

INNOVA JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATION
in preparation for General Certificate of Education Advanced Level
Higher 1

CANDIDATE
NAME

CLASS

INDEX NUMBER

BIOLOGY

8875/01

Paper 1 Multiple Choice

15 September 2017

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.

Write in soft pencil.

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

There are **thirty** questions on 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 booklet.

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

This document consists of **16** printed pages.



- 1 A certain organelle in a eukaryotic cell was isolated and analysed. It was found that the organelle contains proteins, nucleotides and phospholipids.

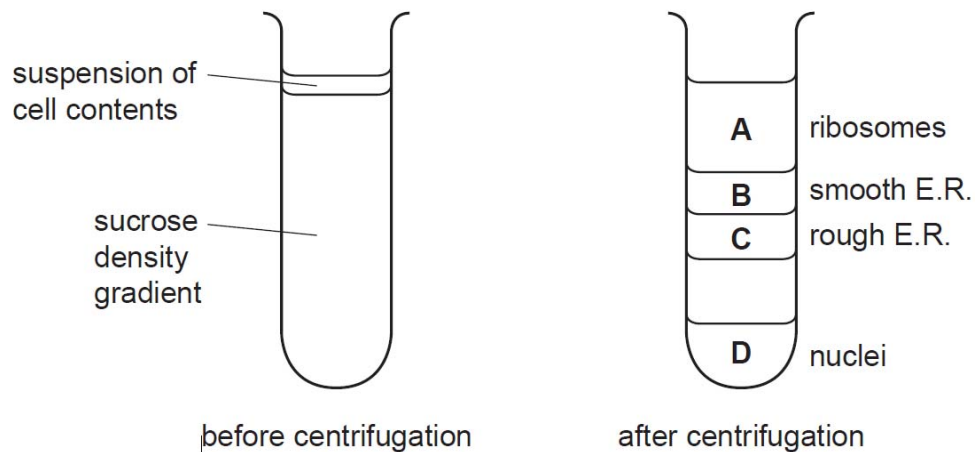
Which organelle(s) could it possibly be?

- 1 nucleus
- 2 lysosome
- 3 ribosome
- 4 mitochondrion

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

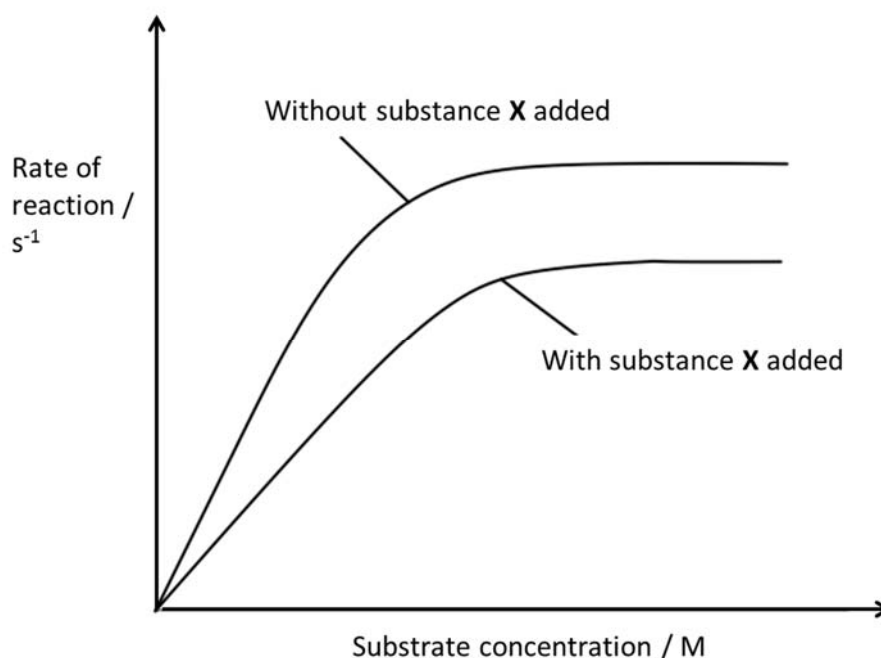
- 2 Sometimes, scientists need to isolate organelles. This can be achieved by taking a number of cells and breaking their cell surface membranes to release the contents of the cells into a buffer solution.

