UKBC

- Question 1 — 4 marks
- Question 2 — 7 marks
- Question 3 — 11 marks
- Question 4 — 9 marks
- Question 5 — 4 marks
- Question 6 — 2 marks
- Question 7 — 4 marks
- Question 8 — 4 marks
- Question 9

FLAG

Holly trees growing in enclosures without herbivores often grow smooth leaves.

Holly trees exposed to herbivores often grow spikey leaves.

What explains this phenomenon?

2 marks

- ○ Learning (to protect themselves from deer).
- ○ Evolution by natural selection (trees exposed to herbivores evolve spikes).
- ○ Evolution by genetic drift.

What explains this phenomenon?

2 marks

- Learning (to protect themselves from deer).
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- Phenotypic plasticity in response to environmental signals.
- Disease caused by exposure to herbivores.

Insect numbers in Europe have dropped by ~75% since 1990.

Scientists measured pansies growing near Paris over the last 30 years.

Compared to historical pansies, living pansies have the same overall weight and produce a similar number of seeds, but have 10% smaller flowers and produce 20% less nectar.

Pansies live only one season, and can self-pollinate.

UKBC

- Question 1 — 4 marks
- Question 2 — 7 marks
- Question 3 — 11 marks
- Question 4 — 9 marks
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- Question 6 — 2 marks
- Question 7 — 4 marks
- Question 8 — 4 marks
- Question 9

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UKBC

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- Question 2 — 7 marks
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- Question 7 — 4 marks
- Question 8 — 4 marks
- Question 9

What explains changing pansies?

2 marks

- ○ Learning (to be less reliant on insects).
- ✓ Evolution by natural selection (to be less reliant on insects).
- ○ Evolution by genetic drift (to be less reliant on insects).
- ○ Phenotypic plasticity in response to environmental signals.
- ○ Disease / ill health (caused by the changing environment).

What do you expect to happen to flowers growing alongside pansies which cannot self-pollinate?

3 marks

- ○ Constant flower size, but increased numbers of seeds.
- ○ Constant flower size, but decreased numbers of seeds.

UKBC

FLAG

- Question 1
  4 marks
- Question 2
  7 marks
- Question 3
  11 marks
- Question 4
  9 marks
- Question 5
  4 marks
- Question 6
  2 marks
- Question 7
  4 marks
- Question 8
  4 marks
- Question 9

Extinctions caused by humans can disrupt the evolutionary trajectory of organisms which survive.

For example, avocados will go extinct without farmers because the giant sloths that once ate them are gone.

The fastest herbivore on earth is the American pronghorn (top speed ~60 mph). Whereas, the fastest predator living in America is the wolf (top speed ~40 mph).

Why is the pronghorn so fast?

UKBC

- Question 1 — 4 marks
- Question 2 — 7 marks
- Question 3 — 11 marks
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- Question 9

The fastest herbivore on earth is the American pronghorn (top speed ~60 mph). Whereas, the fastest predator living in America is the wolf (top speed ~40 mph).

Why is the pronghorn so fast?

2 marks

- 'Running for your life versus dinner' principle: herbivores are always much faster than their predators.
- ✓ Evolutionary arms race with recently extinct predators, such as the American cheetah.
- Pleiotropy: genes which happen to make the pronghorn fast have other, beneficial, functions.

- Question 1
  4 marks
- Question 2
  7 marks
- Question 3
  11 marks
- Question 4
  9 marks
- Question 5
  4 marks
- Question 6
  2 marks
- Question 7
  4 marks
- Question 8
  4 marks
- Question 9

- Adaptation: extreme speed is useful for other things than running away, such as finding food quickly.
- Training: young pronghorns become fast due to play and copying adults.

Madagascan lemurs are terrified of objects and shadows mimicking birds-of-prey. They have specific alarm calls for birds, despite being far too big for living birds to attack.

There are bones of Giant Eagles on Madagascar, but these went extinct 3,600 years ago.

What type of behaviour probably describes the lemurs' alarm calls?

2 marks

UKBC

- Question 1
  4 marks
- Question 2
  7 marks
- Question 3
  11 marks
- Question 4
  9 marks
- Question 5
  4 marks
- Question 6
  2 marks
- Question 7
  4 marks
- Question 8
  4 marks
- Question 9

2 marks

- Conditioning - they associate distress calls with seeing the birds.
- Mimicry - they copy the calls of other lemurs when seeing the birds.
- Learning and culture - young learn to make the calls from adults.
- ✓ Instinct - the distress calls in response to birds are genetically controlled.
- Insight / logic - the lemurs realise that a large shadow / bird could be a threat without experiencing it directly.

NEXT QUESTION →

UKBC

- Question 1 — 4 marks
- Question 2 — 7 marks
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- Question 4 — 9 marks
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- Question 6 — 2 marks
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FLAG

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UKBC

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  4 marks
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  7 marks
- Question 3
  11 marks
- Question 4
  9 marks
- Question 5
  4 marks
- Question 6
  2 marks
- Question 7
  4 marks
- Question 8
  4 marks
- Question 9

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2 marks

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FXO605

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4 marks

Question 2
7 marks

Question 3
11 marks

Question 4
9 marks

Question 5
4 marks

Question 6
2 marks

Question 7
4 marks

Question 8
4 marks

Question 9

If the ants were using chemotaxis to help navigate...

2 marks

... stilts / stumps probably would **not** affect how easily they found the nest.

- [x] True
- [ ] False

... ants would become confused if they are spun around many times.

- [ ] True
- [x] False

... putting the ants back down an equal distance away on the opposite side of the nest would **not** affect how easily they found the nest.

- [x] True
- [ ] False

FXO605

Compared to the desert, forests have more permeant features, less wind and less risk of over-heating.

If the scientists repeat their experiment with leafcutter ants...

Question 1
4 marks

Question 2
7 marks

Question 3
11 marks

Question 4
9 marks

Question 5
4 marks

Question 6
2 marks

Question 7
4 marks

Question 8
4 marks

Question 9

Compared to the desert, forests have more permeant features, less wind and less risk of over-heating.

If the scientists repeat their experiment with leafcutter ants...

2 marks

- [ ] Leafcutter ants with stilts would overshoot their nests.
- [ ] Leafcutter ants are more likely than *C. fortis* to find their way home in the pitch black.
- [x] Leafcutter ants are more likely than *C. fortis* to follow 'roads' around their territory.

FXO605

Question 1
4 marks

Question 2
7 marks

Question 3
11 marks

Question 4
9 marks

Question 5
4 marks

Question 6
2 marks

Question 7
4 marks

Question 8
4 marks

Question 9

Some species of ant often move between lines of unmoving soldier ants.

What are the plausible reasons for this?

3 marks

- [ ] Ants lack navigational skill to find their way if they stray away from the soldiers.
- [ ] The soldiers stop the worker ants from escaping and setting up a new colony.
- [ ] The soldiers ensure boundaries with other territories are respected.

UKBC

- Question 1
  4 marks
- Question 2
  7 marks
- Question 3
  11 marks
- Question 4
  9 marks
- Question 5
  4 marks
- Question 6
  2 marks
- Question 7
  4 marks
- Question 8
  4 marks
- Question 9

3 marks

- [x] Ants lack navigational skill to find their way if they stray away from the soldiers.
- [ ] The soldiers stop the worker ants from escaping and setting up a new colony.
- [ ] The soldiers ensure boundaries with other territories are respected.
- [x] The soldiers stop the workers straying into danger.
- [ ] The soldiers protect the workers from attack.
- [x] Foraging is more efficient if workers can travel in 'lanes' along known 'roads'.
- [x] Compared to forest ants, desert ants are more likely to use 'roads' guarded by soldiers.

FXO605

← BACK

NEXT QUESTION →

Question 1
4 marks

Question 2
7 marks

Question 3
11 marks

Question 4
9 marks

Question 5
4 marks

Question 6
2 marks

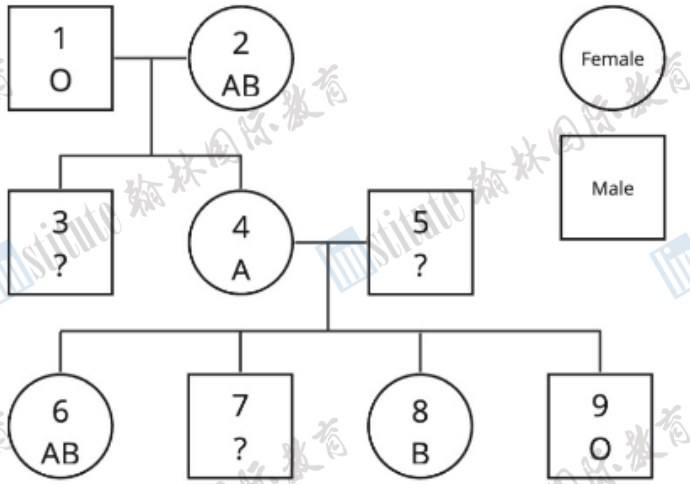
Question 7
4 marks

Question 8
4 marks

Question 9

FLAG

Below is a family tree showing the blood types of each family member.



What blood type(s) could person 3 have?

2 marks

☐ AB

Question 1
4 marks

Question 2
7 marks

Question 3
11 marks

Question 4
9 marks

Question 5
4 marks

Question 6
2 marks

Question 7
4 marks

Question 8
4 marks

Question 9

What blood type(s) could person 3 have?

2 marks

- [ ] AB
- [x] A
- [x] B
- [ ] O

FXO605

What blood type(s) could person 5 have?

2 marks

- [ ] AB
- [ ] A
- [x] B

UKBC

- Question 1
  4 marks
- Question 2
  7 marks
- Question 3
  11 marks
- Question 4
  9 marks
- Question 5
  4 marks
- Question 6
  2 marks
- Question 7
  4 marks
- Question 8
  4 marks
- Question 9

What blood type(s) could person 7 have?

2 marks

- [x] AB
- [x] A
- [x] B
- [x] O

FXO605

If people with the same genotype as 8 and 9 have a child together, what is the chance the child has blood type O?

Give a number as a percentage or frequency(decimal)

3 marks

0.5

FXO605

下一张

UKBC

FLAG

- Question 1
  4 marks
- Question 2
  7 marks
- Question 3
  11 marks
- Question 4
  9 marks
- Question 5
  4 marks
- Question 6
  2 marks
- Question 7
  4 marks
- Question 8
  4 marks
- Question 9

Lizards occupy a wide variety of habitats and are therefore very diverse in appearance.

1

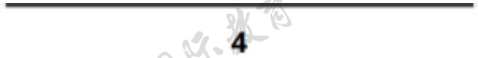
2

3

4

FXO605

3



4

5

6

7

8

Sort the lizards into the most likely groups.

- Question 1
  4 marks
- Question 2
  7 marks
- Question 3
  11 marks
- Question 4
  9 marks
- Question 5
  4 marks
- Question 6
  2 marks
- Question 7
  4 marks
- Question 8
  4 marks
- Question 9

Sort the lizards into the most likely groups.

