/V_{max}$ is changed with increasing substrate concentration while no change in competitive inhibition.
- 3 In non-competitive inhibition, $1/K_m$ changes but in competitive inhibition, $1/K_m$ remains unchanged.
- 4 K_m increases in competitive inhibition but remains constant for non-competitive inhibition.

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

- 12** Two genes, A and B, affect the length of leaf and colour of flower. Gene A has two alleles, S^L and S^l . The genotype $S^L S^L$ produces very long leaf, $S^L S^l$ produces medium length leaf and $S^l S^l$ produces short leaf. Gene B has two alleles. B produces purple pigment and is dominant over the allele b that produces no pigment. Two plants, both heterozygous for both genes are crossed.

How many phenotypes are expected in the next generation?

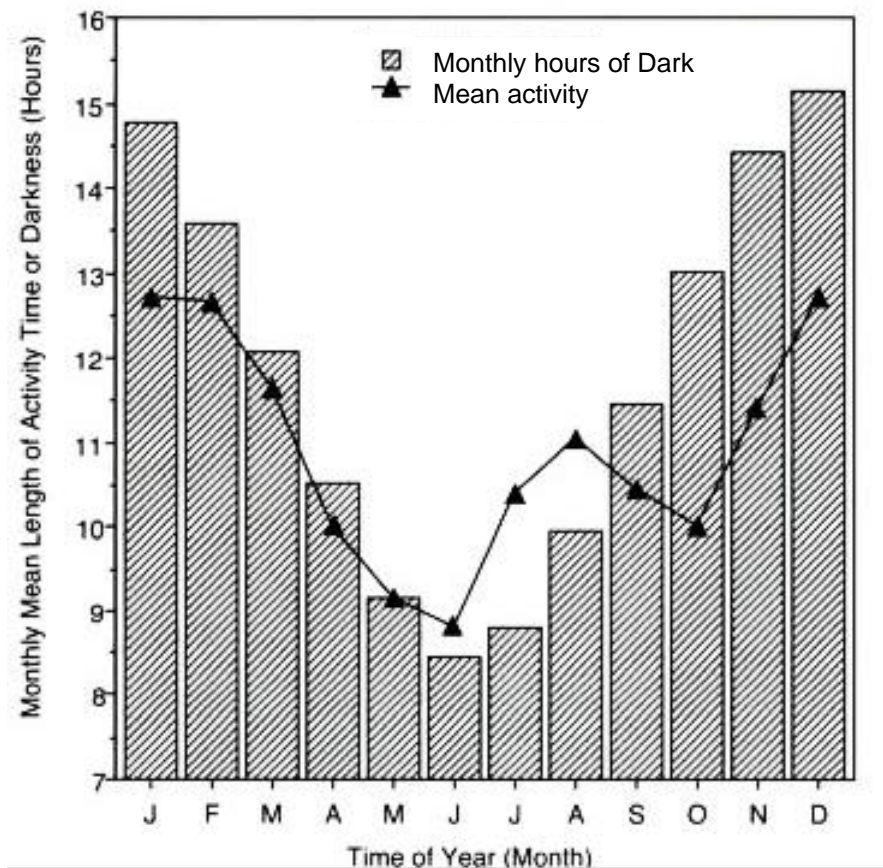
- A** 4
- B** 6
- C** 8
- D** 12
- 13** The fur colour of rabbits is controlled by a gene with 3 alleles. The phenotypes are black, brown and white fur. 4 crosses were repeated many times. The crosses and the outcomes of these crosses are shown in the table below.

Cross	Parents	Offspring phenotype and phenotypic ratio
1	Black x Black	3 Black : 1 white
2	Brown x White	1 Brown : 1 White
3	Black x Black	3 Black : 1 Brown
4	White x White	All white

Which conclusion is correct?

- A** Brown fur is recessive to white fur.
- B** All of the white fur offspring are heterozygous.
- C** The black fur parents in cross **1** have the same genotype as the black fur parents in cross **3**.
- D** Two thirds of the black fur offspring in cross **3** are heterozygous.

- 14 The graph shows the monthly hours of activity of the snowshoe hares in darkness and sunlight across the year. The colour of the fur undergoes a cycle during the year from brown to white and back to brown.



Which statement best explains the cyclical change in colour of the fur?

- A** Hares are most active during the dark and melanin production is least stimulated by retinal cells resulting in new growth of white fur.
- B** Hares are most active during the dark and with the photo-sensitive pigment in the retina, brown pigment is formed.
- C** Hares are most active during the long sunny days and hence, melanin is produced in the sun resulting in brown colour.
- D** Hares are least active during the long sunny days and hence, melanin production is also less stimulated as hares are hibernating.