In zonal centrifugation, the suspension of cell contents is placed on top of a sucrose density gradient. The tube is then placed in a centrifuge and spun at high speed. The larger and denser particles will move towards the bottom of the tube faster than smaller and less dense particles as shown below.



If a sample of intact prokaryotes had been added to a suspension of eukaryotic cell contents, where would you expect them to be found?

- 3 Which statement shows a correct feature of collagen linked to a correct analysis of the amino acid sequence?
- A Collagen has polypeptides arranged parallel to each other and the sequence contains a large variety of amino acids with different sized R-groups.
 - B Collagen has polypeptides that are arranged very closely together and the sequence has every third amino acid as glycine.
 - C Collagen has three polypeptides that can fold into a globular structure and the sequence contains cysteine and amino acids with hydrophobic R-groups.
 - D Collagen is an insoluble molecule and the sequence contains a large proportion of amino acids with hydrophilic R-groups.
- 4 The graph below shows the change in the rate of reaction of an enzyme with and without the addition of substance X.



Which of the following statements about substance X is true?

- A The effect of substance X cannot be reduced by increasing the substrate concentration.
- B Substance X binds to the active site of the enzyme and competes with the substrate.
- C Substance X binds reversibly to the enzyme and changes the shape of its active site.
- D The effect of substance X can be reduced by decreasing the enzyme concentration.

- 5 A chemical known to affect mitosis was added, at different stages of mitosis, to actively dividing plant cells with 12 chromosomes.

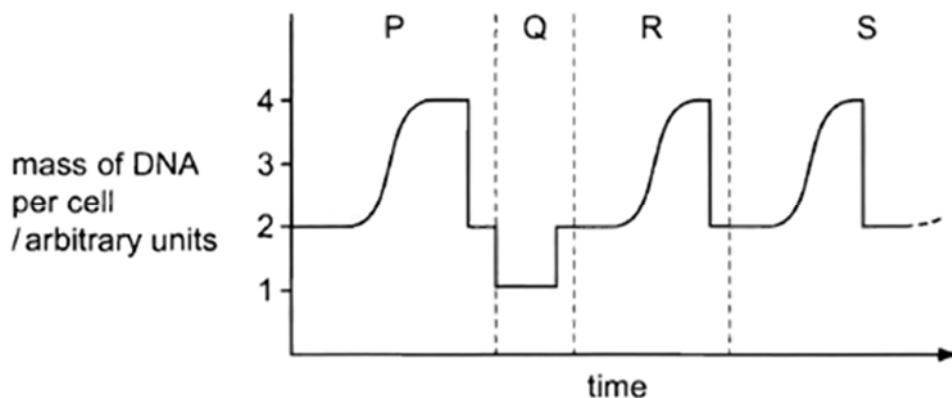
The results showed that adding this chemical during prophase resulted in cells with 24 chromosomes. Adding the chemical at any other stage resulted in cells with 12 chromosomes.

Which process during mitosis is affected by this chemical?

- A Condensing of chromosomes
 - B Organizing the spindle
 - C Producing the centromeres
 - D Separating centrioles
- 6 The retinoblastoma protein (Rb protein) is coded for by the *RB1* gene. Rb protein prevents a cell from progressing into the S phase of a cell cycle when damaged DNA is detected. When both copies of the *RB1* gene are mutated and dysfunctional, cells with damaged DNA may continue to divide uncontrollably to form a tumour.

Which of the following statements is true?

- A *RB1* gene is a proto-oncogene.
 - B The mutated *RB1* allele acts in a recessive manner.
 - C The mutated *RB1* allele codes for a hyperactive Rb protein.
 - D A gain-of-function mutation has occurred.
- 7 A single cell from a female mammal undergoes changes that result in an ovum being formed. If the ovum is fertilised then further changes occur to form an embryo. The graph shows the changes in the mass of DNA per cell during these events.



During which stages might variation occur as a result of changes in the number of sets of chromosomes?

- A P, Q and R only
- B Q, R and S only
- C P and Q only
- D R and S only

8 The descriptions below are of nucleic acids in eukaryotes.

- 1 A polynucleotide of variable length formed by base pairing.
- 2 A small polynucleotide with a specific three-dimensional shape.
- 3 A large polynucleotide with a specific shape associated with proteins.
- 4 A large polynucleotide with super coiled sections associated with proteins.

