

RAFFLES INSTITUTION

2015 Year 6 Preliminary Examination
Higher 1

BIOLOGY

8875/01

Paper 1 Multiple Choice

29 September 2015

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name and shade your Index Number on the Answer Sheet in the spaces provided.

There are **thirty** 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 booklet.

Calculators may be used.

(Erase all mistakes completely. Do not bend or fold the Answer Sheet).

This document consists of **18** printed pages.



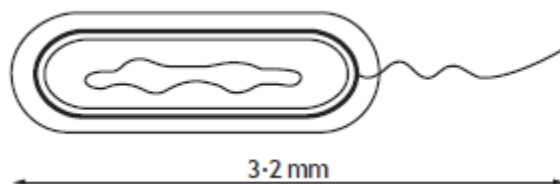
- 1 A sample of yeast cells was grown in a culture. Radioactive amino acids were added to the solution in which they were being grown. At various times, samples of the cells were taken and the amount of radioactivity in different organelles was measured. The results are shown in the table.

Time after radioactive amino acids were added to the solution / min	Amount of radioactivity present / arbitrary units		
	P	Q	R
1	21	120	6
20	42	68	6
40	86	39	8
60	76	28	15
90	50	27	28
120	38	26	56

Which best describes the identities of organelles **P**, **Q** and **R**?

	P	Q	R
A	Golgi apparatus	Rough endoplasmic reticulum	Secretory vesicles
B	Rough endoplasmic reticulum	Smooth endoplasmic reticulum	Golgi apparatus
C	Nucleus	Rough endoplasmic reticulum	Golgi apparatus
D	Smooth endoplasmic reticulum	Golgi apparatus	Secretory vesicles

- 2 The diagram below has been magnified 800 times



Calculate the length of the cell in micrometres (μm)

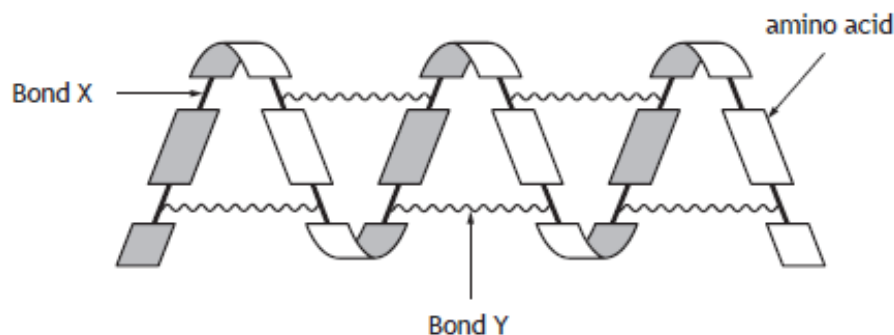
- A 0.004
- B 0.04
- C 0.4
- D 4.0

3 The key below can be used to identify carbohydrates.

- (1) Sugars..... go to (2)
 Polysaccharides go to (4)
- (2) Monosaccharides **A**
 Disaccharides go to (3)
- (3) Contains only 1 type of monomer..... **B**
 Contains only 2 types of monomer..... sucrose
- (4) Structural function..... go to (5)
 Storage function go to (6)
- (5) Structural function in plants..... **C**
 Structural function in animals..... collagen
- (6) Storage function in plants..... starch
 Storage function in animals..... **D**

Which of the above is maltose?

4 The diagram below shows part of a protein molecule.

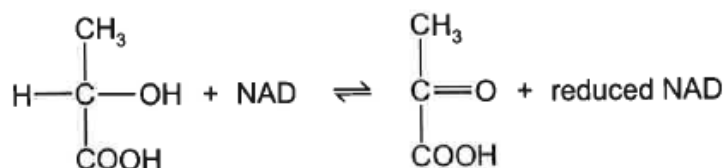


Which of the following statement(s) is/are correct?

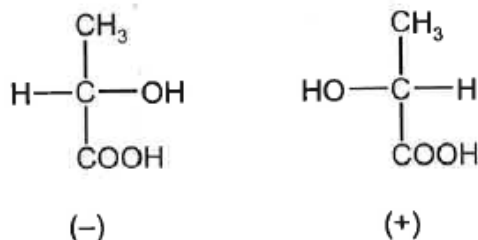
- I Bonds **X** and **Y** are both affected by substitution of an amino acid.
- II Only Bond **Y** may be affected by a base deletion.
- III Amino acids with bulky R groups may prevent Bond **X** from forming.
- IV Formation of Bond **X** is affected by insertion of three bases.

