HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2024

BIOLOGY PAPER 1

8:30 am – 11:00 am (2 hours 30 minutes)
This paper must be answered in English

GENERAL INSTRUCTIONS

(1) There are **TWO** sections, A and B, in this Paper. You are advised to finish Section A in about 35 minutes.

(2) Section A consists of multiple-choice questions in this question paper. Section B contains conventional questions printed separately in Question-Answer Book **B**.

(3) Answers to Section A should be marked on the Multiple-choice Answer Sheet while answers to Section B should be written in the spaces provided in Question-Answer Book **B**. **The Answer Sheet for Section A and the Question-Answer Book B for Section B will be collected separately at the end of the examination.**

INSTRUCTIONS FOR SECTION A (MULTIPLE-CHOICE QUESTIONS)

(1) Read carefully the instructions on the Answer Sheet. After the announcement of the start of the examination, you should first stick a barcode label and insert the information required in the spaces provided. No extra time will be given for sticking on the barcode label after the 'Time is up' announcement.

(2) When told to open this book, you should check that all the questions are there. Look for the words '**END OF SECTION A**' after the last question.

(3) All questions carry equal marks.

(4) **ANSWER ALL QUESTIONS**. You are advised to use an HB pencil to mark all the answers on the Answer Sheet, so that wrong marks can be completely erased with a clean rubber. You must mark the answers clearly; otherwise you will lose marks if the answers cannot be captured.

(5) You should mark only **ONE** answer for each question. If you mark more than one answer, you will receive **NO MARKS** for that question.

(6) No marks will be deducted for wrong answers.

Not to be taken away before the end of the examination session

There are 36 questions in this section.
The diagrams in this section are NOT necessarily drawn to scale.

1. Fertilisers usually contain nitrogen and phosphorous compounds. They can be used by plants for the synthesis of

(1) cell walls.
(2) chlorophyll.
(3) cell membranes.

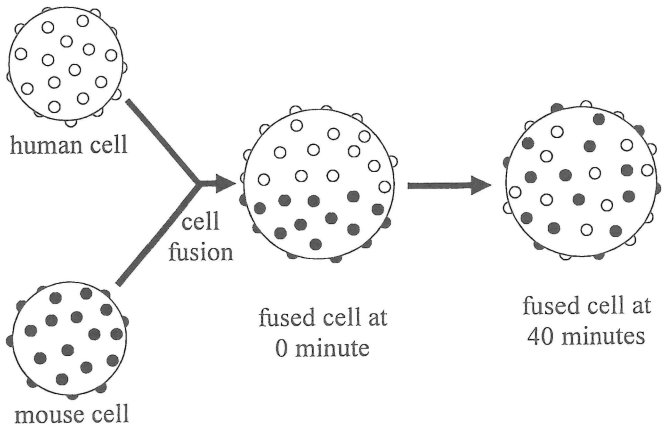
A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

2. The genetic material of a virus contains 1966 adenine (A), 2343 guanine (G), 1749 thymine (T) and 2368 cytosine (C). Based on this information, which of the following combinations of the genetic material for this virus is correct?

	Nucleic acid	*Pentose*
A.	single-stranded	deoxyribose
B.	single-stranded	ribose
C.	double-stranded	deoxyribose
D.	double-stranded	ribose

3. The schematic diagram below shows an investigation into cell membranes. The cell surface proteins of a human cell were labelled with a red dye while those of a mouse cell were labelled with a green dye. The two cells were then fused. The distribution of the cell surface proteins at 0 minute and 40 minutes are shown below:

Key:
○ surface protein stained red
● surface protein stained green

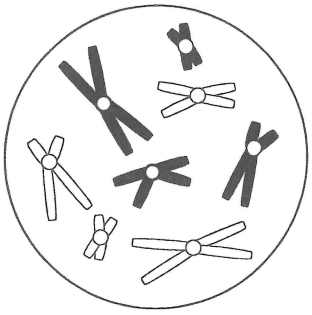


Which of the following properties of the cell membrane can be used to explain the change in the distribution of the surface proteins of the fused cell shown in this investigation?