Which row correctly matches each description to its function?

	Stores coded information	Carries coded information	Carries specific amino acids	Provides a site for protein synthesis
A	3	4	1	2
B	3	4	2	1
C	4	1	2	3
D	4	3	1	2

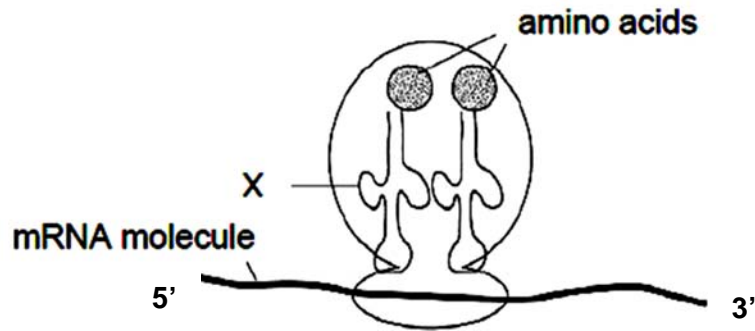
9 The mechanism of action of four drugs that inhibit DNA replication is stated below.

- 1 Aphidicholine inhibits DNA polymerase.
- 2 Cytarabine is converted into a molecule that can substitute for a DNA nucleotide and also inhibits DNA repair mechanisms.
- 3 Epirubicin inhibits an enzyme involved in the unwinding and separation of DNA strands.
- 4 Hydroxycarbamide inhibits an enzyme involved in the production of deoxyribonucleotides.

Which row correctly matches the effects of these drugs on DNA replication?

	Effects of Drug on DNA Replication			
	Decreased pool of available nucleotides inhibits chain elongation	DNA damaged during replication and cell death occurs	DNA strands not available as templates for replication	Exposed DNA template strands unable to be copied
A	aphidicholine	cytarabine	epirubicin	hydroxycarbamide
B	hydroxycarbamide	epirubicin	aphidicholine	cytarabine
C	epirubicin	hydroxycarbamide	cytarabine	aphidicholine
D	hydroxycarbamide	cytarabine	epirubicin	aphidicholine

- 10 The diagram below shows part of a molecule of mRNA bound to a ribosome.



Which of the following is **false** about molecule X?

- 1 It is formed by RNA polymerase in the nucleus.
 - 2 It is able to form hydrogen bonds with mRNA.
 - 3 An amino acid was attached to it by the enzyme amino-acyl tRNA transferase.
 - 4 It is held in the amino-acyl tRNA binding site of the ribosome.
- A 3 only
 B 4 only
 C 1 and 2 only
 D 3 and 4 only
- 11 Gene mutations involve changes in the nucleotide sequence of DNA.

Which of the following descriptions regarding gene mutations is correct?

- A Frameshift mutations can be caused by base substitution.
 B Frameshift mutations can result from an inversion of bases.
 C Missense mutations can be selectively neutral.
 D Silent mutations may not be selectively neutral.

- 12 Two pure-bred lines of different plant varieties, which differed markedly in bean seed mass, were crossed. The mass of bean seeds produced by the two parental varieties and their offspring were measured to the nearest gram. The number of bean seeds in each mass category was counted.

The table below shows the results.

mass of bean / mg		51-150	151-250	251-350	351-450	451-550	551-650	651-750	751-850	851-950
number of beans	Parental	5	375	177				352	955	10
	Offspring			13	544	974	48	2		

Which statement **incorrectly** explains these experimental data?

- A The range of phenotypes for the characteristic of bean seed mass is continuous and is due to several different nucleotide sequences at different chromosomal positions controlling the characteristic.
- B The greater variation in bean seed mass observed in the offspring generation as compared to the parental generation is due to crossing over between homologous chromosomes, random fusion of gametes, different survival rates of the gametes and zygotes.
- C The phenotypic effects of different nucleotide sequences at different chromosomal positions can be summated to determine the bean seed mass in each plant.
- D Various environmental factors affect the mass of bean seeds in plants.
- 13 The speech defect known as stuttering may involve two genes, **G** and **N**. Most people who are homozygous for the alleles **g** and **n** are not stutterers.