- 15 S and T are two identical cells. Only the X chromosomes are shown in these cells. When these cells undergo meiosis to form gametes, non-disjunction of the chromosomes occurred. In cell S, it occurred during meiosis I whereas in cell T, it occurred during meiosis II.

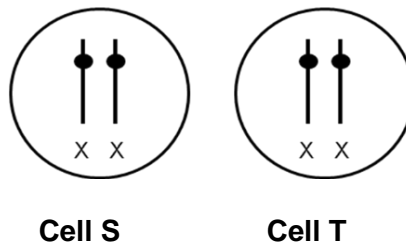
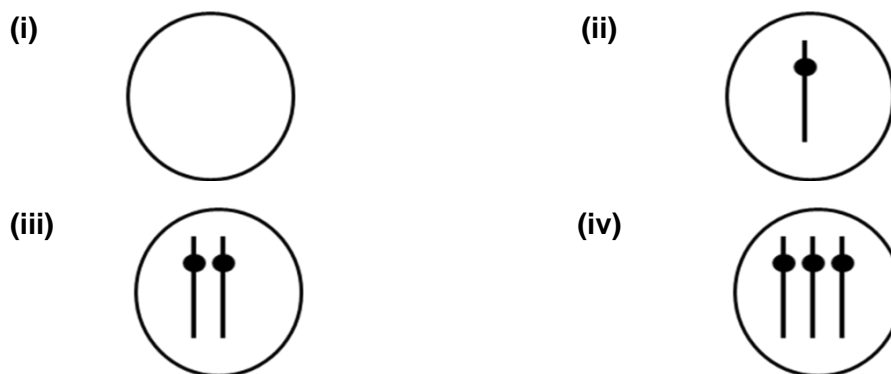


Diagram above showing two identical cells, S and T

The diagrams below show some combinations of X chromosome(s) in gametes.

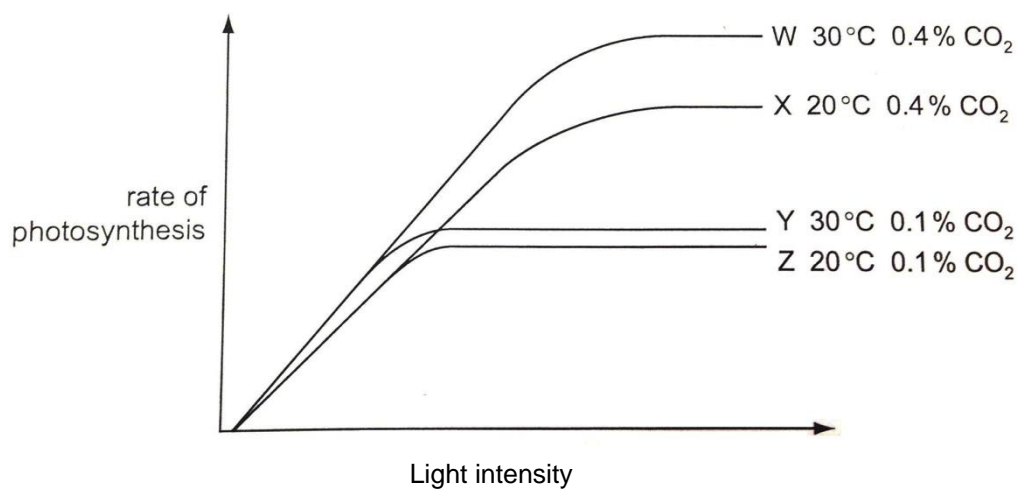


Which of the following options shows correctly the type of gametes that is/are common to both form of non-disjunction?

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

- 16** Which of the following processes could still occur in a chloroplast in the presence of an inhibitor that prevents H^+ from passing through ATP synthase complexes?
- 1 Sugar synthesis
 - 2 Photolysis of water
 - 3 Transfer of electrons down the electron transport chain
 - 4 Oxidation of NADPH
- A** 1 and 2
- B** 1 and 4
- C** 2 and 3
- D** 3 and 4
-
- 17** Which of the following statements regarding cyclic and non-cyclic photophosphorylation is true?
- A** Only cyclic photophosphorylation can function in the absence of photosystem II.
- B** Cyclic photophosphorylation is dependent on products generated through non-cyclic photophosphorylation.
- C** Only non-cyclic photophosphorylation utilises electrochemical gradient generated to drive ATP production.
- D** Cyclic photophosphorylation only requires light at 680 nm to function optimally while non cyclic photophosphorylation requires light at both 680 nm and 700 nm to function optimally.