(1) A cell membrane is fluid in nature.
(2) A cell membrane is differentially permeable.
(3) A cell membrane is an asymmetric structure.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

Directions: Questions 4 to 6 refer to the diagram below, which shows the appearance of chromosomes in a cell at the early stage of meiotic cell division:

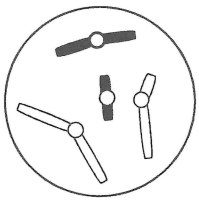


4. If the amount of DNA in this cell is β, what is the amount of DNA in a non-dividing somatic cell of this organism?

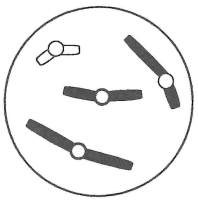
A. ¼ β
B. ½ β
C. β
D. 2 β

5. Which of the following diagrams show the possible combinations of the chromosomes in the daughter cells?

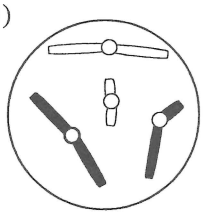
(1)



(2)



(3)



A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

6. Mendel's law can be used to explain the combinations of chromosomes in the daughter cells in Question 5. Which of the following correctly shows the corresponding Mendel's law and the stage of meiotic cell division as described by the law?

	Mendel's law	***Stage***
A.	Law of segregation	first meiotic cell division
B.	Law of segregation	second meiotic cell division
C.	Law of independent assortment	first meiotic cell division
D.	Law of independent assortment	second meiotic cell division

7. Which of the following combinations about the stages of photosynthesis is correct?

	Photochemical reactions	***Calvin cycle***
A.	produces oxygen	produces water
B.	requires carbon dioxide	requires NADPH
C.	occurs in stroma	occurs in grana
D.	light is the energy source	ATP is the energy source

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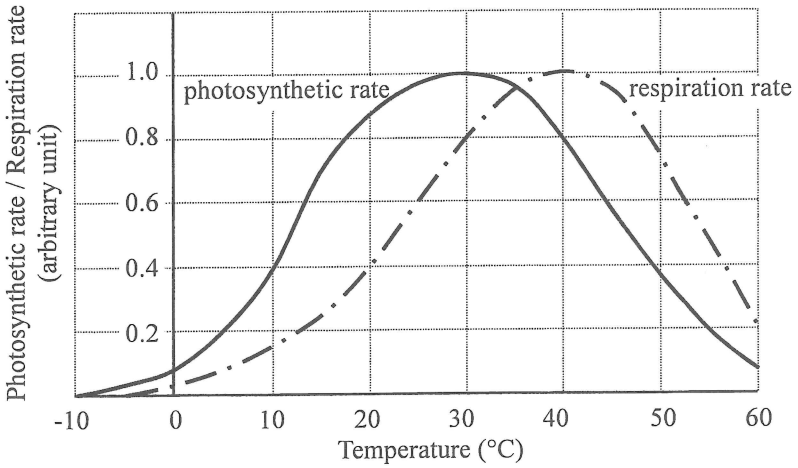
Directions: Questions 8 and 9 refer to the graph below, which shows the changes in the photosynthetic rate and respiration rate of a rice crop at different temperatures while the light intensity and concentration of carbon dioxide were kept constant:



8. Which of the following interpretations about the graph is correct?

A. The crop has maximum growth at 30°C.
B. The crop does not absorb water at 40°C.
C. The crop reaches compensation point at 35°C.
D. The crop has greatest net production of food at 20°C.

9. Based on the data shown in the graph, which of the following is / are possible explanation(s) of the drop in the two rates?

(1) Transpiration rate increases at higher temperatures.
(2) The enzymes involved denature at higher temperatures.
(3) The two processes take place at different organelles of the cell.

