

Biology
Standard level
Paper 2

Friday 28 October 2022 (morning)

Candidate session number

1 hour 15 minutes

Instructions to candidates

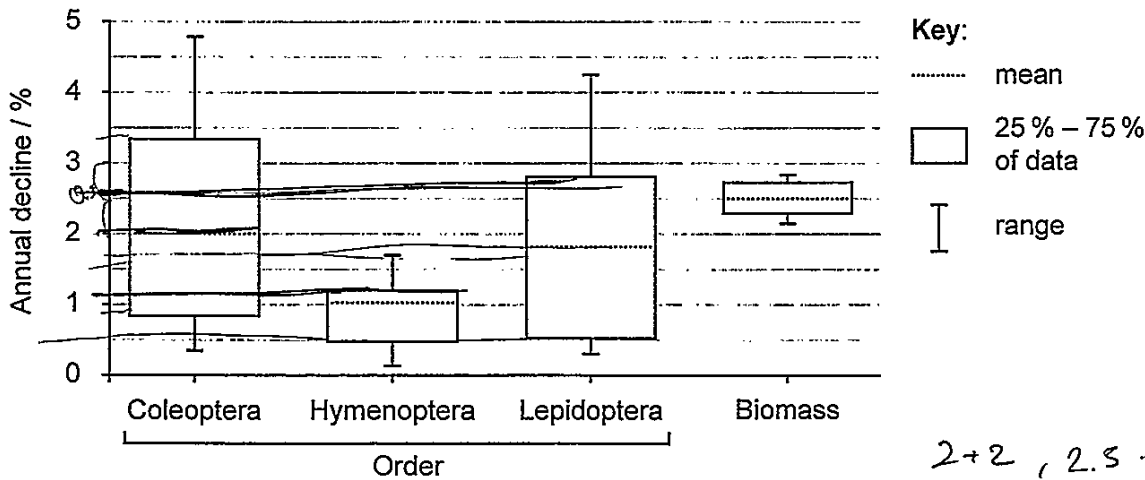
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer one question.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[50 marks]**.



Section A

Answer all questions. Answers must be written within the answer boxes provided.

- The biodiversity of insects worldwide is in decline. Destruction of habitats, pollution and climate change have contributed to the decline in global insect populations and to the extinction of insect species. A comprehensive literature review was carried out to determine the annual global rate of decline in insect species. The graph shows the results for three major orders of terrestrial insects and the total decline in insect biomass worldwide.



[Source: adapted from Sánchez-Bayo, F. and Wyckhuys, K.A.G., 2019. Worldwide decline of the entomofauna: A review of its drivers. *Biological Conservation* 232, pp.8-27.]

- (a) State the mean annual decline in insect biomass. [1]

~~2.5%~~ 1.87% 0

- (b) Compare and contrast the results for Hymenoptera and Lepidoptera. [2]

the Lepidoptera's annual decline rate is higher than Hymenoptera's by approximately 2%. However, their starting percentage is the same.

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20EP03

Turn over

(Question 1 continued)

- (c) Calculate the number of Coleoptera species that would be expected to exist after one year from a starting number of 400 000 species, assuming the mean rate of decline. [1]

$$\begin{aligned} 400.000 \cdot 2\% &= 8.000 // \\ 400.000 - 8000 &= 392.000 \text{ Coleoptera} // \end{aligned}$$

One species of the order Hymenoptera is the buff-tailed bumblebee (*Bombus terrestris*), which feeds on pollen and nectar obtained from specific plants.



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(Question 1 continued)