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

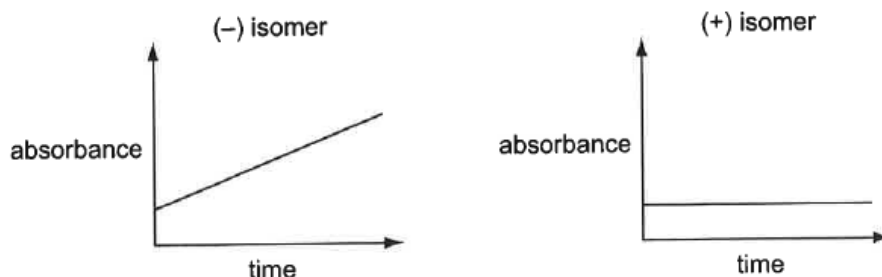
- 5 Lactic dehydrogenase catalyses the conversion of lactic acid as shown in the following equation.



Two forms (isomers) of lactic acid exist, (-) and (+), as shown below.



Reduced NAD absorbs ultraviolet light. NAD does not. The activity of bacterial lactic dehydrogenase on two different isomers of lactic acid was compared. The absorbance of ultraviolet light was measured using an ultraviolet spectrophotometer. The graphs show the results.



What can be concluded about bacterial lactic dehydrogenase?

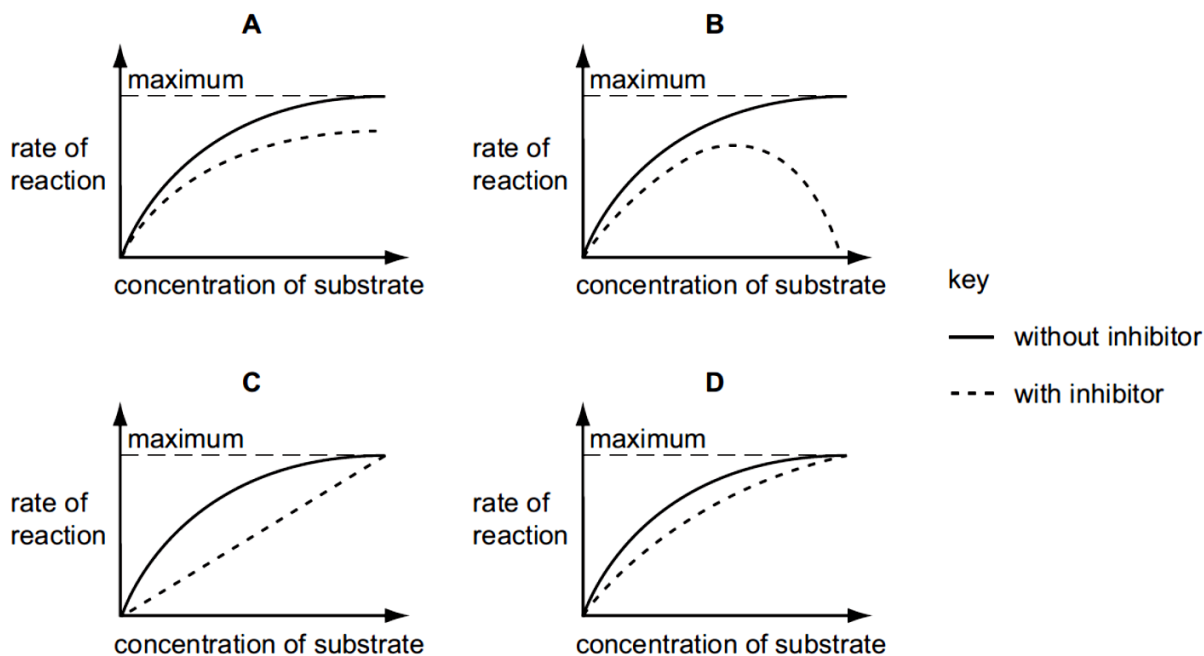
- A Molecules of both isomers fit the active site.
- B Molecules of neither isomer fit the active site.
- C The enzyme is specific to the (-) isomer.
- D The enzyme is specific to the (+) isomer.

6 Which statements about competitive inhibitors of enzyme action are correct?

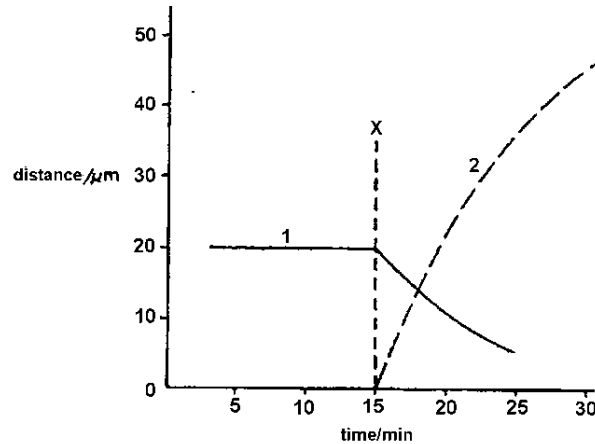
- I Increasing the concentration of the enzyme's substrate will reduce their effect.
- II They bind to an enzyme at its active site.
- III They reduce the activation energy required for a reaction to take place.
- IV They reduce the maximum rate of reaction.