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

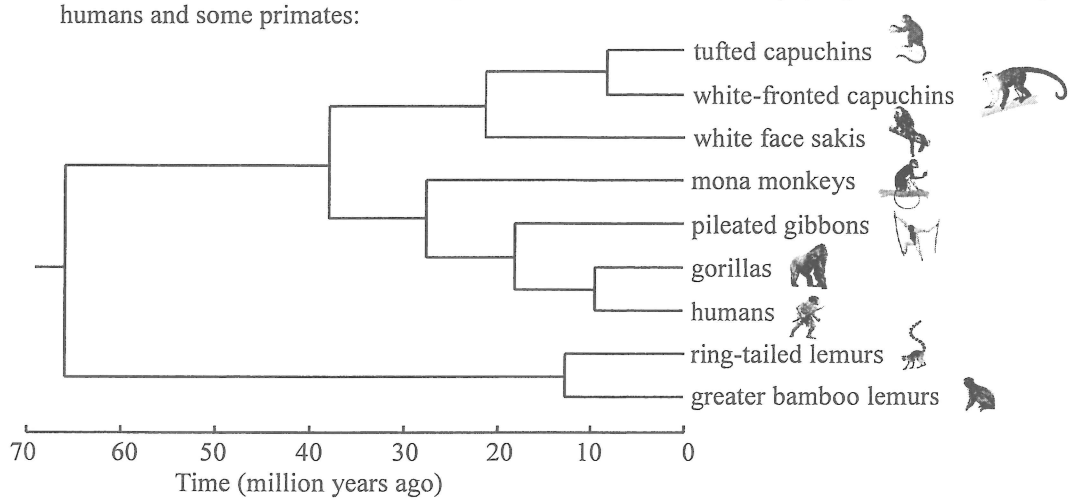
10. Lactic acid is produced during the anaerobic respiration in humans. Which of the following combinations correctly describes the metabolism of the lactic acid produced?

	the location where lactic acid is broken down	***the period involved***
A.	muscle	during vigorous exercise
B.	muscle	after vigorous exercise
C.	the liver	during vigorous exercise
D.	the liver	after vigorous exercise

11. Sharks are considered 'living fossils' because their appearance closely resembles shark fossils from millions of years ago. Which of the following is the most likely reason for the close resemblance?

A. Sharks have few predators.
B. Sharks have a wide range of prey.
C. A shark's body is well-adapted to the ocean environment.
D. A shark's body is most advanced as compared to other species in oceans.

Directions: Questions 12 and 13 refer to the diagram below, which shows the phylogenetic relationships between humans and some primates:



12. Which of the following statements about these primates is correct?

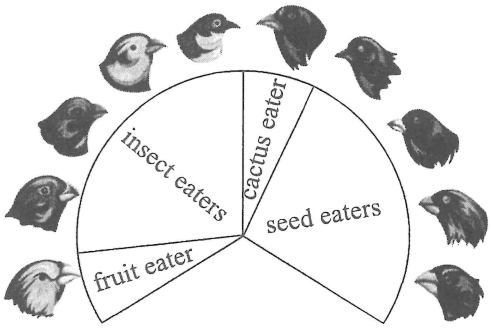
A. Pileated gibbons share a common ancestor with gorillas and humans.
B. Gorillas have a closer relationship with ring tailed lemurs than white face sakis.
C. White face sakis are the common ancestor of tufted capuchins and white-fronted capuchins.
D. The difference between gorillas and humans is the same as that of ring-tailed lemurs and greater bamboo lemurs.

13. Which of the following methods can be used to construct the above phylogenetic relationships of the primates?

(1) comparing the fossil records of different primates
(2) comparing the DNA samples from different primates
(3) comparing the key protein samples from different primates

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

14. Darwin's finches are a group of small birds isolated on the Galapagos Islands. These birds show variations in forms and function of their beak as shown in the diagram below:



What is the significance of these variations to the survival of Darwin's finches on the Galapagos Islands?

A. The variations promote natural selection.
B. They can distinguish each other by their beaks.
C. They interbreed to produce offspring with more variations.
D. They have different ecological niches to reduce competition.