4 marks

Unsorted	Lives in limestone caves	Ground dwelling predator of mammals / birds
8		
3		
2		✓
1	✓	
4		✓
5		

下一

UKBC

- Question 1
  4 marks
- Question 2
  7 marks
- Question 3
  11 marks
- Question 4
  9 marks
- Question 5
  4 marks
- Question 6
  2 marks
- Question 7
  4 marks
- Question 8
  4 marks
- Question 9

4

5

6

7

Lives in a hot desert

5

Tree climbing predators

6. 8

Nocturnal

3

Burrowing

7

FXO605

← BACK

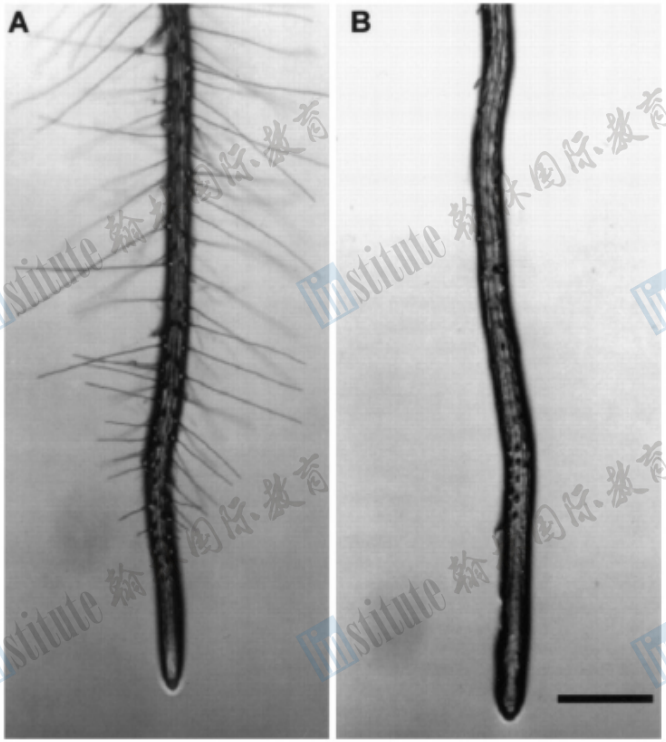
NEXT QUESTION →

UKBC

FLAG

- Question 1
  4 marks
- Question 2
  7 marks
- Question 3
  11 marks
- Question 4
  9 marks
- Question 5
  4 marks
- Question 6
  2 marks
- Question 7
  4 marks
- Question 8
  4 marks
- Question 9

The image shows plant roots.



FXO605

True or false?

Question 1
4 marks

Question 2
7 marks

Question 3
11 marks

Question 4
9 marks

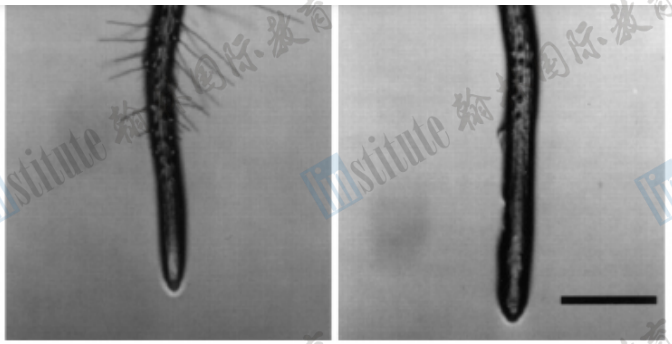
Question 5
4 marks

Question 6
2 marks

Question 7
4 marks

Question 8
4 marks

Question 9



FXO605

True or false?

2 marks

下一张

More water is taken up at the tip of the root than the middle	☐ True	☑ False
Water uptake in the root is an active process	☐ True	☑ False
Plant B is better adapted to live in a desert	☐ True	☑ False

FXO605

← BACK

NEXT QUESTION →

UKBC

FLAG

- Question 1 — 4 marks
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- Question 4 — 9 marks
- Question 5 — 4 marks
- Question 6 — 2 marks
- Question 7 — 4 marks
- Question 8 — 4 marks
- Question 9

Gregor Mendel described the inheritance of round and wrinkled peas. He showed the round (R) phenotype was dominant over wrinkled (r).

The wrinkled phenotype is caused by an insertion of a transposable element into the gene SBE1.

A geneticist made two independent crosses (I and II) between peas with different genotypes. 30 progeny from each cross were analysed by PCR. They used a pair of primers targeting flanking sides of SBE1.

The PCR products were resolved by agarose gel electrophoresis. Each lane shows the results of one progeny.

UKBC

- Question 1 — 4 marks
- Question 2 — 7 marks
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- Question 5 — 4 marks
- Question 6 — 2 marks
- Question 7 — 4 marks
- Question 8 — 4 marks
- Question 9

II.

The downward arrow denotes the direction of migration.

FXO605

Which allele produces a longer PCR product?

1 mark

- R
- r

FXO6

What were the genotypes of the parents in cross I?

UKBC

- Question 1 — 4 marks
- Question 2 — 7 marks
- Question 3 — 11 marks
- Question 4 — 9 marks
- Question 5 — 4 marks
- Question 6 — 2 marks
- Question 7 — 4 marks
- Question 8 — 4 marks
- Question 9

What were the genotypes of the parents in cross I?

2 marks

- RR x RR
- RR x Rr
- RR x rr
- Rr x Rr
- Rr x rr
- rr x rr

FXO605

What were the genotypes of the parents in cross II?

1 mark

UKBC

- Question 1 — 4 marks
- Question 2 — 7 marks
- Question 3 — 11 marks
- Question 4 — 9 marks
- Question 5 — 4 marks
- Question 6 — 2 marks
- Question 7 — 4 marks
- Question 8 — 4 marks
- Question 9

rr x rr

FXO605

What were the genotypes of the parents in cross II?

1 mark

- RR x RR
- RR xRr
- RR x rr
- Rr x Rr
- Rr x rr ✓
- rr x rr

FXO605

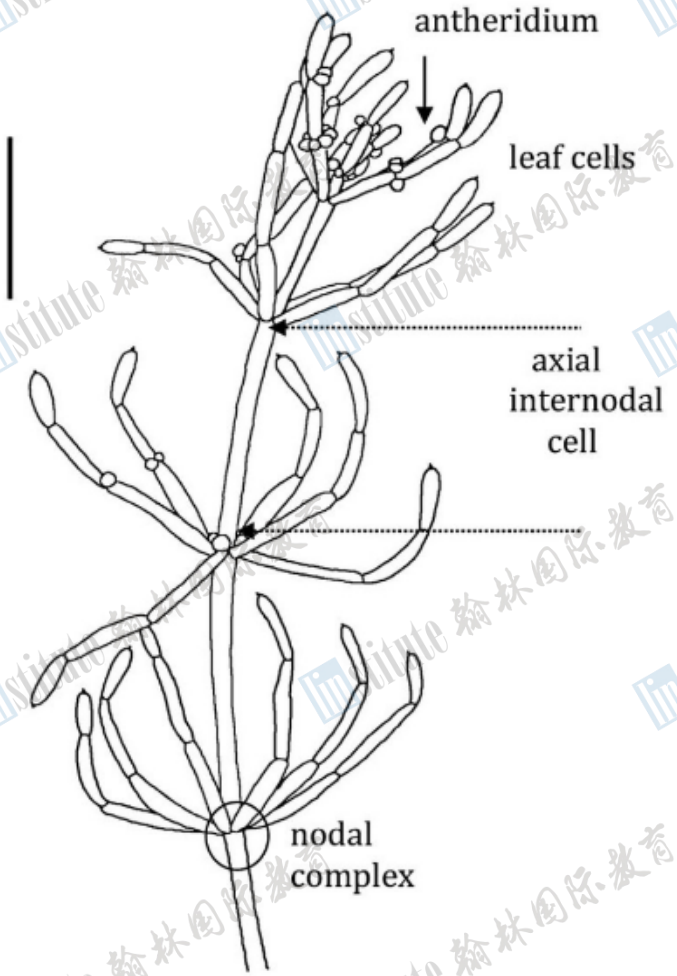
← BACK NEXT QUESTION →

UKBC

- Question 1
  4 marks
- Question 2
  7 marks
- Question 3
  11 marks
- Question 4
  9 marks
- Question 5
  4 marks
- Question 6
  2 marks
- Question 7
  4 marks
- Question 8
  4 marks
- Question 9

Cytoplasmic streaming was discovered 1774.

Below is a video of an internodal cell of *Chara corallina* under a light microscope, playing at 1x speed.



UKBC

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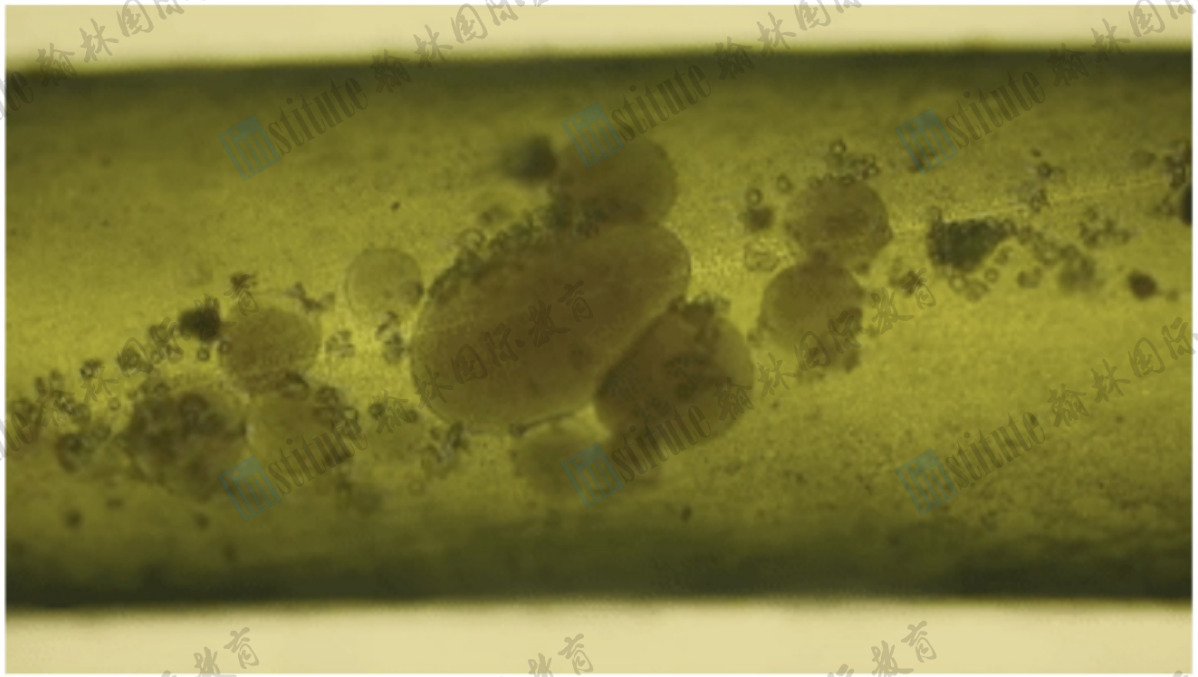

FXO605

True or false?