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

7 Which graph represents the action of a non-competitive inhibitor?



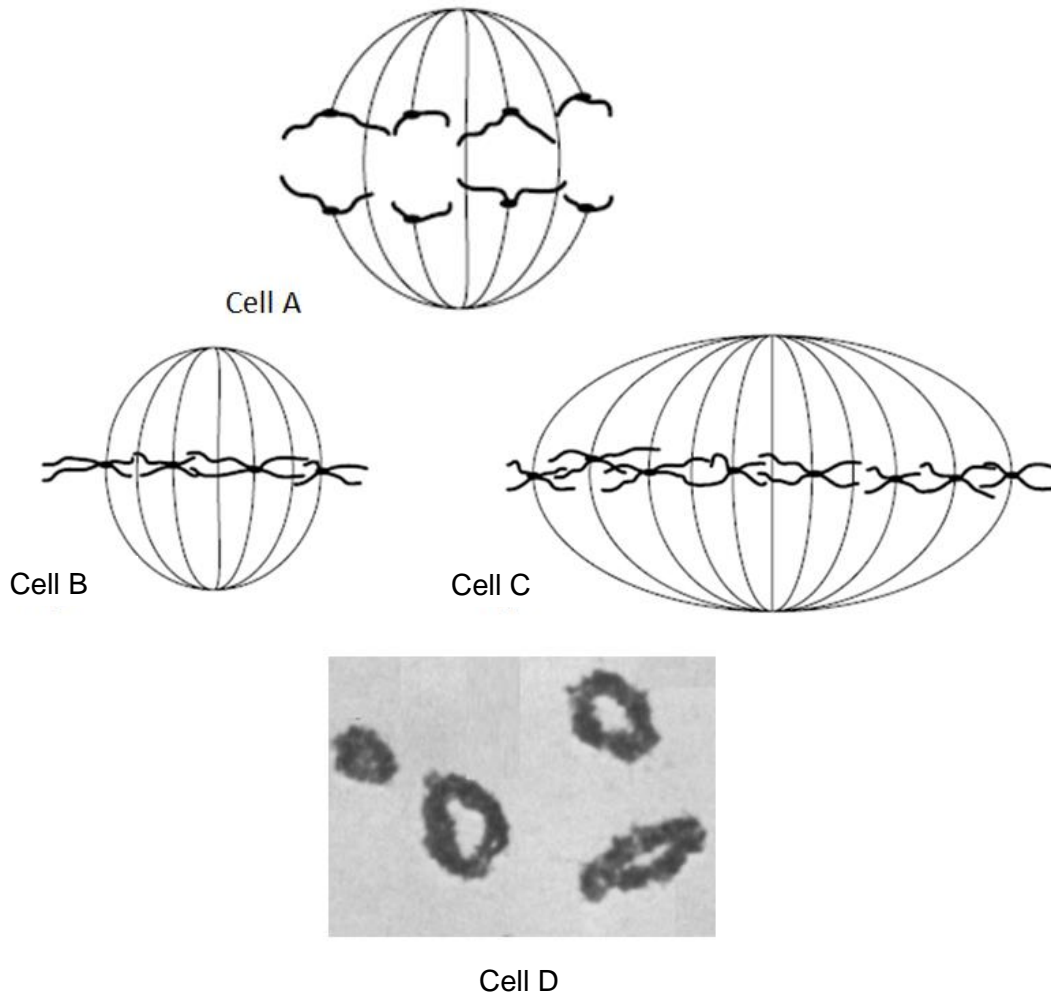
- 8 The graph below illustrates the behaviour of the chromosomes during one mitotic cell division.



Which one of the following correctly indicates the changes illustrated by curves 1 and 2, and the stage of mitosis which is commencing at X?