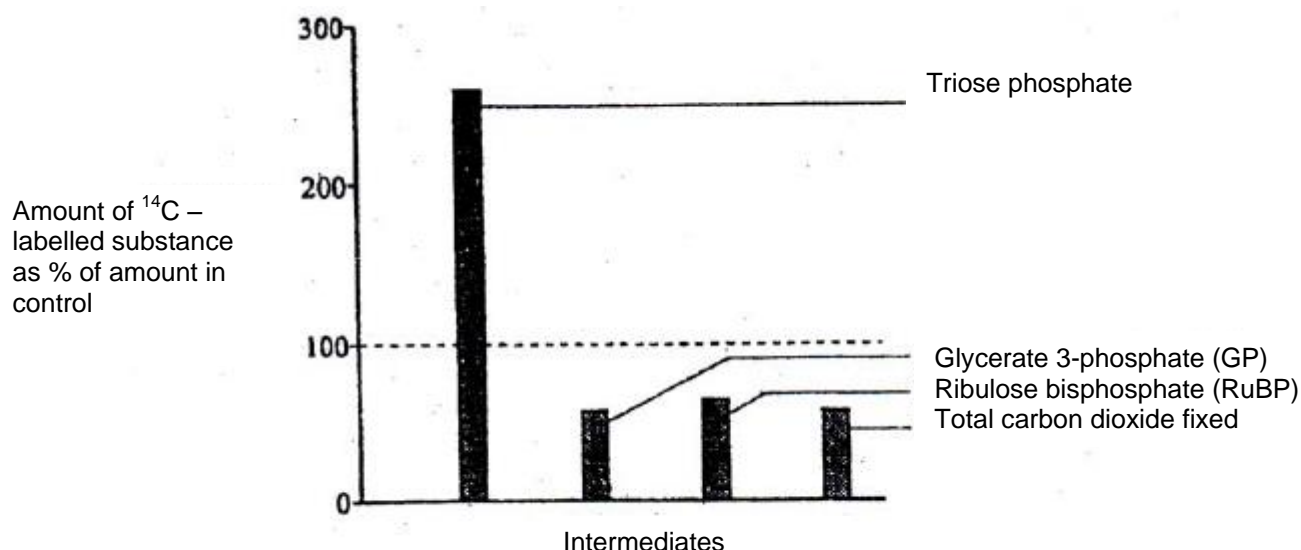
- 18 The diagram shows the results of an investigation into the effect of changing light intensity on the rate of photosynthesis at two different carbon dioxide concentrations and two different temperatures.



Which of the following is true for curve X and which curve supports this?

	Limiting factor	Evidence
A	carbon dioxide	curve Y as a decrease in carbon dioxide concentration decreases rate
B	carbon dioxide	curve Z as rate becomes constant at lower light intensities
C	temperature	curve W as an increase in temperature increases rate
D	temperature	curve Z as rate becomes constant at lower light intensities

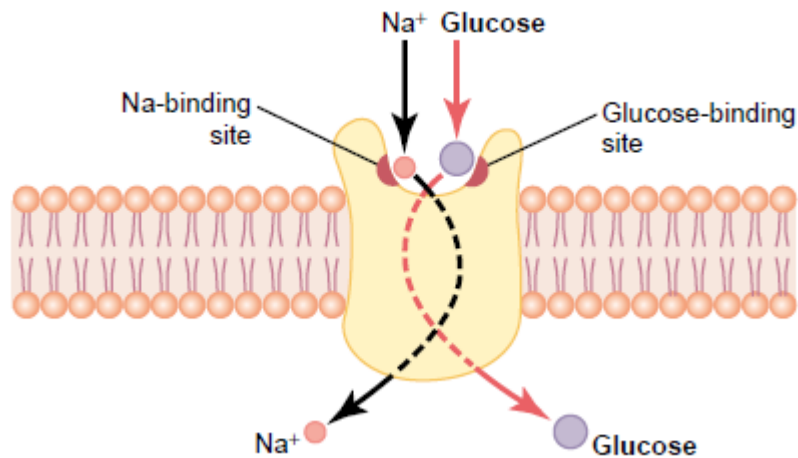
- 19 An illuminated suspension of unicellular alga *Chlorella* in cadmium chloride was treated with carbon dioxide labelled with ^{14}C . The light was switched off and the amount of radioactivity present in some intermediates was determined after 10 minutes in the dark. A control suspension of cells without cadmium chloride was treated in exactly the same way. The bar chart below shows the amount of radioactivity in these intermediates in the cells from the cadmium chloride solution compared with the control cells.