4 marks

C. corallina relies on passive diffusion to move nutrients around the plant

- [ ] True
- [ ] False

FXO605

True or false?

4 marks

C. corallina relies on passive diffusion to move nutrients around the plant	☐ True ☑ False
Like most plants, *C. corallina* has a single vacuole.	☑ True ☐ False
This video shows *C. corallina* must have two separate streams of cytoplasm, rather than one circular flow.	☑ True ☐ False
C. corallina cytoplasmic streaming is the same speed at 12°C as 1°C.	☐ True ☑ False

FXO605

UKBC

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- Question 2 — 7 marks
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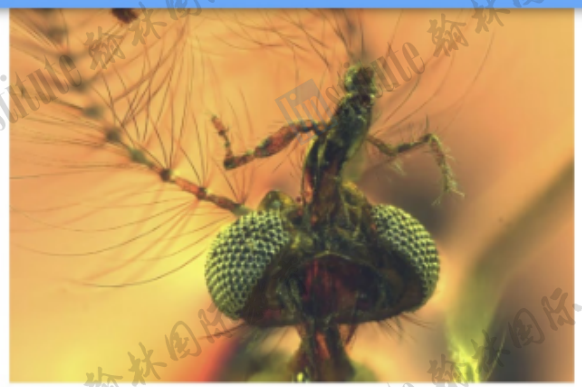
- Question 8 — 4 marks
- Question 9

FLAG

Only female mosquitoes suck blood.

Male mosquitoes instead drink the nectar of mosquito-pollinated flowers.

Mosquitoes are believed to have first evolved in the Jurassic period (201 - 145 million years ago). Flowering plants first became widespread in the Cretaceous (100 million years ago).



FXO605

Which statements could explain the evolution of blood-sucking in mosquitoes?

2 marks

- [x] Both sexes of the first mosquitoes only sucked blood.
- [ ] Both sexes of the first mosquitoes only drank nectar.
- [x] Both sexes of the first mosquitoes fed on fluids from parts of plants other than flowers.
- [ ] Different sexes of mosquitoes have always had different feeding habits.

UKBC

- Question 1 — 4 marks
- Question 2 — 7 marks
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- Question 9

In 2023, Scientists discovered two fossilised mosquitoes trapped in amber for 130 million years. They were both males of the same species.

They both had mouthparts adapted for sucking blood.

Which statements *could* explain the evolution of blood-sucking in mosquitoes?

2 marks

- [x] Both sexes of the first mosquitoes only sucked blood. Males switched to drinking nectar when flowering plants became widespread.
- [ ] Both sexes of the first mosquitoes only fed on fluids from parts of plants other than flowers. Females then adapted to sucking blood as males adapted to drinking nectar when flowering plants became widespread.
- [x] Modern mosquitoes are *not* descended from the same species as the fossil. Most species of mosquitoes have always had sexes with different feeding habits, but males switched to sucking blood in a few species.

FXO605

Question 1
4 marks

Question 2
7 marks

Question 3
11 marks

Question 4
9 marks

Question 5
4 marks

Question 6
2 marks

Question 7
4 marks

Question 8
4 marks

Question 9

Both sexes of the first mosquitoes only fed on fluids from parts of plants other than flowers. Females then adapted to sucking blood as males adapted to drinking nectar when flowering plants became widespread.

Modern mosquitoes are *not* descended from the same species as the fossil. Most species of mosquitoes have always had sexes with different feeding habits, but males switched to sucking blood in a few species.

FXO605

Based on the available evidence, which is the *most likely* explanation of the evolution of mosquitoes?

2 marks

Both sexes of the first mosquitoes only sucked blood. Males switched to drinking nectar when flowering plants became widespread.

Both sexes of the first mosquitoes only fed on fluids from parts of plants other than flowers. Females then adapted to sucking blood as males adapted to drinking nectar when flowering plants became widespread.

Modern mosquitoes are *not* descended from the same species as the fossil. Most species of mosquitoes have always had sexes with different feeding habits, but males switched to sucking blood in a few species.

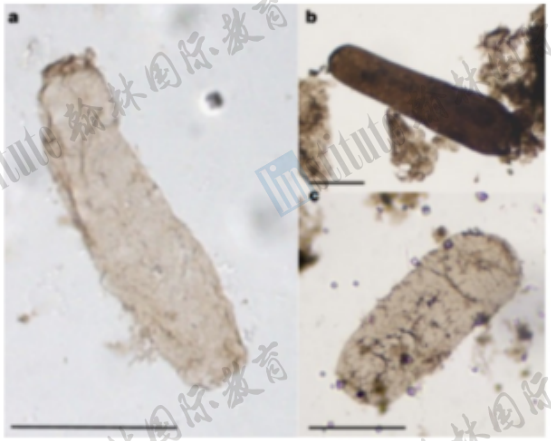
FXO605

← BACK NEXT QUESTION →

FLAG

In 2024, scientists reported finding fossilised microorganisms which contained folded internal membranes which looked like thylakoids. At 1.75 billion years old, these are the oldest fossilised thylakoids.

True or false?



3 marks

The organism certainly had chloroplasts.	☐ True ☐ False
The organism certainly had mitochondria.	☐ True

UKBC

Question 1
4 marks

Question 2
7 marks

Question 3
11 marks

Question 4
9 marks

Question 5
4 marks

Question 6
2 marks

Question 7
4 marks

Question 8
4 marks

Question 9

The organism certainly had chloroplasts.	☐ True	☑ False
The organism certainly had mitochondria.	☐ True	☑ False
Organisms like this could be responsible for the 'oxygen catastrophe'(the accumulation of free O_2 in the atmosphere).	☑ True	☐ False
The organism was probably a cyanobacteria.	☑ True	☐ False
The organism likely absorbed green light.	☐ True	☑ False

Why are key photosynthetic reactions carried out within/on membranes?

3 marks

- ○ To maximise the surface area for the reaction.

UKBC

- Question 1 — 4 marks
- Question 2 — 7 marks
- Question 3 — 11 marks
- Question 4 — 9 marks
- Question 5 — 4 marks
- Question 6 — 2 marks
- Question 7 — 4 marks
- Question 8 — 4 marks
- Question 9

Why are key photosynthetic reactions carried out within/on membranes?

3 marks

- [x] To maximise the surface area for the reaction.
- [x] To maximise the amount of enzymes and pigments which can fit in the cell.
- [x] So potential gradients can be established to power other reactions.
- [ ] To minimise the distance light and substrates must travel through the cell.
- [ ] Because the substrates are hydrophobic.

True or false?

3 marks

In plants, glucose moves into the chloroplast, where it enters the citric acid (Krebs) cycle. ☐ True ☐ False

UKBC

- Question 1 — 4 marks
- Question 2 — 7 marks
- Question 3 — 11 marks
- Question 4 — 9 marks
- Question 5 — 4 marks
- Question 6 — 2 marks
- Question 7 — 4 marks
- Question 8 — 4 marks
- Question 9

So potential gradients can be established to power other reactions.

To minimise the distance light and substrates must travel through the cell.

Because the substrates are hydrophobic.

FXO805

True or false?

3 marks

下一张

In plants, glucose moves into the chloroplast, where it enters the citric acid (Krebs) cycle.	☐ True	☑ False
Plant mitochondria produce ATP that can be used to drive essential cell reactions.	☑ True	☐ False
Plant chloroplasts carry out biosynthesis reactions and assimilate inorganic molecules.	☑ True	☐ False
Mitochondria can produce ATP only in the presence of oxygen.	☑ True	☐ False

FXO805

← BACK NEXT QUESTION →

FLAG

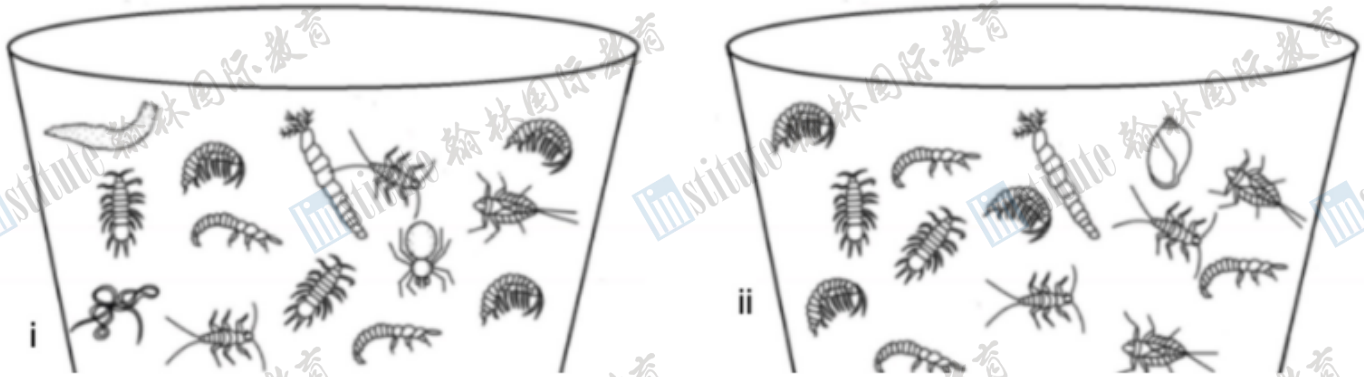
In ecology, the similarity of two communities (A and B) can be measured by calculating the Sorensen-Dice coefficient (DSC).

- A and B are the number of species in the two communities.
- A∩B is the number of species common to both communities.

$$DSC = 2\frac{A \cap B}{A+B}$$

FXO605

In the figure below, you can see two samples of invertebrates, collected from two small rivers, i and ii respectively.



$$DSC = 2\frac{A \cap B}{A + B}$$

FXO605

In the figure below, you can see two samples of invertebrates, collected from two small rivers, i and ii respectively.

FXO605

Calculate DSC for i and ii.

Calculate DSC for i and ii.

5 marks

1.2

The DSC between rivers i and iii is greater than that between i and ii.

Therefore, i and iii are...

1 mark

- [x] ... more similar than i and ii.
- [ ] ... less similar than i and ii.