However, recent research has shown that the presence of either of the mutant alleles **G** or **N** can cause stuttering in heterozygotes.

Using this information, which proportion of the children of a couple, the father with genotype **Ggnn** and the mother **ggNn**, are likely to be stutterers?

- A 3/16
- B 6/16
- C 9/16
- D 12/16

- 14 A cross between a round-leafed, tall plant and round-leafed dwarf plant produced the following offspring:

121 round-leafed, tall plant

124 round-leafed, dwarf plant

42 oval-leafed, tall plant

37 oval-leafed, dwarf plant

Key

R – round leaf

r – oval leaf

T – tall

t – dwarf

What were the genotypes of the parents?

- A RrTt x Rrtt
 - B RrTt x RRtt
 - C RrTT x Rrtt
 - D RrTT x RRtt
- 15 In fruit flies, one gene controls wing form (normal or vestigial) and one gene controls eye colour (red or normal brown). A fly with normal wings and normal brown eyes is crossed with a fly with vestigial wings and red eyes. All the F_1 are normal for both characteristics.

However, when F_1 are crossed with each other, the resulting F_2 is:

45 normal wing, normal brown eye

17 normal wing, red eye

16 vestigial wing, normal brown eye

5 vestigial wing, red eye

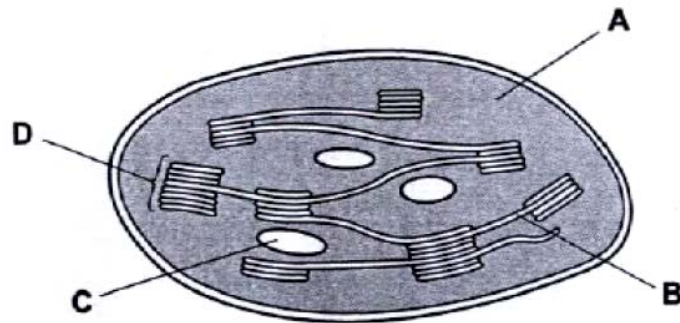
1 normal wing, orange eye

What is the **best** explanation for the results of this dihybrid cross?

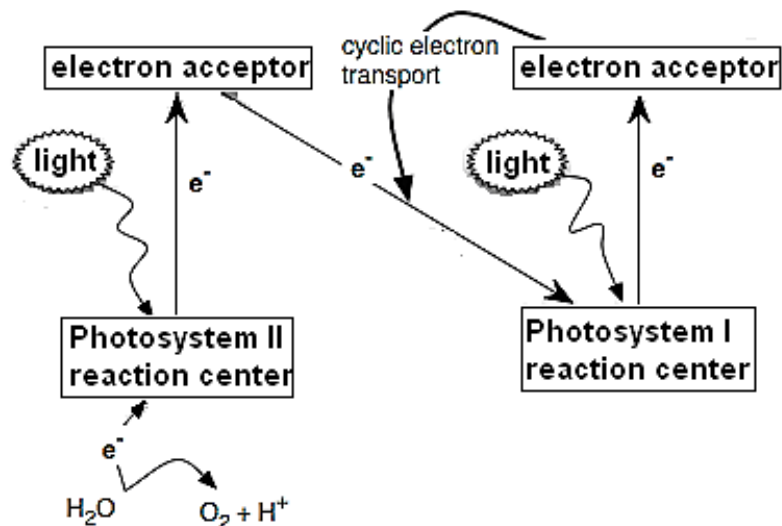
- A codominance
- B gene mutation
- C multiple alleles
- D sex linkage

- 16 The diagram shows a section through a chloroplast.

Where the products of photophosphorylation would be used?



- 17 The figure below shows the Z scheme for cyclic phosphorylation and non-cyclic phosphorylation.



Which of the following statements are true?

- 1 Hydrolysis of ATP occurs in both cyclic and non-cyclic phosphorylation.
- 2 Energy released from the electron transport chain is used to pump protons from the stroma into the thylakoid lumen.
- 3 NADP^+ is oxidized in non-cyclic phosphorylation.
- 4 The products of non-cyclic phosphorylation are NADPH, ATP and oxygen.