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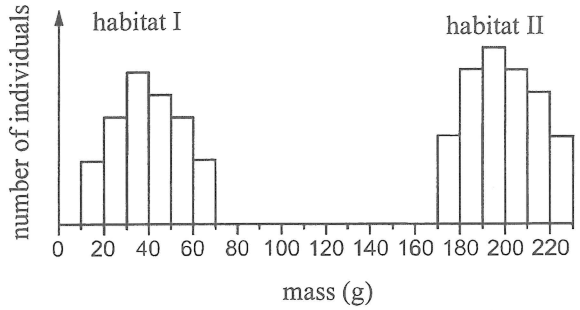
15. The graph below shows the masses of the same plant species grown in two different habitats:



Which of the following can be deduced from the graph?

A. The mass of the species is affected by two genes.
B. The mass of the species is affected by environment.
C. Discontinuous variation is shown in the mass of the species.
D. The mass of the species in habitat II is more affected by environment than that in habitat I.

Directions: Questions 16 to 18 refer to the table below, which shows the results of some crosses in one type of plants. This type of plant produces individuals either bearing male flowers with stamens only or female flowers with carpels only. The colour of the flower is controlled by a single gene.

Cross	*Male parent*	*Female parent*	*Offspring*
1	white flowers	white flowers	all white flowers
2	red flowers	white flowers	all red flowers
3	white flowers	red flowers	all red flowers
4	red flowers	white flowers	some red flowers, some white flowers
5	?	red flowers	some red flowers, some white flowers

16. It is known that the sex determination of this plant is similar to that of humans. Which of the following combinations correctly describes the allele for white flower in this plant?

	Dominant or recessive	*Location of the allele*
A.	dominant	autosome
B.	dominant	sex chromosome
C.	recessive	autosome
D.	recessive	sex chromosome

17. Which of the following combinations is most likely the result from Cross 4?

	No. of individuals with red flowers	*No. of individuals with white flowers*
A.	26	73
B.	48	46
C.	69	37
D.	71	25

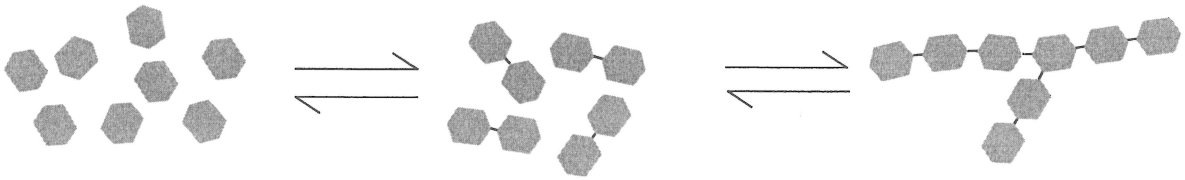
18. Which of the following statements about Cross 5 is correct?

A. The female parent could be a homozygote.
B. The male parent could be a homozygote with red flowers.
C. The male parent could be a homozygote with white flowers.
D. The male parent could be a heterozygote with white flowers.

Directions: Questions 19 and 20 refer to the diagram below, which shows interconversion of three types of compounds catalysed by enzymes in a living organism:

Key: ⬢ six-carbon sugars

X Y Z



19. If the organism is a plant, which of the following statements is ***incorrect***?

A. X is the major form of carbohydrate transported through phloem
B. The conversion of Z to X takes place in a germinating seed.
C. X can be the raw materials for synthesis of cell wall.
D. The conversion of X to Z takes place in chloroplast.