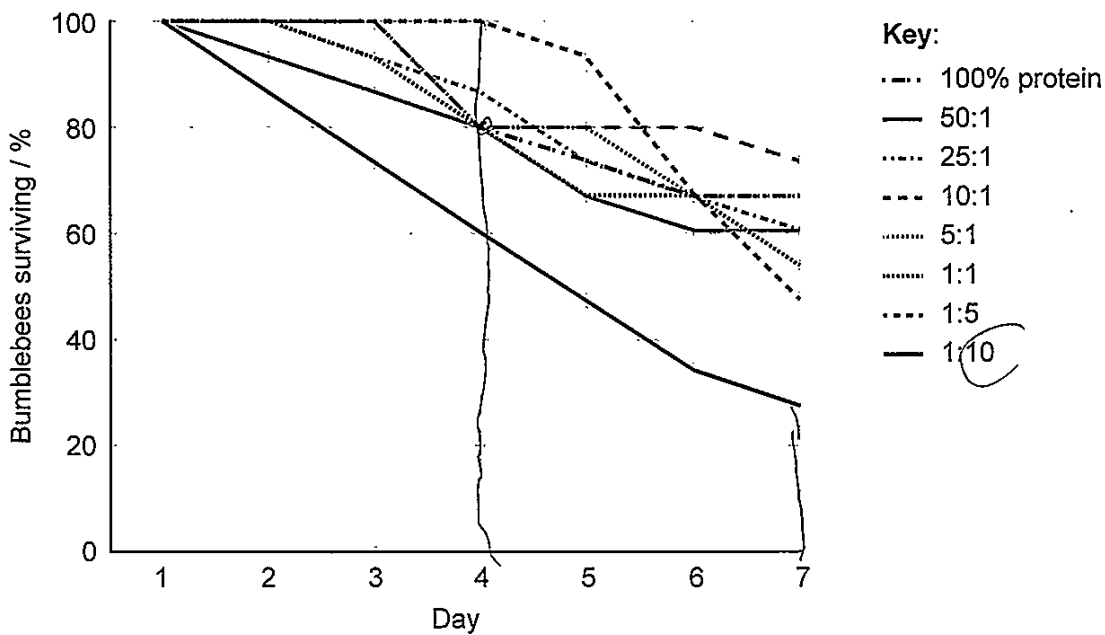
(f) Calculate the mass of lipid eaten when the bumblebees were presented with the 5:1 diet. [1]

~~0.13~~ ~~5%~~ 0.13 5%
~~0.0075~~ = 0.0075 protein 0
 0.13 - 0.0075 = 0.1225 g

(g) Suggest a reason that the mass of protein and lipid mixture eaten at 25:1 is lower than at 50:1. [1]

More protein is consumed than lipid in 50:1 because protein might be their normal diet. ✓

The graph shows the percentage of bumblebees that survived each day while being fed on different P:L diets. For each trial, n = 15.



[Source: adapted from Vaudo, A.D., Stabler, D., Patch, H.M., Tooker, J.F., Grozinger, C.M and Wright, G.A., 2016. Bumble bees regulate their intake of essential protein and lipid pollen macronutrients. *Journal of Experimental Biology* 219, pp.3962-3970.]

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(Question 1 continued)

(h) State the relationship between high lipid content and survivability on day 7. [1]

Survivability decreases as the lipid amount increases. Inversely proportional.

(i) Suggest with a reason which P:L diet is closest to the normal diet of these bumblebees. [1]

100% protein because it shows the highest survivability rate, v.p. until the fourth day.

0

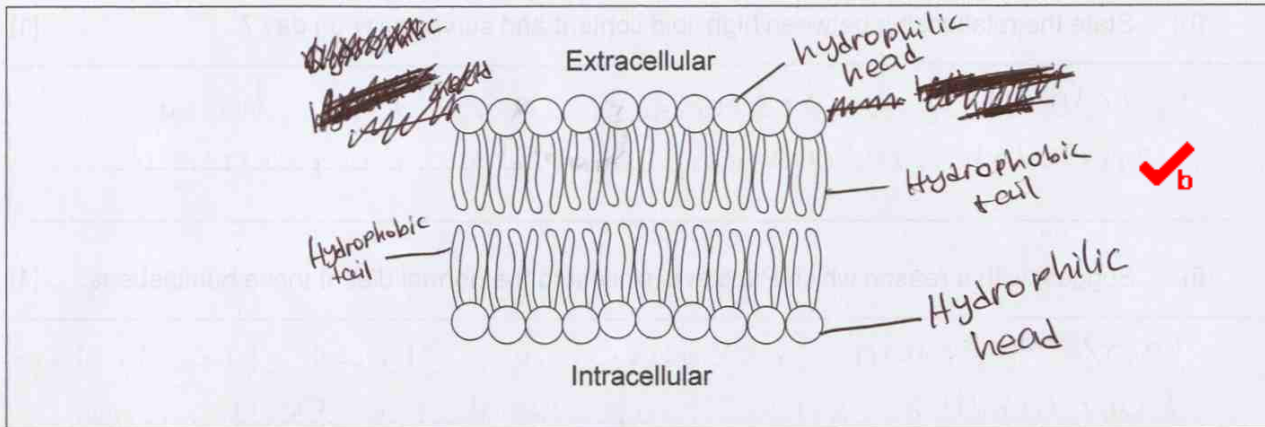
(j) Discuss whether these studies show that habitat destruction can affect global bumblebee numbers. [2]

Habitat destruction ~~creates~~ also destroys the amount of foods bumblebee reaches. As the protein is eaten more, destroying their habitat also destroys their mode of nutrients. Therefore, these studies show that habitat destruction can affect global bumblebee numbers.