- A** Cadmium chloride causes triose phosphate to accumulate as it prevents triose phosphate from being converted to hexose sugars.
- B** Cadmium chloride decreases the total amount of carbon dioxide fixed by RuBP by inhibiting RuBP carboxylase oxygenase.
- C** Cadmium chloride increases the rate at which glycerate-3-phosphate is being reduced to triose phosphate.
- D** Cadmium chloride prevents the regeneration of RuBP by inhibiting the enzyme at the stage just after triose phosphate.

- 20** In the epithelial cells lining the intestines, many glucose transporters are found. This glucose transporter is an integral protein.

Which statement explains how glucose is transported from the intestinal lumen to the epithelial cells?



- A** Glucose is transported across by active transport using energy from the movement of Na^+ down its electrochemical gradient.
- B** Glucose is transported across the membranes by a uniporter, a type of facilitated diffusion protein.
- C** With the binding of Na^+ , the channels of the integral protein are opened to allow the flow of glucose into the cell.
- D** Glucose is transported by active transport using ATP and is coupled with movement of Na^+ down its concentration gradient.
- 21** Which of the following statements are true for natural selection?
- I The mechanism is random.
 - II It usually affects the smaller population.
 - III It results in adaptation.
 - IV It affects the genetic make-up of the population.
- A** I and IV
- B** III and IV
- C** II and III
- D** I, III and IV

22 Which statement(s) correctly describes Darwinian evolutionary theory?

- 1 Advantageous behaviour acquired during the lifetime of an individual is likely to be inherited.
- 2 In competition for survival, the more aggressive animals are more likely to survive.
- 3 Species perfectly adapted to a stable environment will continue to evolve.
- 4 Variation between individuals of a species is essential for evolutionary change.

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

23 The table shows the functions of three bones, M, I and S, in three classes of vertebrates. Each bone arises in the same way in embryos of the three classes.

class	M	I	S
fish	part of the articulation of upper and lower jaws	part of the articulation of upper and lower jaws	attaches the upper and lower jaws to the skull
amphibian	part of the articulation of the lower jaw	part of the articulation of the lower jaw	transmits sound to the inner ear
mammals	transmits sound to the inner ear	transmits sound to the inner ear	transmits sound to the inner ear

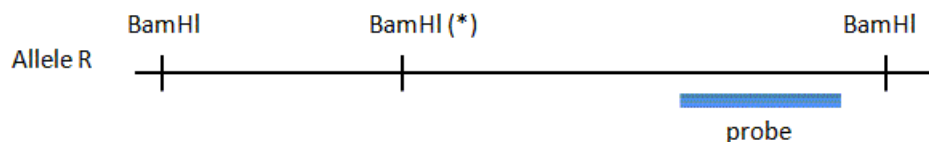
How do the functions of these bones support Darwin's theory of natural selection?

- A** They show convergent evolution of homologous structures.
- B** They show divergent evolution of analogous structures.
- C** They show how analogous structures have become adapted to perform different functions.
- D** They show how homologous structures have become adapted to perform different functions.

- 24 Which row correctly provides the solutions to overcome the problems associated with the expression of eukaryotic genes in prokaryotes using recombinant DNA technology?

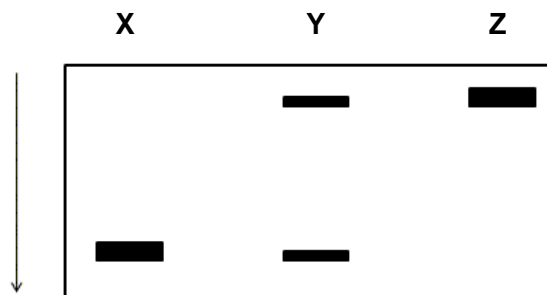
	Problem	Way to overcome
A	Inability to perform post-transcriptional modification	Derive from mRNA with all introns removed and form DNA.
B	Inability to recognize eukaryote's promoter	Replace with a strong bacteria <i>Ori</i>
C	Inability to perform post-translational modifications	Form fusion proteins and mix
D	Inability to perform pre-translational modification	Insert a bacterial signal sequence that targets the protein for secretion.

- 25 The diagram below shows the restrictions sites along allele R recognised by the restriction enzyme, *Bam*HI.



*Bam*HI (*) indicates a mutation within the restriction site which gives rise to recessive allele r.