← BACK NEXT QUESTION →

Question 7
4 marks

Question 8
4 marks

Question 9
6 marks

Question 10
9 marks

Question 11
6 marks

Question 12
5 marks

Question 13
5 marks

Question 14
7 marks

Question 15
11 marks

FLAG

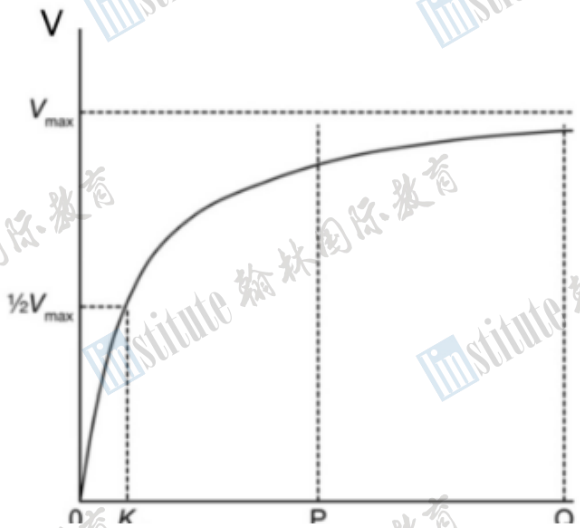
The Michaelis-Menten equation describes the relationship between substrate concentration ([S]) and enzymatic reaction rate (v).

- V_{max} = the maximum rate.
- K_m = represents the affinity of enzymes to particular substrates.

A reaction catalysed by glucose oxidase is used to measure blood glucose concentration.

The blood sample is applied to a strip containing immobilised glucose oxidase. A non-enzyme catalyst oxidises the H_2O_2 and the meter records the flow of electrons (electrical current).

$$v = \frac{V_{max} \times [S]}{K_M + [S]}$$



下一张

激活

Question 7
4 marks

Question 8
4 marks

Question 9
6 marks

Question 10
9 marks

Question 11
6 marks

Question 12
5 marks

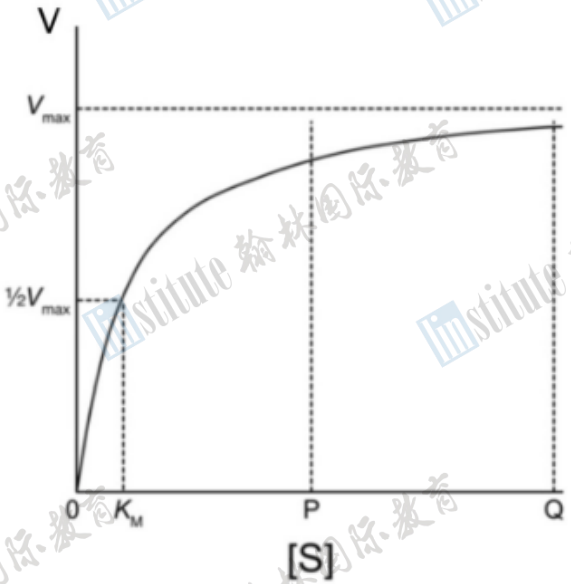
Question 13
5 marks

Question 14
7 marks

Question 15
11 marks

The blood sample is applied to a strip containing immobilised glucose oxidase. A non-enzyme catalyst oxidises the H_2O_2 and the meter records the flow of electrons (electrical current).

$$v = \frac{V_{max} \times [S]}{K_M + [S]}$$



$$\text{Glucose} + O_2 \xrightarrow[\text{oxidase}]{\text{Glucose}} \text{Gluconolactone} + H_2O_2$$

$$H_2O_2 \xrightarrow{\text{Catalyser}} O_2 + 2H^+ + 2e^-$$

FXO605

Question 7
4 marks

Question 8
4 marks

Question 9
6 marks

Question 10
9 marks

Question 11
6 marks

Question 12
5 marks

Question 13
5 marks

Question 14
7 marks

Question 15
11 marks

True or false?

5 marks

Among isoenzymes with the same V_{max} value but different K_m values, the enzyme with the lowest K_m value works best at the lowest substrate concentrations.	☑ True	☐ False
For the meter to accurately measure blood glucose concentration, the glucose oxidase used should have a broad substrate specificity.	☐ True	☑ False
For the meter to accurately measure blood glucose concentration, the reaction on the strip should be in the P–Q range of the substrate concentration (see the image).	☐ True	☑ False
The two-step reaction on the test strip is essentially irreversible in real-world conditions.	☑ True	☐ False
An acidic buffer facilitates oxidation of H_2O_2.	☐ True	☑ False

← BACK NEXT QUESTION →

FLAG

Scientists in London created a puzzle box for bees.

The bees could pull on either a blue tab, or a red tab, to access a nectar reward.

Scientists trained some bees by only giving reward for pulling the blue tab ("*blue-trained*"), and some only for pulling the red tab ("*red-trained*").

Scientists then put the trained bees into colonies of fresh bees with puzzle boxes which could be opened with either tab.

Colony	Trained bee	Duration of experiment	Number of puzzles solved	% of pulls on blue
1	Red	6 days	437	3
2	Red	6 days	182	1
3	Red	12 days	980	1
4	Blue	6 days	565	99
5	Blue	6 days	219	99
6	Blue	12 days	1006	98
7	None	6 days	6	50
8	None	6 days	5	40
9	None	12 days	41	12
10	None	12 days	269	6

Question 7
4 marks

Question 8
4 marks

Question 9
6 marks

Question 10
9 marks

Question 11
6 marks

Question 12
5 marks

Question 13
5 marks

Question 14
7 marks

Question 15
11 marks

FXO605

下一张

Bees solve the problem by:

1 mark

- Instinct
- Learning
- Reflex
- Random chance

Bees solve the problem by:

1 mark

- Instinct
- Learning
- Reflex
- Random chance
- Logic

- Question 7
  4 marks
- Question 8
  4 marks
- Question 9
  6 marks
- Question 10
  9 marks
- Question 11
  6 marks
- Question 12
  5 marks
- Question 13
  5 marks
- Question 14
  7 marks
- Question 15
  11 marks

Random chance

Logic

True or False?

4 marks

Bees are able to teach other bees.	☑ True	☐ False
Bees solve the puzzle more quickly in the presence of trained bees.	☑ True	☐ False
Without training, bees prefer the red tab to the blue tab.	☑ True	☐ False
Only some bees are good 'teachers'.	☐ True	☑ False
All members of a hive tend to use the same solution even if they are aware of alternatives.	☐ True	☑ False

← BACK NEXT QUESTION →

FLAG

Carnivorous sea snails feed on a bivalve-shelled mollusc.

FXO605

The sea snails drill through bivalve shells to inject poison, which relaxes the bivalve muscle that holds their shell shut.

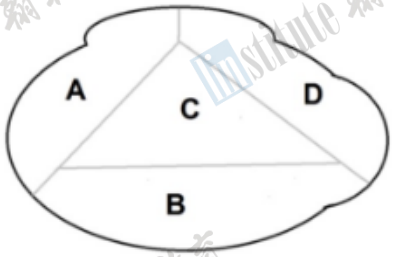
Scientists divided the surface of prey shells into four areas with equal size:
A – anterior area.
B – basal area.
C – central area.
D – distal area.

100 dead prey shells were analysed. The number of holes drilled by hunting snails in different areas, and their combinations, are

D – distal area.

100 dead prey shells were analysed. The number of holes drilled by hunting snails in different areas, and their combinations, are shown in the Table.

Drilling position	A	B	C	D	A & B	A & C	A & D	B & C	B & D	C & D	A, B & D	A, C & D	0 holes
Number of shells with these holes	23	5	6	25	4	4	16	1	3	5	1	1	6



True or false?

4 marks

Hunting snails prefer to drill the anterior end of prey and avoid the distal end of shells. ☐ True ☐ False

FXO605

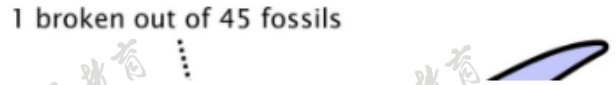
True or false?

4 marks

Hunting snails prefer to drill the anterior end of prey and avoid the distal end of shells.	☐ True	☑ False
Prey probably have two muscles, the first in area A and the second in area D.	☑ True	☐ False
Hunting snails are probably the major cause of death for these prey.	☑ True	☐ False
The majority of attacks are likely to be fatal.	☑ True	☐ False

Some fossilised skulls of triceratops (a type of dinosaur) show injuries sustained while the animal was *alive*.

Injuries in the highlighted bones were assessed.



The majority of attacks are likely to be fatal. ☐ True ☐ False

FXO605

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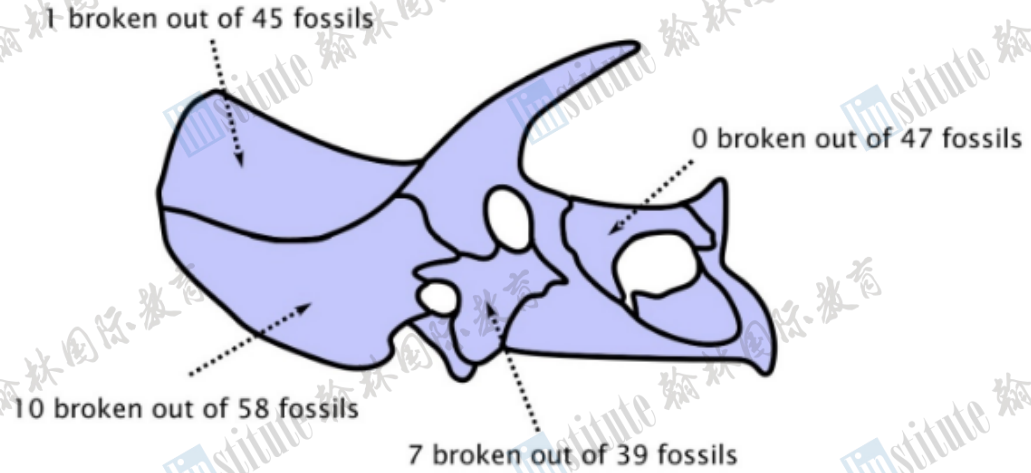
Injuries in the highlighted bones were assessed.



FXO605

True or false?

Question 7
4 marks

Question 8
4 marks

Question 9
6 marks

Question 10
9 marks

Question 11
6 marks

Question 12
5 marks

Question 13
5 marks

Question 14
7 marks

Question 15
11 marks

10 broken out of 58 fossils

7 broken out of 39 fossils

FXO605

True or false?

3 marks

Nasal bones are the most abundant fossils.	☐ True	☑ False
The large bone forming the bottom of the collar had the highest frequency of breaks.	☐ True	☑ False
The distribution of injuries is better explained by combats between triceratops males, rather than *Tyrannosaurus rex* attacks. (*T. rex* was tall).	☑ True	☐ False
The pattern is explained by larger bones being more likely to get damaged.	☐ True	☑ False

FXO605

← BACK NEXT QUESTION →

Question 7
4 marks

Question 8
4 marks

Question 9
6 marks

Question 10
9 marks

Question 11
6 marks

Question 12
5 marks

Question 13
5 marks

Question 14
7 marks

Question 15
11 marks

FLAG

Drosophila melanogaster (fruit fly) is a common laboratory model animal.