λ



2. The image shows a phospholipid bilayer that is a component of the cell membrane.



(a) Annotate the diagram to illustrate the amphipathic nature of phospholipids. [2]

(b) Outline a function of cholesterol in cell membranes. [1]

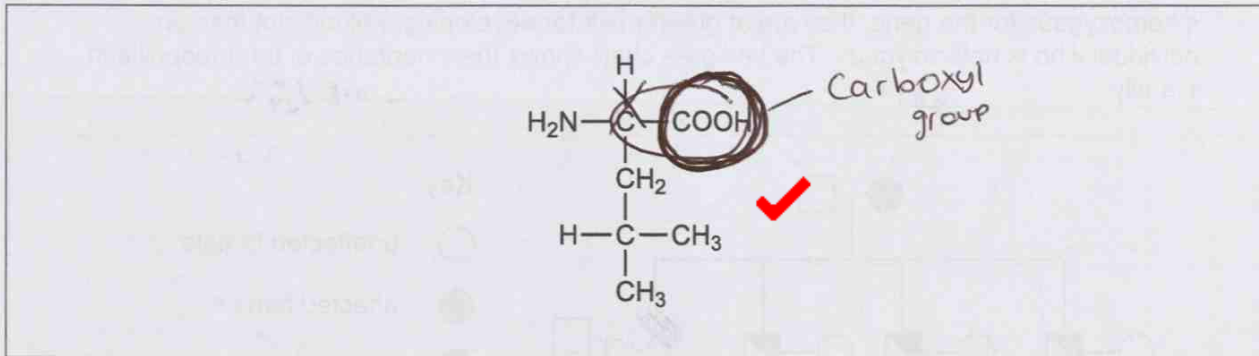
... To ... regulate ... the ... membrane ... fluidity ... cholesterol ... is present.

(c) Describe **two** pieces of evidence that show that eukaryotic cells originated by endosymbiosis. [2]

Mitochondria and Chloroplast have their own circular DNA and they produce 70S ribosomes. Similar to prokaryotes.



3. The diagram shows the molecular structure of the amino acid leucine.



- (a) Draw a circle on the diagram to enclose the carboxyl group. [1]
- (b) State one protein that acts as a hormone. [1]