	Stage of mitosis commencing at X	Distance between centromeres of chromosomes and poles of spindle	Distance between centromeres of sister chromatids
A	Anaphase	1	2
B	Anaphase	2	1
C	Metaphase	1	2
D	Metaphase	2	1

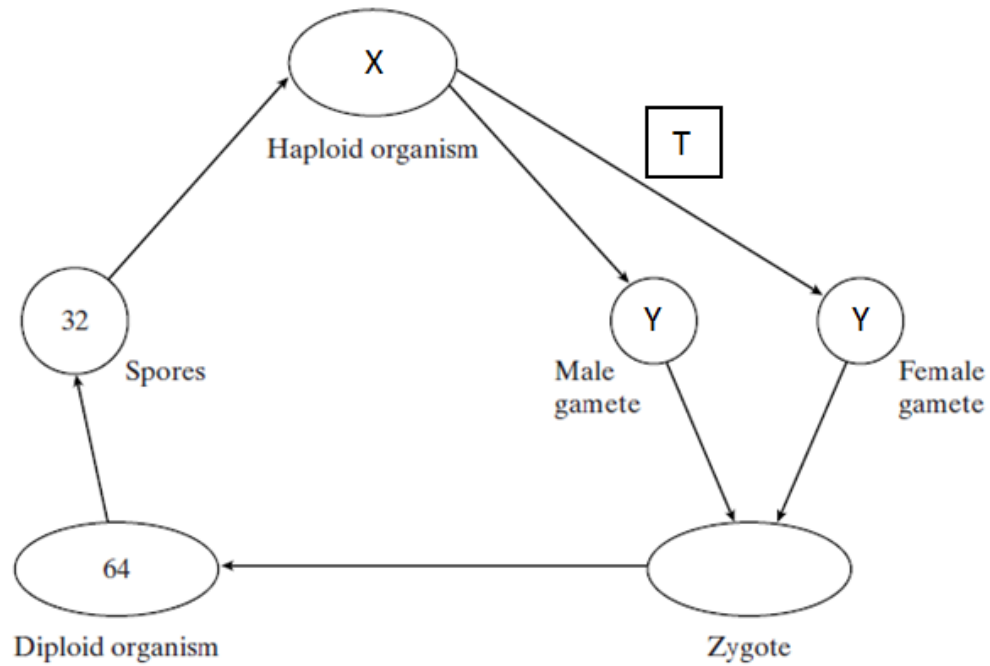
- 9 The figures below show cells obtained from various stages of nuclear division of a diploid organism. Cell A is undergoing anaphase II of meiosis.



Which statement correctly describes cells B to D?

- A Cell B is undergoing metaphase of mitosis.
- B Cell C is obtained from a cell that has been treated with colchicine.
- C Cells C and D are undergoing the same type of nuclear division.
- D Cell D shows a diploid cell.

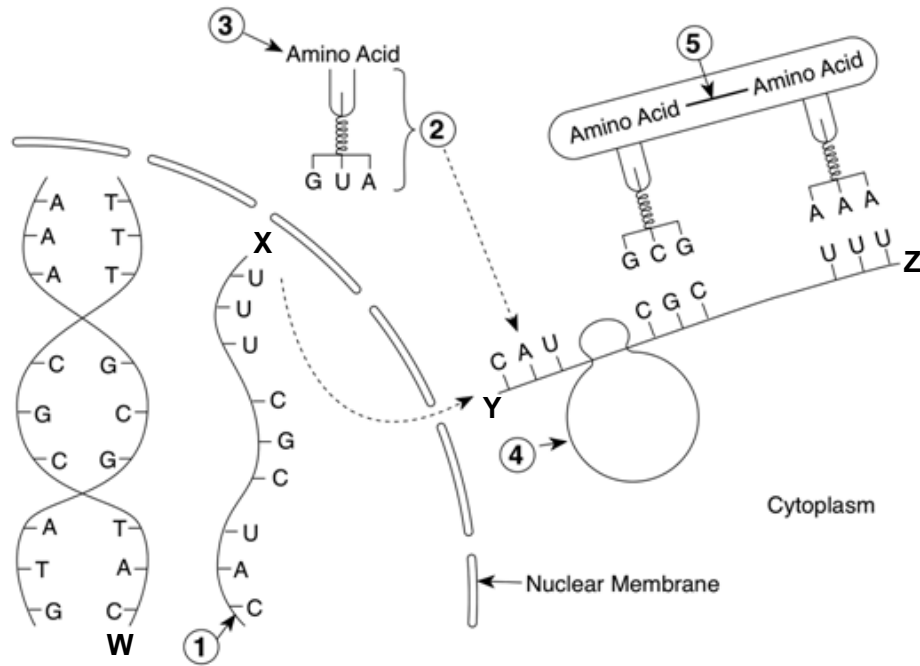
- 10 The diagram shows the life cycle of an organism. The numbers show how many chromosomes are present in one cell at each stage of the life cycle.



Which of the following correctly shows the type of division and number of chromosomes?

	Type of cell division	Number of chromosomes	
	T	X	Y
A	Mitosis	16	8
B	Meiosis	16	16
C	Mitosis	32	32
D	Mitosis	32	16

- 11 The diagram below represents some biochemical reactions involved in protein synthesis.