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

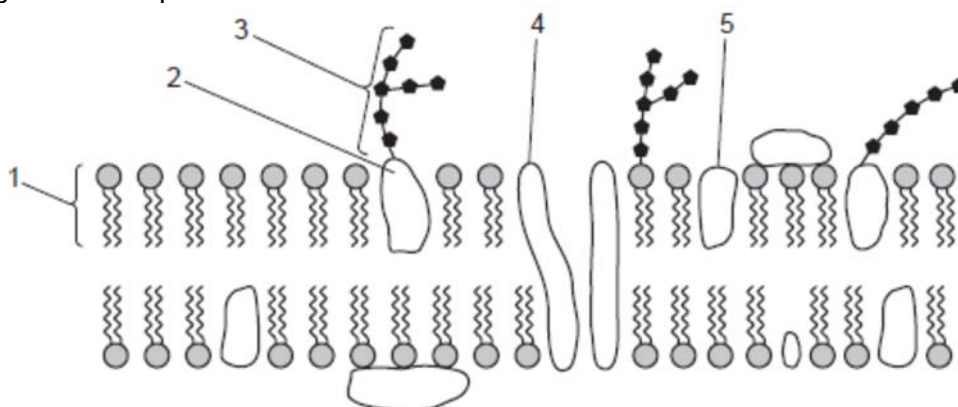
- 18** After vigorous exercise, changes occur in the muscle tissue. Compared with 'at rest' conditions, what will the changes be?

	glycogen	ATP	lactate	pH
A	decreased	decreased	increased	decreased
B	decreased	increased	increased	increased
C	increased	increased	increased	increased
D	increased	decreased	decreased	decreased

- 19** What is the 'link reaction' in eukaryotic respiration?

- A** Oxidation of NADH to yield electrons and protons
- B** Passage of coenzyme A through the mitochondrial membrane
- C** Pyruvate combining with coenzyme A to produce CO_2 and NADH/H^+
- D** Acetyl coenzyme A combining or joining with a C_4 compound to give C_6 + coenzyme

- 20** The diagram shows part of a cell surface membrane.

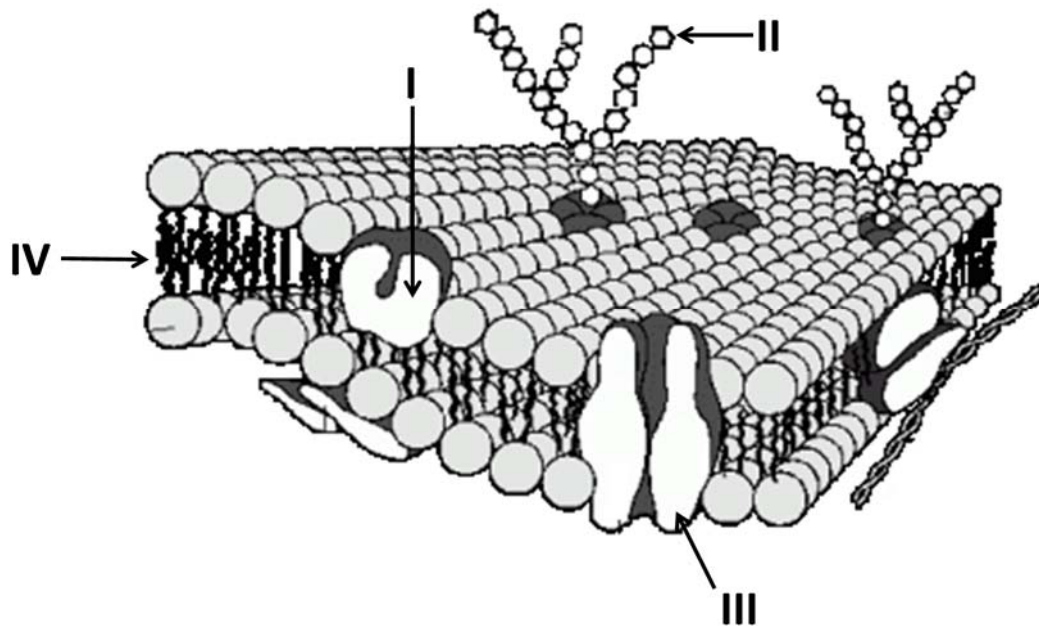


Which molecules have both hydrophobic and hydrophilic regions?