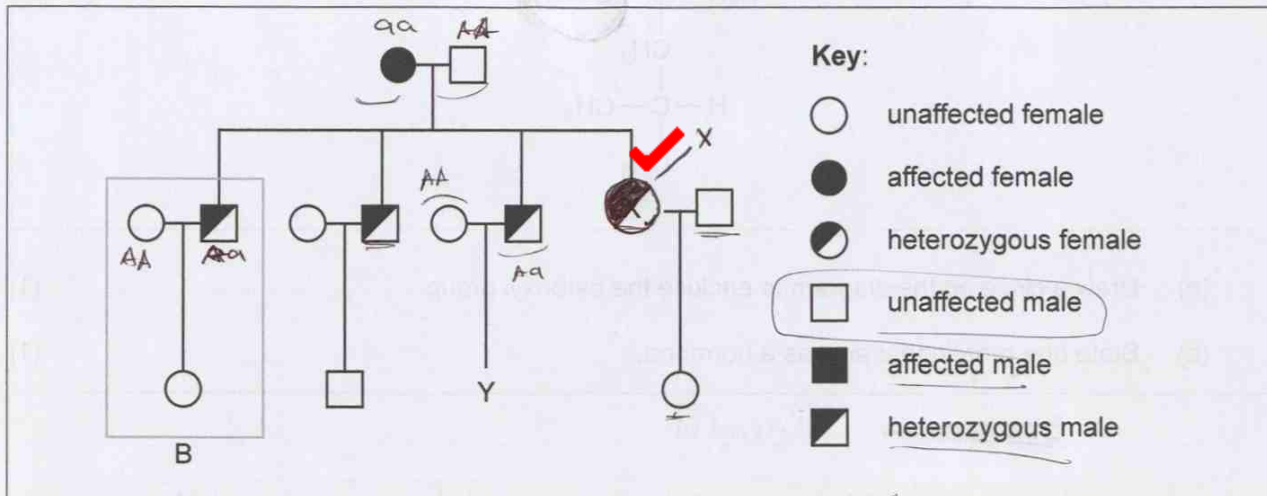
~~Insulin~~ Insulin ✓

- (c) Explain how enzymes are used in the preparation of milk suitable for individuals who are lactose intolerant. [2]

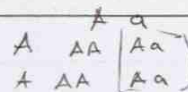
The enzyme lactase is used in the preparation of lactose free milk. The oligosaccharide beads act as coenzymes and as the milk passes through ^b that, lactose, a disaccharide, is broken down into glucose and galactose. ✓_c

Oligosaccharide beads

4. Thrombophilia is a human genetic condition where the blood has an increased tendency to clot. The condition is caused by a single base substitution mutation in DNA. If a person is homozygous for the gene, they are at greater risk for developing a blood clot than an individual who is heterozygous. The pedigree chart shows the inheritance of thrombophilia in a family.



(a) Draw the symbol for individual X on the diagram.



[1]

(b) Calculate the probability of male Y having an allele for the disorder.

[1]

The child is not sick in every scenario, though the child will be 50% carrier, which have the allele.

(c) Explain how the information in the box labelled B indicates that the gene is **not** sex-linked. [2]

~~Not sex-linked~~ (see the answer booklet)

(d) Explain how a single base substitution mutation in DNA can cause a change to a protein. [2]

When DNA's single base changes and another base substitutes that, the entire protein can be changed as mRNA that transcribes it will transcribe another codon. And anticodons on tRNA, that each is coded for amino acid, will translate for an entirely different amino acid.

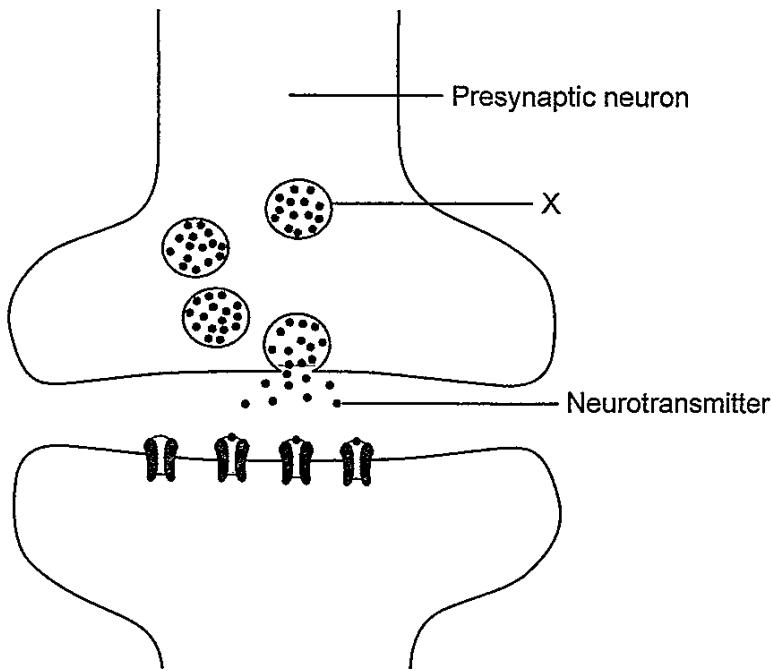
An example would be Sickle cell anemia, where CTC is changed to CAC, and glutamic acid became Valine.





4 (c) In sex-linked diseases, fathers cannot be carriers due to the fact that they only have one x chromosome, and X is the only chromosome that can contain disease alleles. The father either becomes sick, or not affected. However, the father in B is shown to be a carrier, which is not possible when it comes to sex linked diseases.