Wild *D. melanogaster* and *D. simulans* have broad ranges but do not live on the Seychelles archipelago. *D. sechellia* lives only on the Seychelles.

The plant *Morinda citrifolia* also lives only on the Seychelles.

This question examines how *Drosophila* choose where to lay eggs.

50 flies of each species were placed in a petri dish with 4 different fruits and the eggs laid on each fruit were counted.

FXO605

Question 7
4 marks

Question 8
4 marks

Question 9
6 marks

Question 10
9 marks

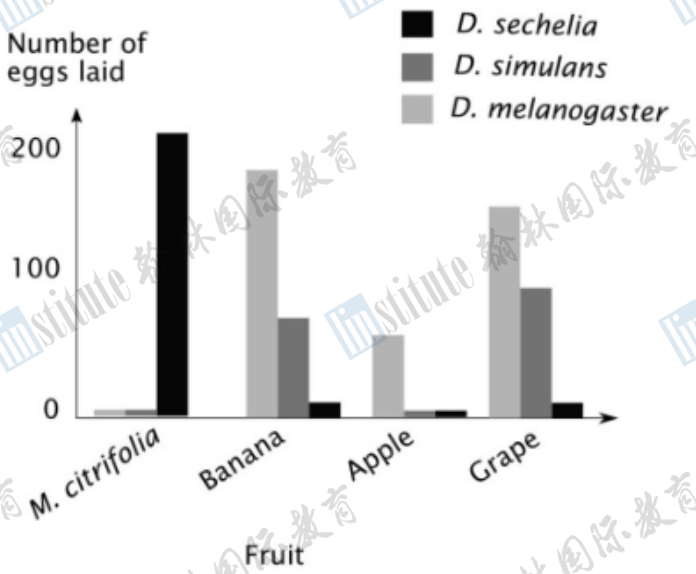
Question 11
6 marks

Question 12
5 marks

Question 13
5 marks

Question 14
7 marks

Question 15
11 marks



True or false?

2 marks

True or false?

2 marks

Drosophila melanogaster will lay eggs on any of the four fruits.	☑ True ☐ False
Drosophila melanogaster and *Drosophila sechellia* lay similar numbers of eggs.	☐ True ☑ False
The results could be explained if *Morinda citrifolia* has a tasteless, smelless poison of unadapted *Drosophila*.	☑ True ☐ False

Similar results were recorded when:

- The choice assay was carried out in the dark.
- The fruits were painted different colours.

True or false?

1 mark

The results could be explained if *Morinda citrifolia* has a tasteless, smelless poison of unadapted *Drosophila*.

☐ True
☐ False

Similar results were recorded when:

- The choice assay was carried out in the dark.
- The fruits were painted different colours.

True or false?

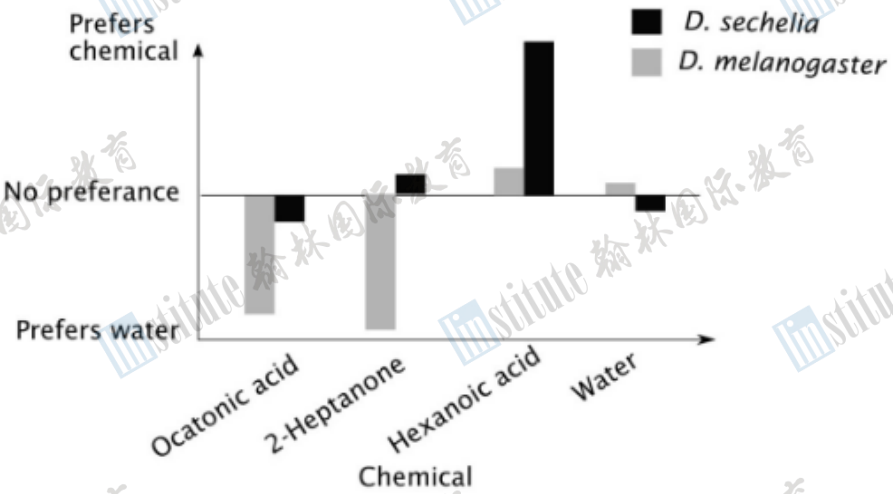
1 mark

Vision plays an essential role in correct fruit choice.	☐ True	☑ False
Vision plays the primary role in correct fruit choice when it is available.	☐ True	☑ False

Two wells in a petri dish contained either water (left hand well) or a chemical abundant in *Morinda citrifolia* fruit (right hand well). The proportion of flies choosing either the water or the chemical was recorded.

Prefers ■ *D. sechelia*

Two wells in a petri dish contained either water (left hand well) or a chemical abundant in *Morinda citrifolia* fruit (right hand well). The proportion of flies choosing either the water or the chemical was recorded.



True or false?

1 mark

If the chemicals are neither attractive nor repulsive, the fruit flies tend to favour the left-hand well.

- [ ] True
- [ ] False

Ocato… 2-Hep… Hexa…

Chemical

FXO6…

True or false?

1 mark

If the chemicals are neither attractive nor repulsive, the fruit flies tend to favour the left-hand well.	☑ True ☐ False
It is more important to carry out the experiment with many different flies of each species than repeatedly with the same flies.	☑ True ☐ False
It is important only fertilised females were used for the study.	☐ True ☑ False

FXO605

How does *D. sechellia* respond to each chemical?

1 mark

Unrotted … Encourages egg laying … Minimal effect on … Suppresses egg …

How does *D. sechellia* respond to each chemical?

1 mark

Unsorted	Encourages egg laying	Minimal effect on egg laying	Suppresses egg laying
2-Heptanone	✓		
Octanoic Acid			✓
Hexanoic Acid			✓

How does *D. melanogaster* respond to each chemical?

1 mark

Unsorted	Encourages egg laying	Minimal effect on egg laying	Suppresses egg laying

Which chemical (chemical X) is most important for *D. sechellia* to sense *Morinda citrifolia* fruit?

1 mark

- Octanoic Acid
- 2-Heptanone
- Hexanoic Acid ✓
- None

FXO605

Chemical X is sensed by a receptor called Ionotropic receptor 75b (Ir75b).

Scientists made mutant *D. melanogaster* flies which did not express Ir75b. These flies then had the *D. melanogaster* Ir75b or *D. sechellia* Ir75b reintroduced. Assays were carried out to assess their preference for chemical X or water.

Key:

- WT - *D. melanogaster*
- mut - *D. melanogaster* with no Ir75b

Question 7
4 marks

Question 8
4 marks

Question 9
6 marks

Question 10
9 marks

Question 11
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Question 12
5 marks

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5 marks

Question 14
7 marks

Question 15
11 marks

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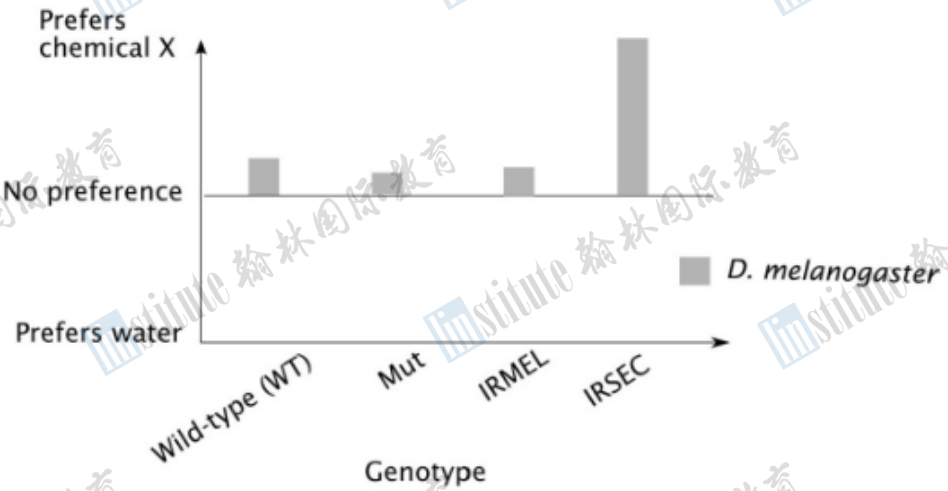
Key:

- WT - *D. melanogaster*
- mut - *D. melanogaster* with no Ir75b
- IRMEL - *D. melanogaster* with reintroduced *D. melanogaster* Ir75b
- IRSEC - *D. melanogaster* with reintroduced *D. sechellia* Ir75b



- Question 7 — 4 marks
- Question 8 — 4 marks
- Question 9 — 6 marks
- Question 10 — 9 marks
- Question 11 — 6 marks
- Question 12 — 5 marks
- Question 13 — 5 marks
- Question 14 — 7 marks
- Question 15 — 11 marks

True or false?

2 marks

D. melanogaster Ir75b causes flies to avoid *Morinda citrifolia* fruit.	☐ True	☑ False
D. sechellia Ir75b is sufficient to determine fruit choice in the absence of other cues.	☐ True	☑ False

FXO605

Which is the most likely hypothesis?

2 marks

- ◉ IRSEC flies will choose to lay eggs on *Morinda citrifolia* fruit over grapes.
- ○ IRSEC flies will **not** choose to lay eggs on *Morinda citrifolia* fruit.
- ○ IRSEC flies will be conflicted on whether to lay eggs on *Morinda citrifolia* fruit.
- ○ Mut flies will choose to lay eggs on *Morinda citrifolia* fruit over grapes.

FXO6

← BACK

Calculate DSC for i and ii.

5 marks

1, 2

The DSC between rivers i and iii is greater than that between i and ii.

Therefore, i and iii are...

1 mark

- ✓ ... more similar than i and ii.
- ... less similar than i and ii.

← BACK NEXT QUESTION →

Question 7
4 marks

Question 8
4 marks

Question 9
6 marks

Question 10
9 marks

Question 11
6 marks

Question 12
5 marks

Question 13
5 marks

Question 14
7 marks

Question 15
11 marks

FLAG

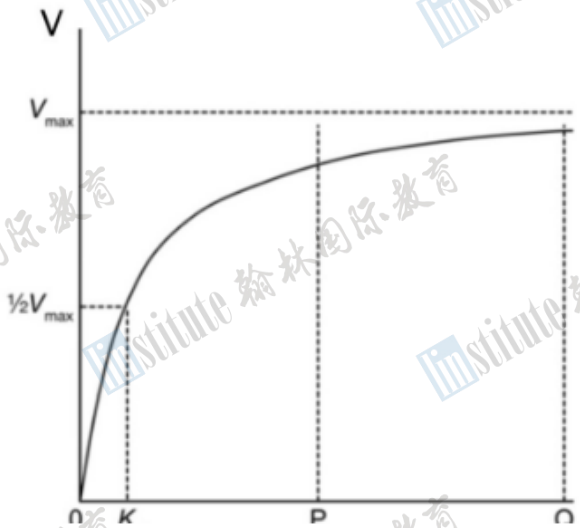
The Michaelis-Menten equation describes the relationship between substrate concentration ([S]) and enzymatic reaction rate (v).