Which of the following is correct?

	Entire molecule coded directly from DNA	5' end of molecule	Enzyme involved in catalysing bond 5
A	1 and 2	Z	peptidyl transferase
B	1 and 2	Y	aminoacyl tRNA synthetase
C	1, 2 and 3	X	aminoacyl tRNA synthetase
D	1, 2 and 4	W	peptidyl transferase

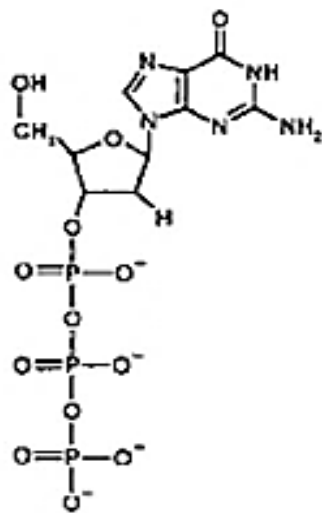
- 12 Imagine that you discovered an organism which has DNA that contains two other nucleotide bases in addition to A, T, C and G. These two nucleotide bases form a base pair, so that the DNA contains six different bases which form three base pairs.

What would be the maximum number of amino acids that its DNA can code for, assuming that there are three stop codons and that there are three bases per codon?

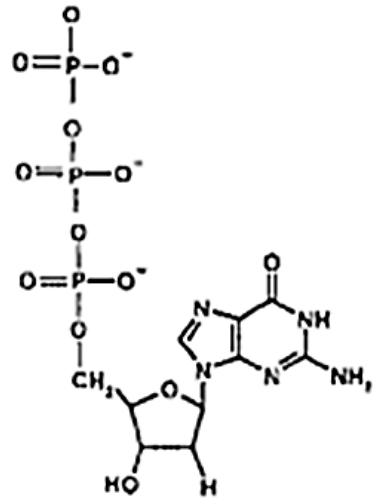
- A 15
- B 61
- C 213
- D 726

13 Which of the following is the correct physiological substrate for DNA polymerase?

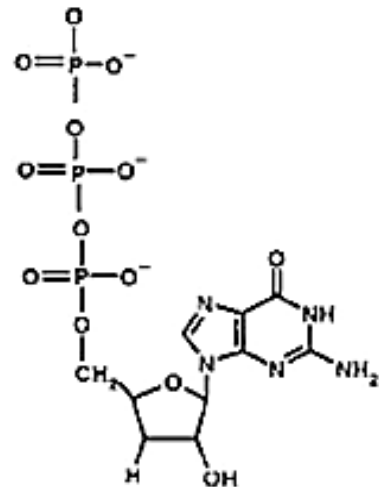
A



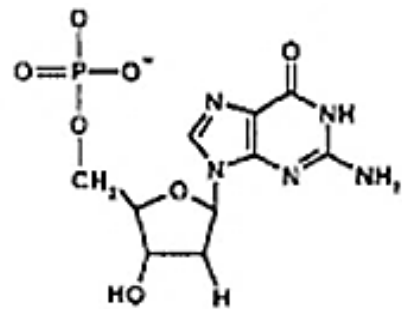
B



C



D



14 What protein would be coded by the following DNA molecule?

5' – CCTACTATGCGCCAGTATAAGTGACAATTA – 3'
 3' – GGATGATACGCGGTCATATTCAGTGAAT – 5'

		Second Letter					
		U	C	A	G		
1st letter	U	UUU Phe UUC UUA Leu UUG	UCU Ser UCC UCA UCG	UAU Tyr UAC UAA Stop UAG Stop	UGU Cys UGC UGA Stop UGG Trp	U C A G	3rd letter
	C	CUU Leu CUC CUA CUG	CCU Pro CCC CCA CCG	CAU His CAC CAA Gln CAG	CGU Arg CGC CGA CGG	U C A G	
	A	AUU Ile AUC AUA AUG Met	ACU Thr ACC ACA ACG	AAU Asn AAC AAA Lys AAG	AGU Ser AGC AGA Arg AGG	U C A G	
	G	GUU Val GUC GUA GUG	GCU Ala GCC GCA GCG	GAU Asp GAC GAA Glu GAG	GGU Gly GGC GGA GGG	U C A G	

- A Met – Arg – Gln – Tyr – Lys
 B Met – Arg – Gln – Lys – Lys
 C Met – Lys – Arg – Gly – Gln – Lys – His – Arg
 D Met – Ile – Arg – Gly – His – Ile – His – Cys

15 In rats, the allele of a gene for 'mottled' coat (**M**) and the recessive allele (**m**) for 'normal' coat are sex linked. The allele of a gene for 'long' whiskers (**W**) and the recessive allele (**w**) for 'short' whiskers are autosomal.