20. If the organism is a human, which of the following statements are correct?

(1) Conversion of Z to Y takes place in the stomach.
(2) Conversion of X to Z takes place in the liver.
(3) Z is present in muscle.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

21. Patients who have had their gall bladder removed should eat less oily food. This is because they are ***unable*** to

A. store bile.
B. store lipase.
C. produce bile.
D. produce lipase.

22. Which of the following combinations correctly compares pupil reflex in humans and phototropism in plants?

		pupil reflex	***phototropism***
(1)	stimulus	light intensity	direction of light
(2)	location of receptors	retina	shoot tip
(3)	effector	pupil	shoot

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

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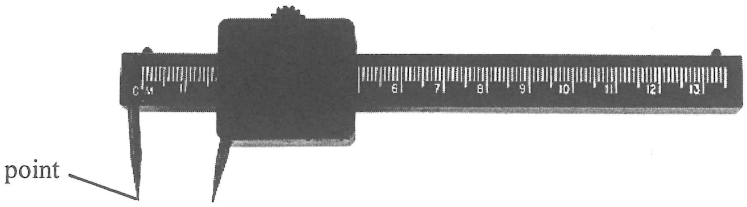
Directions: Questions 23 to 25 refer to a two-point discrimination test on the human skin by following the procedure shown below:

1. Blindfold the subjects (tested persons).
2. Set the calipers (shown below) at a distance of 30 mm. Apply the two points of the calipers with equal pressure on the fingertip of the subject's index finger. Have the subjects identify if they feel one touch or two touches.



3. Repeat step 2 by using a progressively shorter distance (e.g. 28 mm, 26 mm, 24 mm) between the two points until the subject feels one touch. Record the distance.
4. Repeat steps 2 and 3 by touching the palm of the hand, the back of the hand and the upper arm.
5. Over the course of the experiment, randomly use the caliper set at 0 mm for every couple of trials. It is important to make sure that the subjects tell you that they only feel one touch when the caliper is set at 0 mm.

23. Based on the procedure given, how many independent variable(s) is/are being studied in this investigation?

A. 1
B. 2
C. 3
D. 4

24. The investigation was designed to show the density of the touch receptors of the skin. What is the assumption of this investigation?

A. The subjects do not cheat by peeking out of the blindfold.
B. The fingertip is more sensitive than the other parts of the body.
C. A closer distance means that the density of the touch receptors is higher.
D. The two-touch sensations are produced by two separated touch receptors without overlapping.

25. Which of the following correctly explains the importance of Step 5 in this investigation?

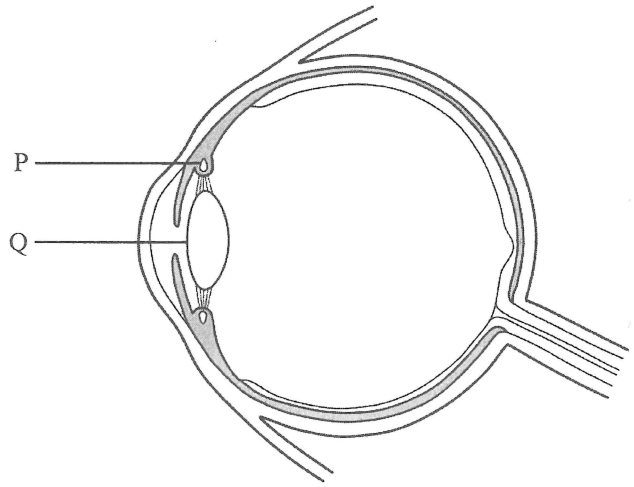
A. It ensures the validity of the measurement.
B. It checks the accuracy of the measurement.
C. It improves the reliability of the measurement.
D. It reduces the random error of the measurement.

26. Which of the following parts of the brain are responsible for coordination when one is speaking?

(1) cerebellum
(2) motor area
(3) sensory area
(4) association area

A. (2) and (4) only
B. (1), (2) and (3) only
C. (1), (2) and (4) only
D. (1), (3) and (4) only

Directions: Questions 27 and 28 refer to the diagram below, which shows a section of a human eyeball:



27. Ken and Jane are looking at a bird flying away from them. Which of the following combinations correctly describes the conditions of structures P and Q of their eyeball?