DNA samples from three individuals, X, Y and Z, were subjected to restriction digestion by *Bam*HI and separated by gel electrophoresis. The following results were obtained after probing.



Deduce the genotype of individual Z.

- A RR
- B Rr
- C rr
- D $X^R Y$

- 26** When a polymerase chain reaction (PCR) amplification was performed on human genomic DNA, multiple products of varying sizes were obtained, including one of the expected size.

Which of the following modifications to the protocol is most likely to eliminate the extra PCR products?

- A** Raising the denaturation temperature from 94 °C to 96 °C.
 - B** Raising the annealing temperature from 52 °C to 56 °C.
 - C** Raising the elongation temperature from 70 °C to 74 °C.
 - D** Increasing the elongation time from 3 minutes to 4 minutes.
- 27** Which description of the human genome project and its implications is correct?
- A** a project that is analysing the base pair sequence of all the autosomes in a cell and which has led to considerations of what is 'right' and 'wrong'
 - B** a project that is analysing the base pair sequence of all the genetic material in a cell and which aims to reduce the gap between 'rich' and 'poor'
 - C** a project that is analysing the nucleotide sequence of all the genetic material in a cell and which has led to considerations of the 'ethical standards' that exist in society
 - D** a project that is analysing the nucleotide sequence of all of the gamete haploid chromosome sets and which has led to considerations of so-called 'designer babies'
- 28** *Bam*HI is a restriction enzyme produced by *Bacillus amyloliquefaciens*. It recognises the specific nucleotide sequence GGATCC. *B. amyloliquefaciens* is susceptible to attack by viruses known as bacteriophages.

Which statement describes the natural function of *Bam*HI?

- A** *Bam*HI enzymatic modification of nucleotides occurs in all the GGATCC nucleotide sequences of *B. amyloliquefaciens*, to protect DNA from degradation by bacteriophage enzymes and prevent the nucleotides from being used for viral nucleic acid synthesis.
- B** Infectivity rate is lowered when *B. amyloliquefaciens* is subjected to invasion by bacteriophages that have double-stranded DNA as their genetic material, since *Bam*HI can recognise and cleave specific viral nucleotide sequences.
- C** Restriction fragments produced as a result of *Bam*HI binding to and cleaving DNA at all sites within the bacterial cell that have a GGATCC nucleotide sequence, prevent integration of bacteriophage nucleic acid into the bacterial genome.
- D** Transcription and translation of the *B. amyloliquefaciens* gene encoding the *Bam*HI enzyme is followed by secretion of the enzyme into the external environment, where it has antibacterial action against non-related bacterial species.

- 29** Induced pluripotent stem cells are stem cells that can be generated directly from adult stem cells under the influence of molecular signals.

Which of the following statements is/are true?

- 1 An induced pluripotent stem cell can become any cell of the developed organism, but cannot produce trophoblast and placenta to support organismal development, whereas a totipotent stem cell can produce a whole organism including extraembryonic tissue.
- 2 A totipotent stem cell and induced pluripotent stem cell can give rise to any cell.
- 3 An induced pluripotent stem cell can give rise to a single cell lineage whereas a totipotent stem cell can give rise to multiple, but limited number of cell lineages.
- 4 A totipotent stem cell can become any cell of a developed organism, but cannot produce trophoblast and placenta to support organismal development, whereas an induced pluripotent stem cell can produce a whole organism including extraembryonic tissue.
- 5 Induced pluripotent stem cells have the same developmental potential as embryonic stem cells.

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

- 30** In some countries where rice is eaten, the lack of β -carotene in the diet can lead to blindness.

Golden rice has had two genes added to it to make it produce β -carotene. Seeds have been available since 2004, but people are cautious about the growth of genetically modified crops, fearing these genes could be transferred to other plants.

Which of these possible reasons is the best argument for allowing cultivation of golden rice?

- A** Cultivation will occur in countries geographically remote from protesters against genetic modification.
- B** Cultivation will be strictly controlled, so no gene transfer will occur.
- C** Many plants already produce carotene, so gene transfer will not be a problem.
- D** Cultivation will occur in developing countries where people are unlikely to object.

End of Paper

2015 H1 Biology JC2 Preliminary Examination Paper 1 ANSWER KEY

1	A	2	B	3	C	4	B	5	A
6	B	7	D	8	D	9	A	10	A
11	D	12	B	13	D	14	A	15	C
16	C	17	A	18	C	19	D	20	A
21	B	22	D	23	D	24	A	25	C
26	B	27	C	28	B	29	B	30	C