A male rat with a normal coat and short whiskers was mated on several occasions to the same female. The offspring showed the following phenotypes in equal proportions:

- mottled females and males with long whiskers
- mottled females and males with short whiskers
- normal females and males with long whiskers
- normal females and males with short whiskers

What are the genotypes of the parents?

- A X^mYww and X^MX^MWw
 B X^mY^mww and X^MX^MWw
 C X^mY^mww and X^MX^mWW
 D X^mYww and X^MX^mWw

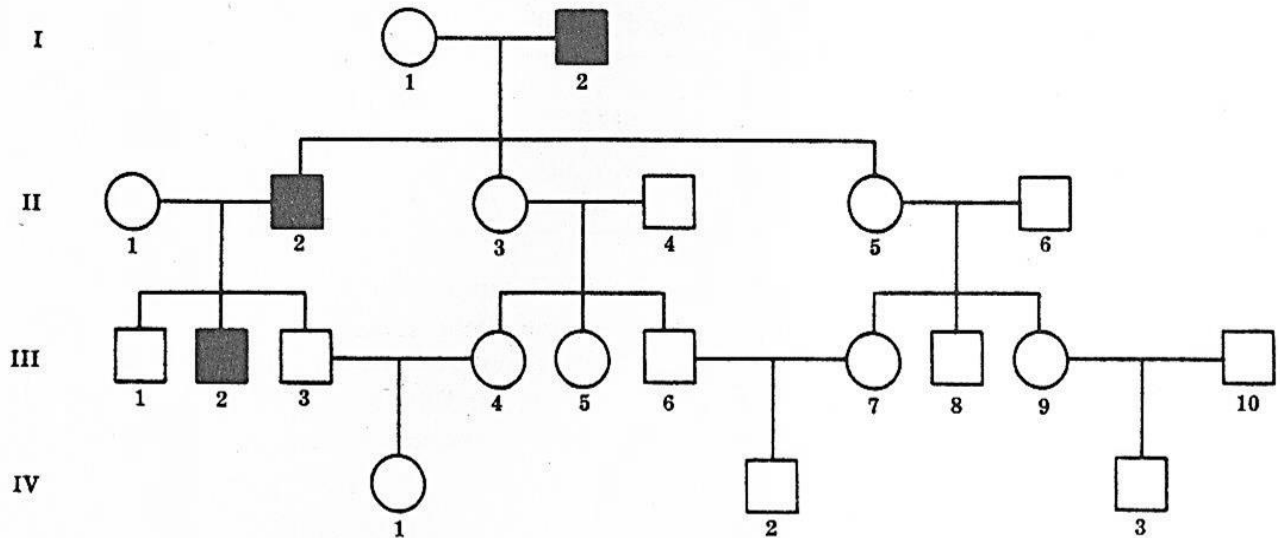
- 16 The shape oval or round, of a type of fruit is controlled by a pair of alleles at one gene locus. The gene for the colour of the fruit, red or yellow, is at a different locus. The genes are not linked.

A pure breeding plant with oval, red fruit is crossed with a pure breeding plant with round, yellow fruit. All the offspring have oval, orange fruit.

Which phenotypic ratio would you expect if these plants with oval, orange fruit were selfed?

- A 1: 1: 1: 1
 B 6: 3: 3: 2: 1: 1
 C 9: 2: 2: 2: 1
 D 9: 3: 3: 1
- 17 A recessive allele **r** is largely responsible for the development of red hair in humans. Dark hair is largely due to its dominant allele **R**.

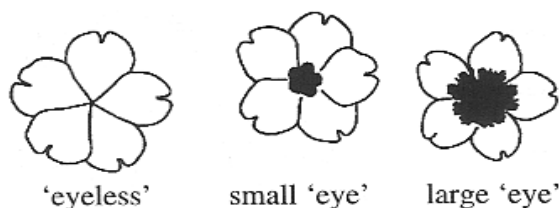
In the hypothetical family pedigree below, unless there is evidence to the contrary, assume that individuals who marry into this family **do not** carry the **r** allele. Solid symbols represent red hair and open symbols represent dark hair.



What is the probability of red hair appearing in children from the hypothetical marriage of individuals with same genotype as **III-3** and **III-9**?

- A $1/4$
 B $1/8$
 C $1/2$
 D $3/8$

- 18 The flowers of a species of *Primula* may have a yellow 'eye' in the centre of the flower or they may be 'eyeless'. The 'eye' may be small or large as shown below.