	Structure P	***Structure Q***
A.	relaxing	becoming thinner
B.	relaxing	becoming thicker
C.	contracting	becoming thinner
D.	contracting	becoming thicker

28. When the bird flies away to a certain distance, Ken can still see it clearly but Jane cannot. Ken has normal eyesight. Which of the following combinations correctly describes Jane's condition?

	Eyeball	***Position of image***
A.	too long	focused behind the retina
B.	too long	focused in front of the retina
C.	too short	focused behind the retina
D.	too short	focused in front of the retina

29. Study the following two statements:

I: Not all copulations lead to fertilisation and pregnancy.
II: Fertilisation occurs when a sperm enters the ovum at the oviduct.

Which of the following descriptions about the two statements is correct?

A. Both I and II are correct and II correctly explains I.
B. Both I and II are correct but II does not explain I.
C. I is correct but II is incorrect.
D. I is incorrect but II is correct.

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Directions: Questions 30 and 31 refer to an investigation about the effects of auxins on the growth of shoots. 10 mm sections of shoots were obtained from a number of seedlings. Auxin solutions of different concentrations were prepared. Three shoot sections were put into each solution for two days. The results are shown in the table below:

Auxin concentration (ppm)	*Length of the shoot section after 2 days (mm)*		
	Shoot 1	*Shoot 2*	*Shoot 3*
0	15.0	14.5	15.1
0.1	32.5	32.4	32.2
1	37.1	37.2	10.1
10	24.0	23.9	23.8
100	12.5	12.5	13.0
1000	10.0	9.8	10.3

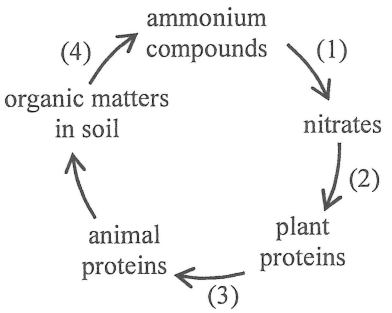
30. Based on the above results, which of the following is the lowest auxin concentration that inhibits the growth of the shoots?

A. 0.1 ppm
B. 10 ppm
C. 100 ppm
D. 1000 ppm

31. Which of the following best explains the result of Shoot 3 in 1 ppm auxin concentration solution?

A. This datum is anomalous.
B. It is an error which should be deleted.
C. It is due to variations in individual differences.
D. The shoot section is likely taken from the region of cell differentiation.

Directions: Questions 32 and 33 refer to the diagram below, which shows the conversion of some nitrogenous compounds in nature:



32. Which of the following statements about the conversions is correct?

A. Process (1) involves nitrogen fixing bacteria.
B. Process (2) is anabolic in nature.
C. Process (3) is catabolic in nature.
D. Process (4) involves denitrifying bacteria.

33. Which of the following process(es) involve(s) assimilation?

A. (1) only
B. (3) only
C. (1) and (2) only
D. (2) and (3) only

Directions: Questions 34 and 35 refer to some information about the interaction among three organisms: butterflies, plant species X and ants. Butterflies lay eggs on the leaf surfaces of plant species X. When caterpillars hatch from the eggs, they feed on the leaves. Plant species X secretes a sugary solution on their leaves. Ants are attracted to feed on the sugary solution and the eggs.

34. Which of the following combinations correctly describes the relationship between the organisms mentioned?

	Plant species X and ant	*Ant and butterfly*
A.	mutualism	competition
B.	mutualism	predation
C.	commensalism	competition
D.	commensalism	predation

35. It is believed that the ancestors of plant species X did not possess the structure to secrete a sugary solution on their leaves. Which of the following are the possible reasons that could have led to the emergence of this structure in plant species X?

(1) Spontaneous mutations of leaf cells of the ancestors.
(2) Gene mutation during meiotic cell division of the ancestors.
(3) Individuals with this structure survived better than those without this structure.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

36. Which of the following are examples of non-specific defence in humans?

(1) tear glands
(2) phagocytes
(3) epithelial tissue

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

END OF SECTION A
Go on to Question-Answer Book B for questions on Section B