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

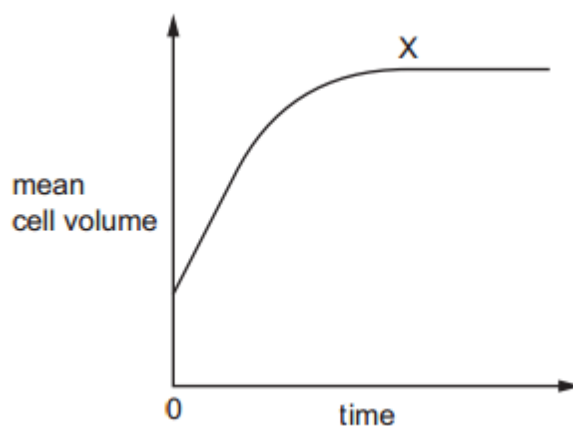
21 The diagram below shows a section of the cell surface membrane from an arctic fish.

Which of the following options regarding the labelled components of the membrane is correct?



	I	II	III	IV
A	Plays a role in cell-cell adhesion	Plays a role in cell-cell recognition	Allows transport of proteins like insulin	Contains a high amount of saturated lipids
B	Plays an enzymatic role	Variation in branching of oligosaccharide allows for cell-cell recognition	Allows transport of amino acids	Contains a high amount of cholesterol
C	Maintains the fluidity of the cell surface membrane	Variation in branching of amino acids allows cell-cell recognition	Plays a role in maintaining membrane potential	Is produced at the Rough Endoplasmic Reticulum
D	Is involved in active transport of ions	Is termed collectively with other glycolipids as the glycocalyx	Is localised to a specific region in the cell surface membrane	Plays a role in cell-cell recognition

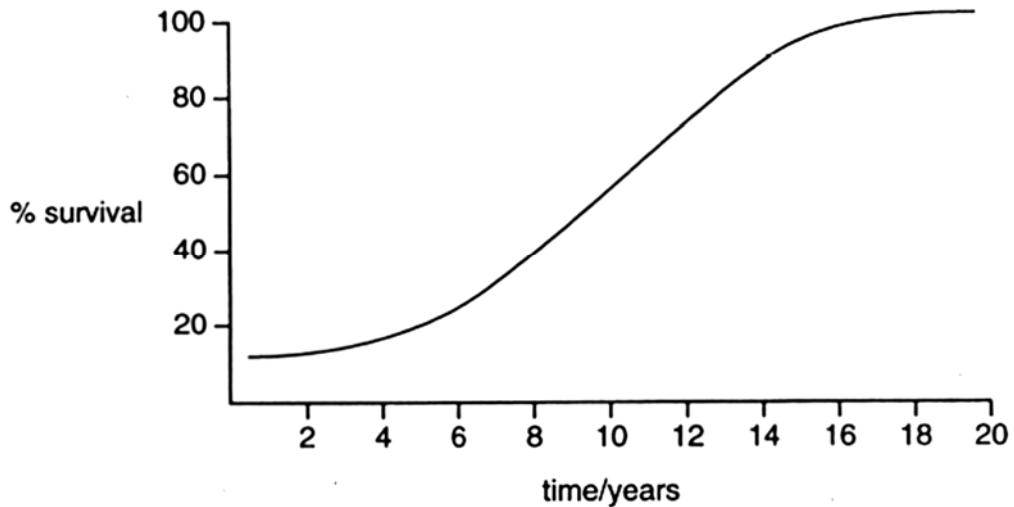
- 22** A tissue composed of plasmolysed plant cells was put into distilled water. The graph shows how the mean cell volume changes with time.



What is the cause of the plateau at X?