- V_{max} = the maximum rate.
- K_m = represents the affinity of enzymes to particular substrates.

A reaction catalysed by glucose oxidase is used to measure blood glucose concentration.

The blood sample is applied to a strip containing immobilised glucose oxidase. A non-enzyme catalyst oxidises the H_2O_2 and the meter records the flow of electrons (electrical current).

$$v = \frac{V_{max} \times [S]}{K_M + [S]}$$



下一张

激活

Question 7
4 marks

Question 8
4 marks

Question 9
6 marks

Question 10
9 marks

Question 11
6 marks

Question 12
5 marks

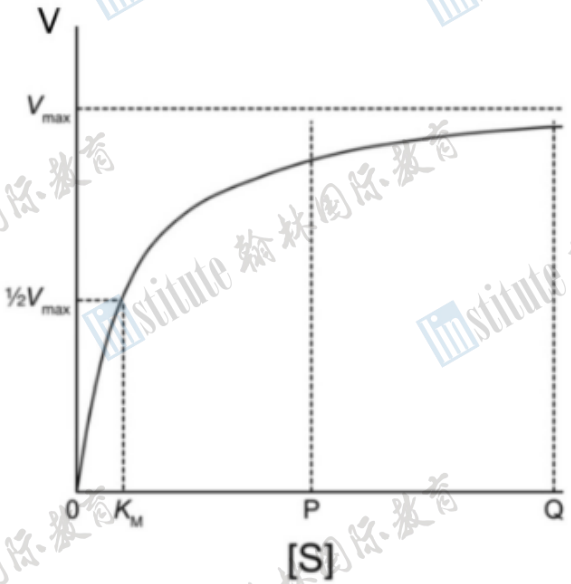
Question 13
5 marks

Question 14
7 marks

Question 15
11 marks

The blood sample is applied to a strip containing immobilised glucose oxidase. A non-enzyme catalyst oxidises the H_2O_2 and the meter records the flow of electrons (electrical current).

$$v = \frac{V_{max} \times [S]}{K_M + [S]}$$



$$\text{Glucose} + O_2 \xrightarrow[\text{oxidase}]{\text{Glucose}} \text{Gluconolactone} + H_2O_2$$

$$H_2O_2 \xrightarrow{\text{Catalyser}} O_2 + 2H^+ + 2e^-$$

FXO605

Question 7
4 marks

Question 8
4 marks

Question 9
6 marks

Question 10
9 marks

Question 11
6 marks

Question 12
5 marks

Question 13
5 marks

Question 14
7 marks

Question 15
11 marks

True or false?

5 marks

Statement	Answer
Among isoenzymes with the same V_{max} value but different K_m values, the enzyme with the lowest K_m value works best at the lowest substrate concentrations.	☐ True ☐ False
For the meter to accurately measure blood glucose concentration, the glucose oxidase used should have a broad substrate specificity.	☐ True ☐ False
For the meter to accurately measure blood glucose concentration, the reaction on the strip should be in the P–Q range of the substrate concentration (see the image).	☐ True ☐ False
The two-step reaction on the test strip is essentially irreversible in real-world conditions.	☐ True ☐ False
An acidic buffer facilitates oxidation of H_2O_2.	☐ True ☐ False

← BACK NEXT QUESTION →

FLAG

Scientists in London created a puzzle box for bees.

The bees could pull on either a blue tab, or a red tab, to access a nectar reward.

Scientists trained some bees by only giving reward for pulling the blue tab ("*blue-trained*"), and some only for pulling the red tab ("*red-trained*").

Scientists then put the trained bees into colonies of fresh bees with puzzle boxes which could be opened with either tab.

Colony	Trained bee	Duration of experiment	Number of puzzles solved	% of pulls on blue
1	Red	6 days	437	3
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4	Blue	6 days	565	99
5	Blue	6 days	219	99
6	Blue	12 days	1006	98
7	None	6 days	6	50
8	None	6 days	5	40
9	None	12 days	41	12
10	None	12 days	269	6

Question 7
4 marks

Question 8
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Question 9
6 marks

Question 10
9 marks

Question 11
6 marks

Question 12
5 marks

Question 13
5 marks

Question 14
7 marks

Question 15
11 marks

FXO605

下一张

Bees solve the problem by:

1 mark

- Instinct
- Learning
- Reflex
- Random chance

Bees solve the problem by:

1 mark

- Instinct
- Learning
- Reflex
- Random chance
- Logic

Random chance

Logic

True or False?

4 marks

Bees are able to teach other bees.	☐ True	☐ False
Bees solve the puzzle more quickly in the presence of trained bees.	☐ True	☐ False
Without training, bees prefer the red tab to the blue tab.	☐ True	☐ False
Only some bees are good 'teachers'.	☐ True	☐ False
All members of a hive tend to use the same solution even if they are aware of alternatives.	☐ True	☐ False

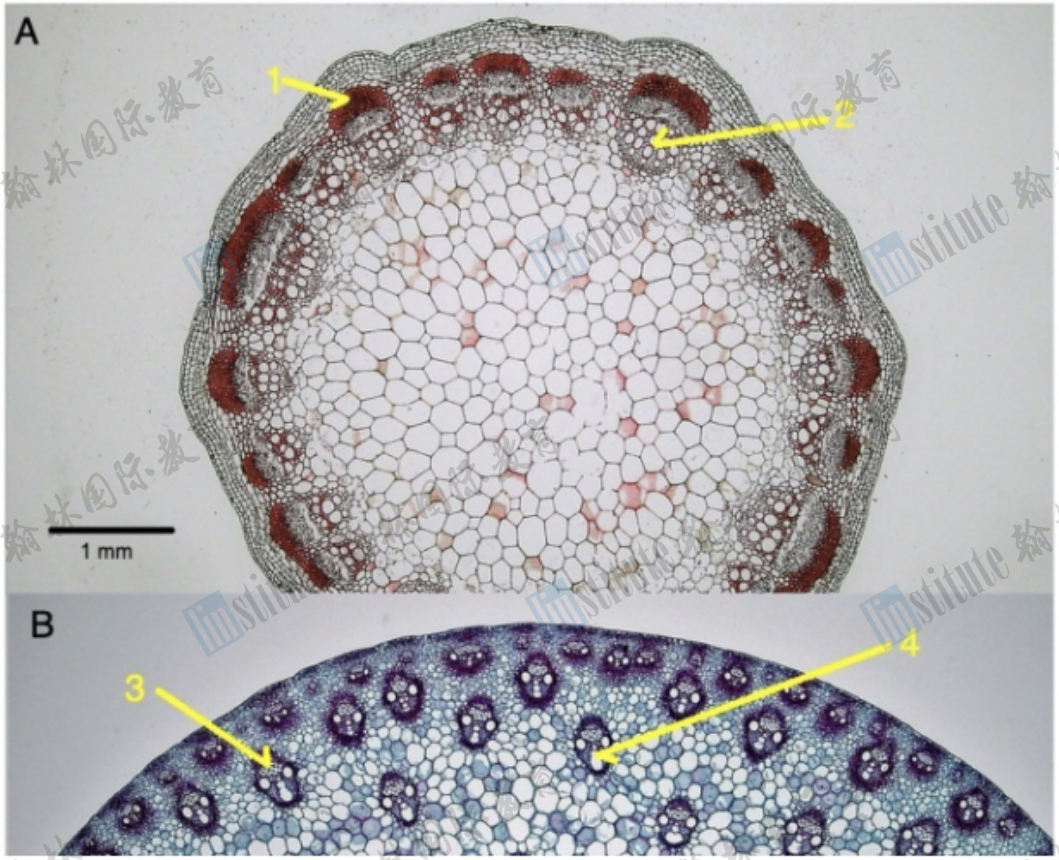
← BACK NEXT QUESTION →

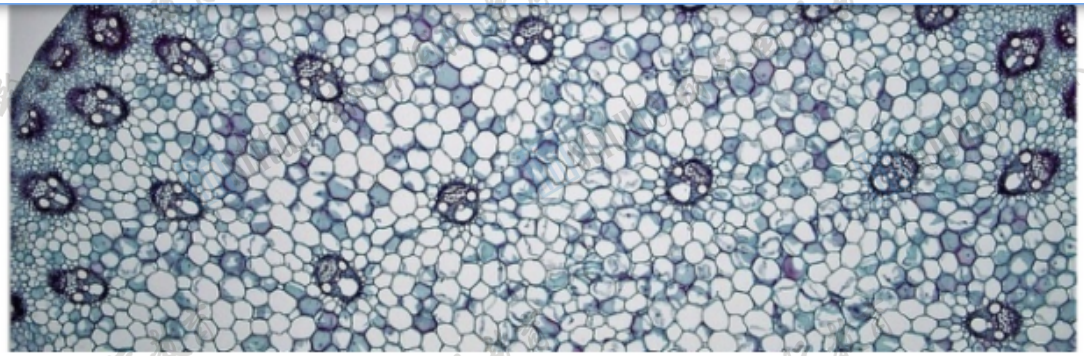
UKBC

- Question 1
  10 marks
- Question 2
  6 marks
- Question 3
  11 marks
- Question 4
  7 marks
- Question 5
  7 marks
- Question 6
  7 marks
- Question 7
  15 marks
- Question 8
  8 marks
- Question 9

The xylem and phloem move resources between the roots and shoots of plants.

Micrographs A and B were originally taken at 40x magnification, then digitally manipulated to the size shown on your screen.





FXO605

To the nearest mm, how wide is the sample in A?
(It does not matter whether or not you type the unit, mm)

3 marks

0.15

FXO605

The micrograph could have been taken at 100x magnification and then digitally manipulated to be the same size as shown.

How would this micrograph differ from the micrograph shown in the question?

2 marks

UKBC

- Question 1 — 10 marks
- Question 2 — 6 marks
- Question 3 — 11 marks
- Question 4 — 7 marks
- Question 5 — 7 marks
- Question 6 — 7 marks
- Question 7 — 15 marks
- Question 8 — 8 marks
- Question 9

The micrograph could have been taken at 100x magnification and then digitally manipulated to be the same size as shown.

How would this micrograph differ from the micrograph shown in the question?

2 marks

The scale bar would be smaller.	☐ True ☑ False
The image would be at higher resolution.	☑ True ☐ False
It would have been harder to fit the whole sample into the field of view.	☑ True ☐ False
To take this micrograph, the scientist would need a different type of microscope and dye.	☐ True ☑ False

下一张

UKBC

- Question 1
  10 marks
- Question 2
  6 marks
- Question 3
  11 marks
- Question 4
  7 marks
- Question 5
  7 marks
- Question 6
  7 marks
- Question 7
  15 marks
- Question 8
  8 marks
- Question 9

Which label(s) are of phloem or xylem?

2 marks

Unsorted	Phloem	Xylem
3	✓	
1	✓	
2		✓
4		✓

FXO605

Which substances are transported in the phloem, xylem or neither?