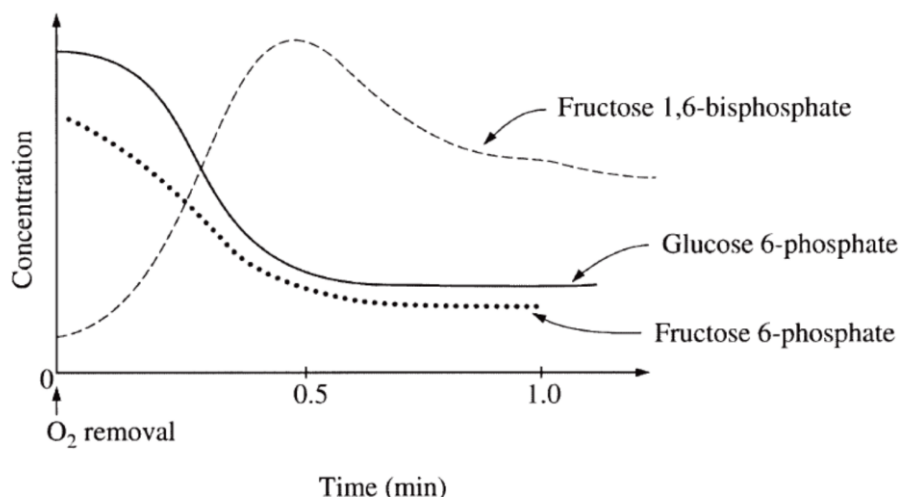


These phenotypes are produced by **three** alleles of a gene. Allele A^S suppresses yellow pigment production in the 'eye', giving 'eyeless' flowers. Allele A^S is dominant to allele A^R , which restricts the size of the 'eye', resulting in flowers with small 'eyes'. Both A^S and A^R are dominant to allele a .

Which of the following correctly shows the phenotype and all corresponding genotypes of the flower?

	Phenotype	All possible genotypes
A	'eyeless' flowers	$A^S A^S$; $A^S a$
B	'small-eyed' flowers	$A^R A^R$
C	'eyeless' flowers	$A^S A^S$; $A^S a$; $A^R A^S$
D	'large-eyed' flowers	$A^R A^S$

- 19 Muscle cells were incubated in the presence of oxygen. Concentrations of various metabolites were measured immediately following the removal of oxygen. The results are shown below:



The change in the concentration of glucose 6-phosphate can be best explained by

- A increased demand for ATP in the cells.
- B increased rate of glycolysis.
- C decreased synthesis of glucose 6-phosphate.
- D increased enzymatic inhibition by fructose 1,6-bisphosphate.

- 20** The concentration of carbon dioxide in a sample of air was found to be 280 ppm (parts per million). A controlled experiment was designed to measure the concentration of carbon dioxide in the air after it had flowed over the leaves of a green plant. Measurements were taken at a range of light intensities.

Light intensity (% of full sunlight)	Concentration of carbon dioxide in air after flowing over leaves (ppm)
75	253
50	252
25	254
10	280

Which one of the following statements is **incorrect**?

- A** In the dark, concentration of carbon dioxide in the air after it had flowed over leaves would be at least 280 ppm.
- B** At the lower light intensities tested, rate of photosynthesis is limited by light intensity.
- C** At the higher light intensities tested, the rate of photosynthesis is affected by factors other than light.
- D** At a light intensity of 10% of full sunlight, photosynthesis does not occur.
- 21** Some photosynthetic organisms contain chloroplasts that lack photosystem II that are able to survive. The best way to detect the lack of photosystem II in these organisms would be
- A** to test for carbon fixation in the dark.
- B** to test for liberation of oxygen in the light.
- C** to test for presence of starch.
- D** to determine if they have thylakoids in the chloroplasts.
- 22** In 1954, copper waste in the Finniss River in Australia killed numerous fish. This caused various species in the area to die out. However, one species, the black-banded rainbow fish, increased in numbers. The black-banded rainbow fish have modified gills that enable the fish to filter and remove the copper before it enters their body.

With respect to the black-banded rainbow fish it is reasonable to conclude that

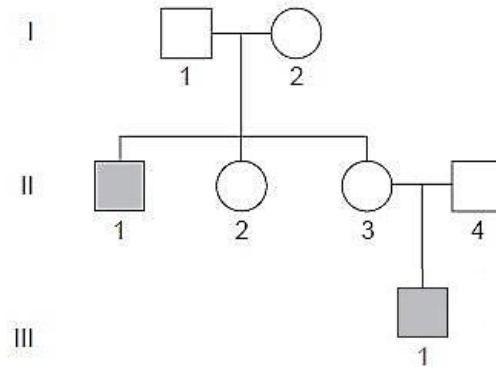
- A** a mutation occurred in their population in 1954.
- B** the ability of their gills to remove copper already existed in 1954.
- C** the high levels of copper in the water changed the structure of their modified gills.
- D** their genomes are identical with those of the other species of fish that existed in 1954.