- 1 water potential in the plant cell has become more negative
 - 2 cells have become fully turgid
 - 3 no net movement of water into cells
- A** 1, 2 and 3
B 1 and 2 only
C 1 and 3 only
D 2 and 3 only

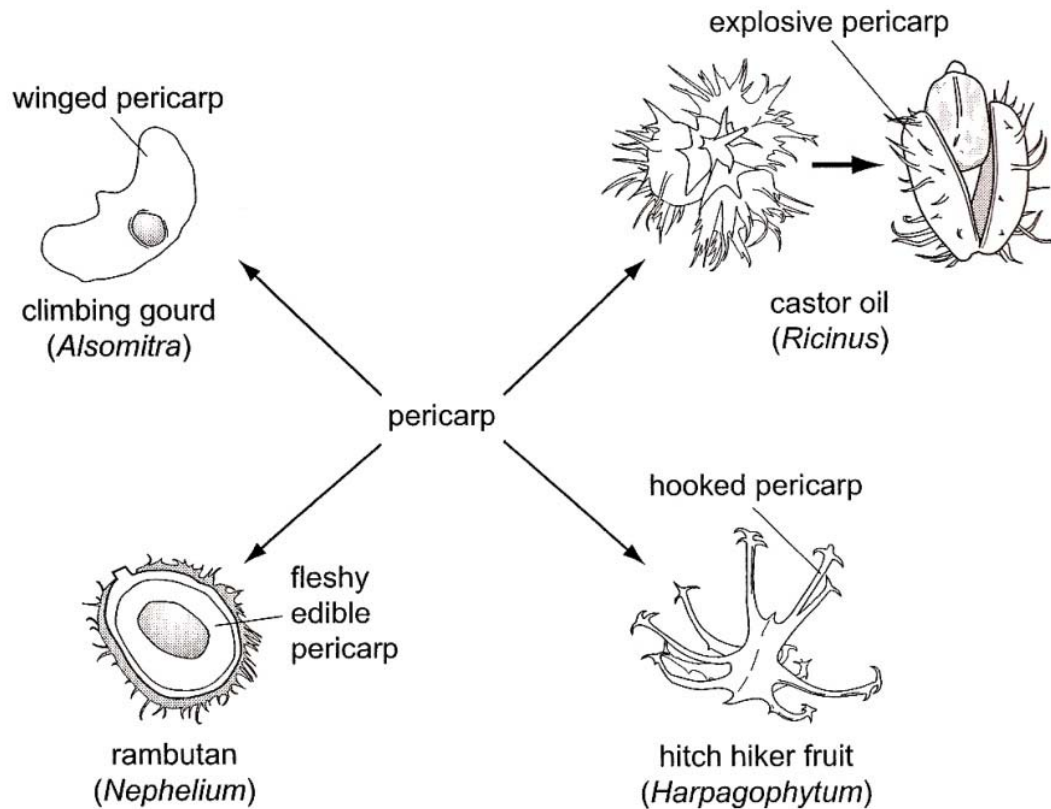
- 23** The graph shows the effect of pesticide treatment on houseflies over a number of years. A standard amount of pesticide was used each year in summer.



How is the effect of the pesticide best explained?

- A** A few resistant flies reproduced more successfully and the resistance allele increased in frequency.
 - B** At every generation an increasing proportion of flies mutated to become resistant.
 - C** Repeated exposure to the pesticide caused the flies to become more resistant.
 - D** The allele for resistance mutated from the recessive form to the dominant form.
- 24** 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.

- 25 The diagram illustrates variation in the pericarp (fruit wall) for a variety of methods of seed dispersal.

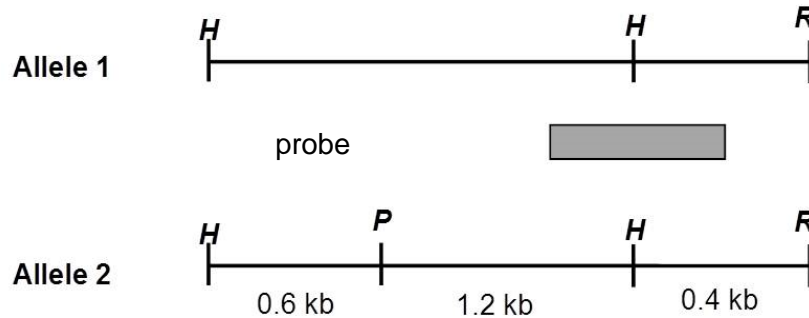


What do these examples illustrate?

- A The adaptive radiation of analogous structures showing convergent evolution.
 - B The adaptive radiation of analogous structures showing divergent evolution.
 - C The adaptive radiation of homologous structures showing convergent evolution.
 - D The adaptive radiation of homologous structures showing divergent evolution.
- 26 Which of the following is **not** a reason for plasmids being used as cloning vector?
- A They are small.
 - B They have an origin of replication.
 - C They can undergo independent replication.
 - D They always produce sticky ends when cut by restriction enzymes.