下一张

激活 W

UKBC

- Question 1 — 10 marks
- Question 2 — 6 marks
- Question 3 — 11 marks
- Question 4 — 7 marks
- Question 5 — 7 marks
- Question 6 — 7 marks
- Question 7 — 15 marks
- Question 8 — 8 marks
- Question 9

Which substances are transported in the phloem, xylem or neither?

3 marks

Unsorted	Phloem	Xylem	Neither
Sucrose	✓		
Starch			✓
Potassium		✓	
Glucose			✓
Water		✓	
Amino Acids	✓		

下一张

UBC

FLAG

- Question 1 — 10 marks
- Question 2 — 6 marks
- Question 3 — 11 marks
- Question 4 — 7 marks
- Question 5 — 7 marks
- Question 6 — 7 marks
- Question 7 — 15 marks
- Question 8 — 8 marks
- Question 9

In an experiment, soldiers were ordered to march through a hot desert until exhaustion.

- One group (red) had no food or water.
- The second (blue) group had access to limitless water.
- The third group (black) had access to both limitless water and limitless savoury (salty, low energy) food.

Cardiac output is always proportional to the pressure of blood in the great veins. This is because the heart cannot suck blood through vessels (they collapse); it can only pressurise the blood which the great veins deliver to it. In turn, the pressure of blood in the great veins depends on the volume of blood in the body.

Camels are adapted to withstand larger swings in osmolarity and core temperature than other mammals.

Camels and humans both have the very rare ability to sweat. Sweat is mostly water, with a small amount of salt. (Note: camel humps do not provide water either directly or indirectly).

激活

UKBC

- Question 1
  10 marks
- Question 2
  6 marks
- Question 3
  11 marks
- Question 4
  7 marks
- Question 5
  7 marks
- Question 6
  7 marks
- Question 7
  15 marks
- Question 8
  8 marks
- Question 9

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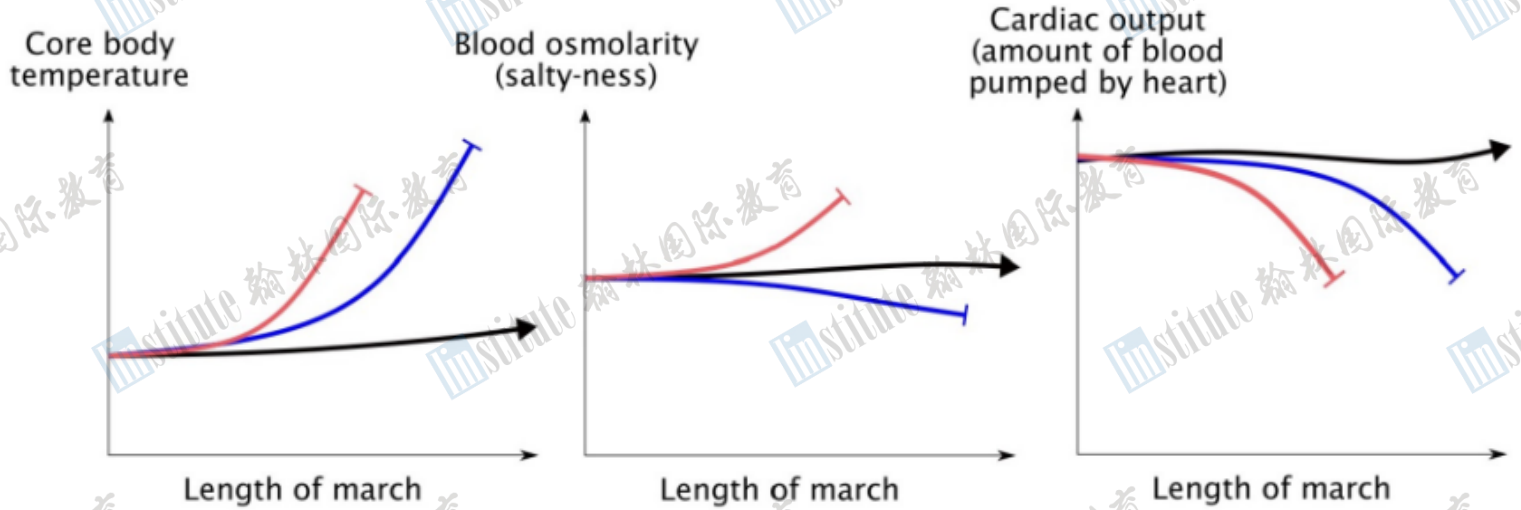


UKBC

- Question 1 — 10 marks
- Question 2 — 6 marks
- Question 3 — 11 marks
- Question 4 — 7 marks
- Question 5 — 7 marks
- Question 6 — 7 marks
- Question 7 — 15 marks
- Question 8 — 8 marks
- Question 9

True or false?

4 marks

The change in blood osmolarity in the blue group is adaptive and helps them to last longer.	☑ True ☐ False
The blue group drinks more water than the black group.	☐ True ☑ False
Circulatory failure is the proximate ('final straw') cause of exhaustion in these conditions.	☑ True ☐ False
Of the three groups, camels would follow a trajectory most similar to the blue group (but extended). *Assume the camels do **not** eat or drink.*	☑ True ☐ False
A group given unlimited dry food, but not water, would last longer than the red group.	☐ True ☑ False

UKBC

- Question 1 — 10 marks
- Question 2 — 6 marks
- Question 3 — 11 marks
- Question 4 — 7 marks
- Question 5 — 7 marks
- Question 6 — 7 marks
- Question 7 — 15 marks
- Question 8 — 8 marks
- Question 9

A group given unlimited dry food, but not water, would last longer than the red group. ☐ False

FXO605

Antidiuretic hormone (ADH, also known as vasopressin) is usually released from the pituitary gland in proportion to blood osmolarity (higher blood osmolarity leads to more ADH release).

- ADH acts in the kidney to increase water reabsorption.

FXO605

Some patients have tumours which secrete ADH (syndromes of inappropriate ADH secretion).

2 marks

These patients have more concentrated urine than normal.	☑ True	☐ False
These patients have higher blood osmolarity than normal.	☐ True	☑ False
The patients should be given restricted access to fluids.	☑ True	☐ False

FXO605

← BACK NEXT QUESTION →

激活

UKBC

- Question 1 — 10 marks
- Question 2 — 6 marks
- Question 3 — 11 marks
- Question 4 — 7 marks
- Question 5 — 7 marks
- Question 6 — 7 marks
- Question 7 — 15 marks
- Question 8 — 8 marks
- Question 9

FLAG

Some shrubby trees have very extensive surface and deep roots.

Most grasses have fewer roots, but can grow very fast from their base which is protected from grazers.

In a mixed grassland / shrubland, which habitat type is favoured by each of the climate changes?

3 marks

Unsorted	Grasses dominating over shrubs	Shrubs invading grassland	Desert with few plants
Reduced rainfall with cattle ranching			

UKBC

- Question 1 — 10 marks
- Question 2 — 6 marks
- Question 3 — 11 marks
- Question 4 — 7 marks
- Question 5 — 7 marks
- Question 6 — 7 marks
- Question 7 — 15 marks
- Question 8 — 8 marks
- Question 9

3 marks

Unsorted	Grasses dominating over shrubs	Shrubs invading grassland	Desert with few plants
Reduced rainfall with cattle ranching			
Increased rainfall			
Reduced rainfall			

What type of process drives the habitat transitions from grassland to shrubby forest and back?

2 marks

- Disease
- Competitive exclusion

下一

激活 W

UKBC

- Question 1
  10 marks
- Question 2
  6 marks
- Question 3
  11 marks
- Question 4
  7 marks
- Question 5
  7 marks
- Question 6
  7 marks
- Question 7
  15 marks
- Question 8
  8 marks
- Question 9

What type of process drives the habitat transitions from grassland to shrubby forest and back?

2 marks

- Disease
- Competitive exclusion
- Maladaptation
- Hybridisation
- Migration

Diverse biomes are complex systems which return to their equilibrium position after disruptions. However, if conditions are pushed too far for too long, they may suddenly switch to a new equilibrium following disruption, and not revert even if conditions improve (ecosystem collapse).

The Amazon rainforest may be temporarily self-sustaining, even though global weather patterns may already favour

UKBC

- Question 1
  10 marks
- Question 2
  6 marks
- Question 3
  11 marks
- Question 4
  7 marks
- Question 5
  7 marks
- Question 6
  7 marks
- Question 7
  15 marks
- Question 8
  8 marks
- Question 9

Diverse biomes are complex systems which return to their equilibrium position after disruptions. However, if conditions are pushed too far for too long, they may suddenly switch to a new equilibrium following disruption, and not revert even if conditions improve (ecosystem collapse).

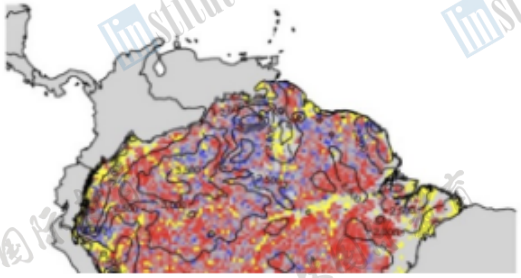
The Amazon rainforest may be temporarily self-sustaining, even though global weather patterns may already favour savannah. Scientists searched for evidence of ecosystem instability in the Amazon.

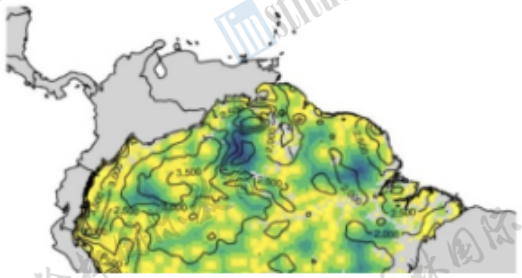
FXO605

For 100 km² areas, satellites measured:

- The amount of vegetation (including all layers of the canopy),
- The distance to human activity.

For each area, scientists calculated a statistic correlated with the time it takes vegetation to revert to baseline after disturbance.





- Question 1
  10 marks
- Question 2
  6 marks
- Question 3
  11 marks
- Question 4
  7 marks
- Question 5
  7 marks
- Question 6
  7 marks
- Question 7
  15 marks
- Question 8
  8 marks
- Question 9

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- The distance to human activity.