23 Sympatric speciation develops reproductive isolation without

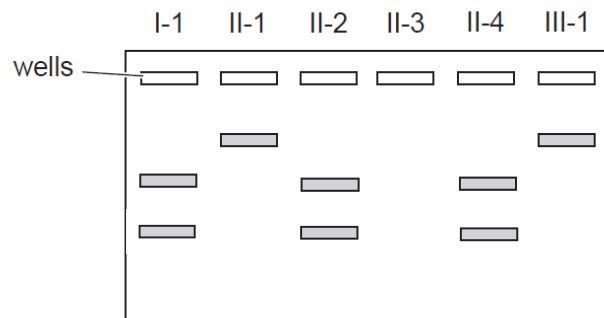
- A** barrier to mating.
- B** genetic change.
- C** barrier to gene flow.
- D** geographical barrier.

24 Menkes' Disease in humans is characterised by sparse and wiry hair, growth failure and deterioration of the nervous system. Onset of the Menkes' syndrome usually occurs during infancy.

A family in which this X-linked disorder was present, underwent Restriction Fragment Length Polymorphism (RFLP) analysis using gel electrophoresis. The family pedigree is shown below.



The RFLP analysis resulted in the following distribution of bands in the gel.



What would be the band pattern of individual II-3?

- A**
- B**
- C**
- D**

- 25 Which of the following options correctly describe the events occurring in each process?

	Action of restriction enzyme	Ligation	Annealing	Denaturation
A	Breaking of hydrogen bonds	Formation of hydrogen bonds	Formation of phosphodiester bonds	Breaking of phosphodiester bonds
B	Breaking of hydrogen bonds	Formation of hydrogen bonds	Formation of phosphodiester bonds	Formation of phosphodiester bonds
C	Breaking of phosphodiester bonds	Formation of phosphodiester bonds	Formation of hydrogen bonds	Breaking of hydrogen bonds
D	Breaking of phosphodiester bonds	Formation of phosphodiester bonds	Breaking of hydrogen bonds	Formation of hydrogen bonds

- 26 The DNA sequences of the normal and mutated versions of a gene are shown below.

Normal DNA sequence:
GAGAATCCTTGAGCTCTTAAGCTTATT

Mutated DNA sequence:
GAGAATCCTTGAGGTCTTAAGCTTATT

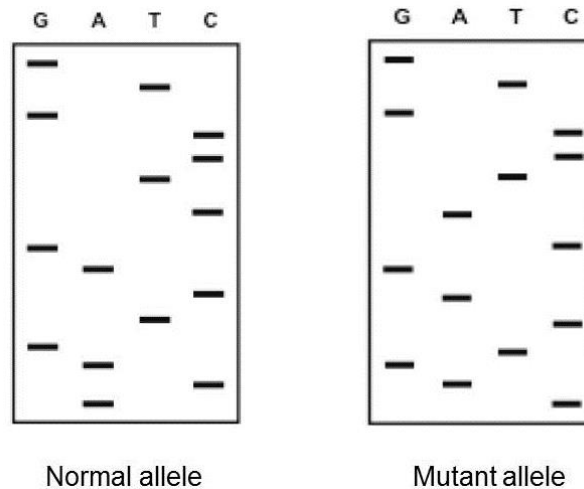
The table below shows the recognition sequences of four restriction endonucleases.

Restriction endonuclease	Recognition site
<i>Bam</i> HI	GGATCC
<i>Eco</i> RI	GAATTC
<i>Hind</i> III	AAGCTT
<i>Sac</i> I	GAGCTC

Which of the restriction endonucleases would produce different number of fragments when used to digest normal and mutant DNA?

- A** *Bam*HI
- B** *Eco*RI
- C** *Hind*III
- D** *Sac*I

- 27 In a particular genetic disease, individuals with the disease produced a protein with a different primary structure. In order to study the genetic basis of this disease, a researcher isolated the normal and mutant allele, and carried out Sanger sequencing followed by gel electrophoresis. The resulting band patterns show the DNA sequences of the normal and mutant alleles.



- 29** A research laboratory wishes to produce a line of embryonic stem cells. Which quantitative test should be used to determine if these cells are considered embryonic stem cells?
- A** Level of transcription factors.
 - B** Level of telomerase.
 - C** Number of active genes.
 - D** Number of promoters in developmental genes.
- 30** According to the producers of the genetically modified salmon, the meat
- A** contains trace levels of ocean pout growth hormone.
 - B** looks and tastes the same as unmodified salmon.
 - C** has higher nutritional quality.
 - D** can be frozen for longer periods of time.

--- END ---

H1 P1 Answers

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