- 27** Cystic fibrosis is a genetic disease that affects the respiratory and digestive systems. Individuals with cystic fibrosis have two copies of the mutated *CFTR* allele.

Diagram below shows the positions of various restriction sites of a segment of KM-19, an RFLP (restriction fragment length polymorphism) marker that is closely linked to the *CFTR* gene locus. Position complementary to a radioactive probe is also shown. Allele 2 is linked to the mutant *CFTR* allele.



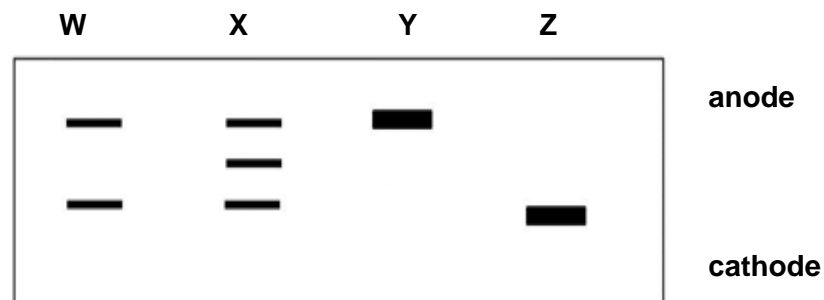
Legend

H represents *Hind*III restriction site

P represents *Pst*I restriction site

R represents *Eco*RI restriction site

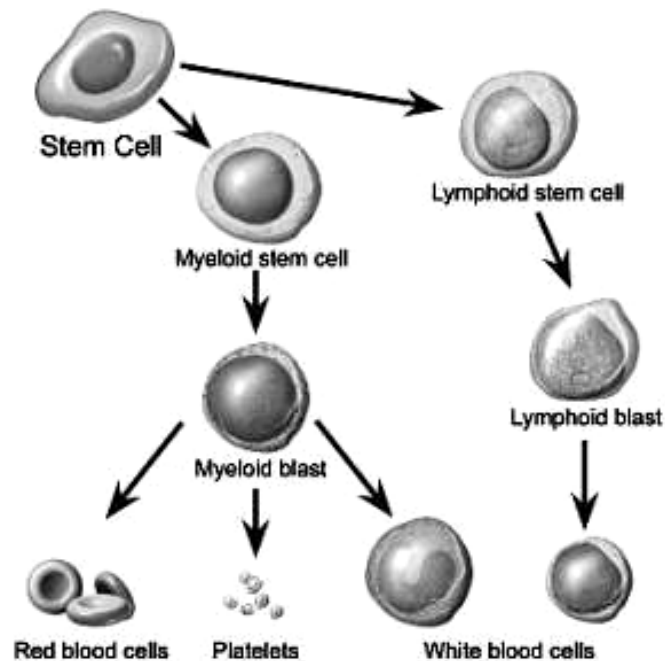
DNA from different individuals are digested using *Pst*I and separated using gel electrophoresis. Results of the autoradiograph are shown below.



Which of the following individual suffers from CF?

- A** W
 - B** X
 - C** Y
 - D** Z
- 28** Why are primers added to polymerase chain reaction (PCR) mixture?
- A** Because Taq polymerase cannot initiate synthesis of a polynucleotide strand.
 - B** So that there would not be leading and lagging strand.
 - C** To anneal to the 3' OH end to the target DNA.
 - D** To separate the double stranded DNA into 2 single strands.

- 29 The following diagram shows how a stem cell can differentiate into different specialized cell types.



Which of these statements is **false** with regards to the stem cells shown?

- A The stem cells are multipotent.
 - B The stem cells can be found in both a fetus and an adult body.
 - C The stem cells can differentiate into the three germ layers in the adult body.
 - D The stem cells may be used in a bone marrow transplant to treat a patient with leukemia, a form of blood cancer.
- 30 Some scientists are concerned about the release of genetically modified microorganisms into their natural habitat.

What is the most likely reason for this concern?

- A The microorganisms may reproduce quickly.
- B The microorganisms may not survive.
- C The mutation rate of the microorganisms would increase.
- D The transfer of changed genes to other organisms.