5. The diagram shows the release of a neurotransmitter across a synapse.



(a) Identify the structure labelled X. [1]

Neurotransmitter carrier vesicle ✓

(b) Outline how the neuron is stimulated to release the neurotransmitter. [2]

Action potential reaches to the voltage-gated calcium channels and when they diffuse into the membrane, vesicles that have neurotransmitters are stimulated.

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(Question 5 continued)

(c) Explain the action of neonicotinoid pesticides in insects.

[3]

In insects... the neurotransmitter, Acetylcholine, is carried from presynaptic synapse to the postsynaptic and they ~~are~~ bind ^e to the receptors. However, neonicotinoids binds irreversibly ^d to those ~~receptors~~ postsynaptic receptors. Thus, Acetylcholine cannot be broken down and the action potential cannot be initiated. This ~~results in a paralyze~~ yields to paralyzed ^f and dead insects.



Section B

Answer **one** question. Up to one additional mark is available for the construction of your answer. Answers must be written within the answer boxes provided.

6. The continued survival of all living organisms depends on sustainable communities in which plants play a vital role.
- (a) Outline how energy flows in an ecosystem. [4]
 - (b) Describe how plants affect the amount of carbon dioxide in the atmosphere. [4]
 - (c) Explain how a newly discovered plant species would be classified and named. [7]
7. Humans ingest food which provides energy and nutrients to carry out life processes.
- (a) Outline how ^{alpha glucose} starch in the diet is modified for absorption in humans. [3]
 - (b) Describe how the small intestine is adapted for efficient absorption of nutrients. [5]
 - (c) Blood transports nutrients to all tissues of the body. Explain the initiation of the heartbeat and how blood flow is controlled in the heart. [7]

Valves

First Pacemaker
Bundle of His
and Purkinjee Fibres
Valves

Second heartbeat



6- (a). ~~The energy flow starts with~~ The energy flow starts with the energy coming from the sun. This is referred to as 'light energy' and it is the primary way for plants and other ~~autotrophic~~ autotrophic organisms to turn inorganic molecules to organic ones. Through photosynthesis of autotrophs, the organic compound is produced so that other ~~autotrophs~~ heterotrophs can obtain these organic molecules from them. However, the energy flow is never 100% efficient, and in each trophic level, only approximately 10% of the energy can be transferred. ~~Although energy is not reusable~~ ~~recycled, it is lost~~ However, energy is not recycled.

~~Heterotrophic organisms use the energy from~~ Heterotrophic organisms use the energy from autotrophs for their metabolic and cellular functions. ~~Such as the use of ATP, etc. as energy, also energy as~~ ~~Such as the use of ATP, etc. as energy, also energy as~~ ~~Such as the use of ATP, etc. as energy, also energy as~~ However, since energy is not recycled, the ~~food~~ food chain is also limited. The energy is lost as heat too as **seen** ~~the~~ food chain progresses.

SEEN (b) plants are autotrophic living things, and they are capable of turning ~~inorganic~~ inorganic materials such as CO₂ to organic materials, such as glucose. Plants use CO₂ in the air for the use of photosynthesis and the CO₂ is broken down in the light independent phase of the photosynthesis in order to create



Organic [✓] materials. The water, H_2O , is broken down and Hydrogen atoms are released, and ~~then~~ through the combination of CO_2 the organic materials are produced. Therefore plants use many CO_2 in the air for the sake of producing organic materials. However, along with photosynthesis, they also make cellular respiration and contribute [✓] to the atmospheric CO_2 amount.

(c) In classification of the living things, ~~the~~ two methods are used: [✓] analysing the base sequence of DNA and [✓] amino acid sequence of polypeptide. This natural classification gives a clear insight into the evolutionary [✓] pathway of the organism and sheds light on the common ancestors of the organism. With these two methods, the plant is classified ~~into a~~ For plants, however, there are more specific features as each phylum shows certain features. If the plant has vascularization, then the plant cannot be bryophyta. If it does not produce spores ~~and has vascularization~~, it cannot be Filicinophyta, if it has vascularization and produce seeds but cannot produce flowers, then ~~it's not~~ it's [✓] gymnosperms. And finally, if it has flowers, it's [✓] angiosperms. For the naming, Binomial [✓] ~~name~~ system is used so that every scientist [✓] can agree the name of the plant. First the genus is written with capital letter, then, species is



written **bold** it should be *italic*. If, however, plants show differences and new discoveries regarding their amino acid/base sequence, they can be reclassified

Qd