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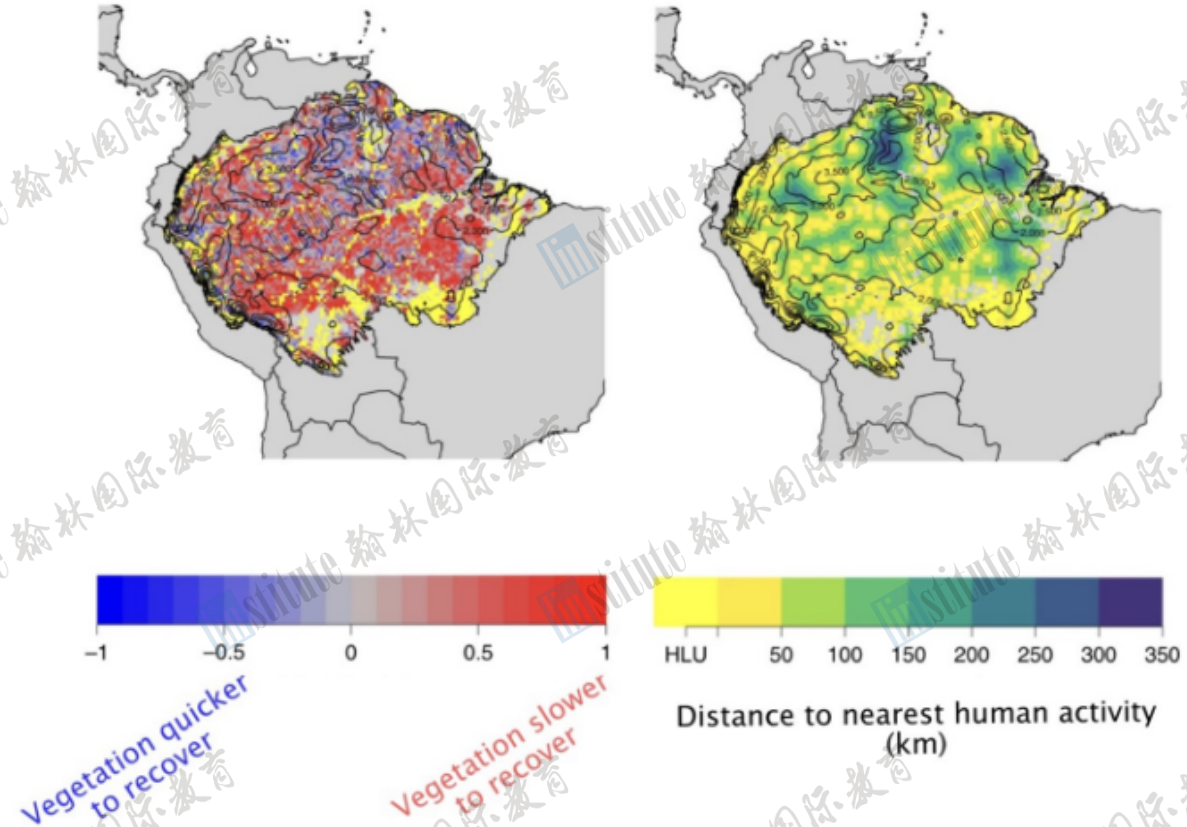
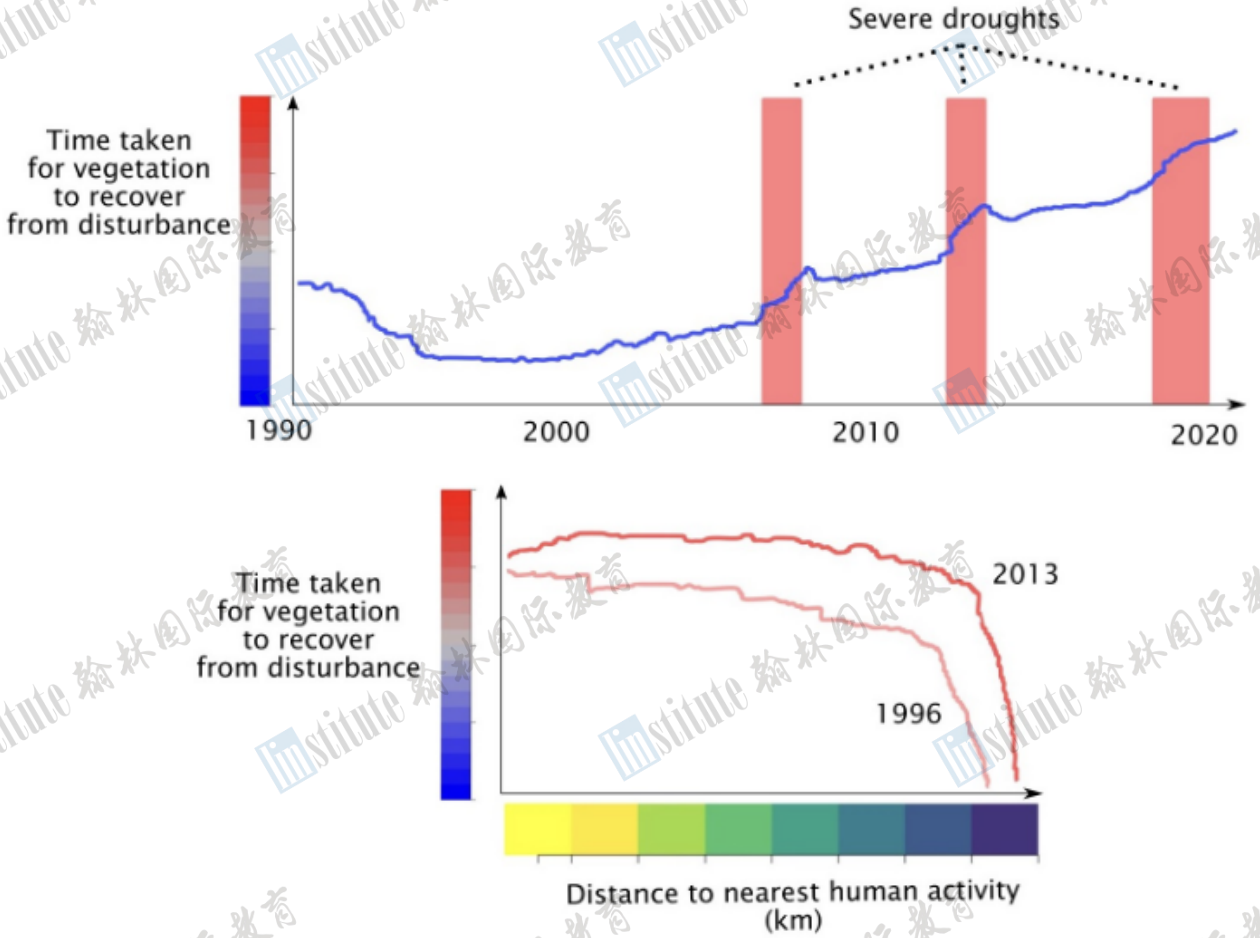


UKBC

- Question 1 — 10 marks
- Question 2 — 6 marks
- Question 3 — 11 marks
- Question 4 — 7 marks
- Question 5 — 7 marks
- Question 6 — 7 marks
- Question 7 — 15 marks
- Question 8 — 8 marks
- Question 9

The data were plotted for the amazon as a whole.



Distance to nearest human activity (km)

Which areas of the satellite data should be excluded from the analyses to determine whether the Amazon rainforest biome has become unstable?

2 marks

- [x] Areas bordering other biomes.
- [ ] Areas containing rivers and lakes.
- [ ] Areas near the centre of the Amazon.
- [x] Areas containing ongoing human activity (farms, roads, houses, mines etc).
- [ ] Areas in different countries.

Question 1
10 marks

Question 2
6 marks

Question 3
11 marks

Question 4
7 marks

Question 5
7 marks

Question 6
7 marks

Question 7
15 marks

Question 8
8 marks

Question 9

4 marks

The rainforest is taking longer to revert after disturbance now than in the past.	☑ True ☐ False
There is a strong correlation between the distance of an area to human activity and how long it takes to revert.	☑ True ☐ False
These data show extreme droughts may have pushed the Amazon closer to a tipping point.	☑ True ☐ False
These data show it is already too late to save the Amazon.	☐ True ☑ False
These data show reforesting deforested areas is likely to improve the resilience of the rest of the Amazon.	☐ True ☑ False
The statistical variance in amount of vegetation is likely to have increased over time.	☑ True ☐ False
These data show the Amazon has become more sensitive to human activity over time.	☑ True ☐ False

UKBC

FLAG

- Question 1
  10 marks
- Question 2
  6 marks
- Question 3
  11 marks
- Question 4
  7 marks
- Question 5
  7 marks
- Question 6
  7 marks
- Question 7
  15 marks
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  8 marks
- Question 9

Many organisms alter their physiology to suit the environment.

Iron is an essential nutrient but bio-available iron is scarce. *Pseudomonas aeruginosa* is a bacteria which can survive in both low- and high-iron environments. It can infect humans, but also live outside.

The liver produces an iron chelating protein called transferrin. Transferrin keeps the concentration of free-iron in the blood very low.

P. aeruginosa can create two siderophores. Siderophores are iron chelators which are released into the environment where they can bind iron, diffuse back towards the bacterium and be reabsorbed.

- Pyoverdine has a very low K_d (dissociation constant) and is 'expensive' to make.
- Pyocheline has a high K_d and is 'cheap' to make.

UKBC

- Question 1 — 10 marks
- Question 2 — 6 marks
- Question 3 — 11 marks
- Question 4 — 7 marks
- Question 5 — 7 marks
- Question 6 — 7 marks
- Question 7 — 15 marks
- Question 8 — 8 marks
- Question 9

True or false?

4 marks

When infecting humans, *P. aeruginosa* will tend to make more of both siderophores.	☐ True ☑ False
In a high-iron environment, a mutant *P. aeruginosa* without pyoverdine may be slightly fitter than wild-type.	☑ True ☐ False
Pyoverdine from pathogenic *P. aeruginosa* has a lower K_d than transferrin.	☑ True ☐ False
P. aeruginosa receive more benefit from siderophores when they are surrounded by other *P. aeruginosa* bacteria which are also producing siderophores.	☑ True ☐ False
The production of siderophores is likely to be controlled by both iron availability and quorum sensing.	☑ True ☐ False

For the following metabolic processes, decide whether iron is an essential nutrient.

UKBC

- Question 1
  10 marks
- Question 2
  6 marks
- Question 3
  11 marks
- Question 4
  7 marks
- Question 5
  7 marks
- Question 6
  7 marks
- Question 7
  15 marks
- Question 8
  8 marks
- Question 9

For the following metabolic processes, decide whether iron is an essential nutrient.

3 marks

Unsorted	Iron is essential	Iron is **not** essential

Oxygen transport in horseshoe crabs, some true crabs and crustaceans.

UKBC

FLAG

Many organisms alter their physiology to suit the environment.

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UKBC

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FXO605

For the following metabolic processes, decide whether iron is an essential nutrient.

UKBC

Yinuo Miao - Time spent on paper: 03:15

For the following metabolic processes, decide whether iron is an essential nutrient.

3 marks

Unsorted	Iron is essential	Iron is **not** essential
Oxygen transport in horseshoe crabs, some true crabs and crustaceans. 		

UKBC

Yinuo Miao - Time spent on paper: 03:19

Light capture by chlorophyll.

Cellular respiration

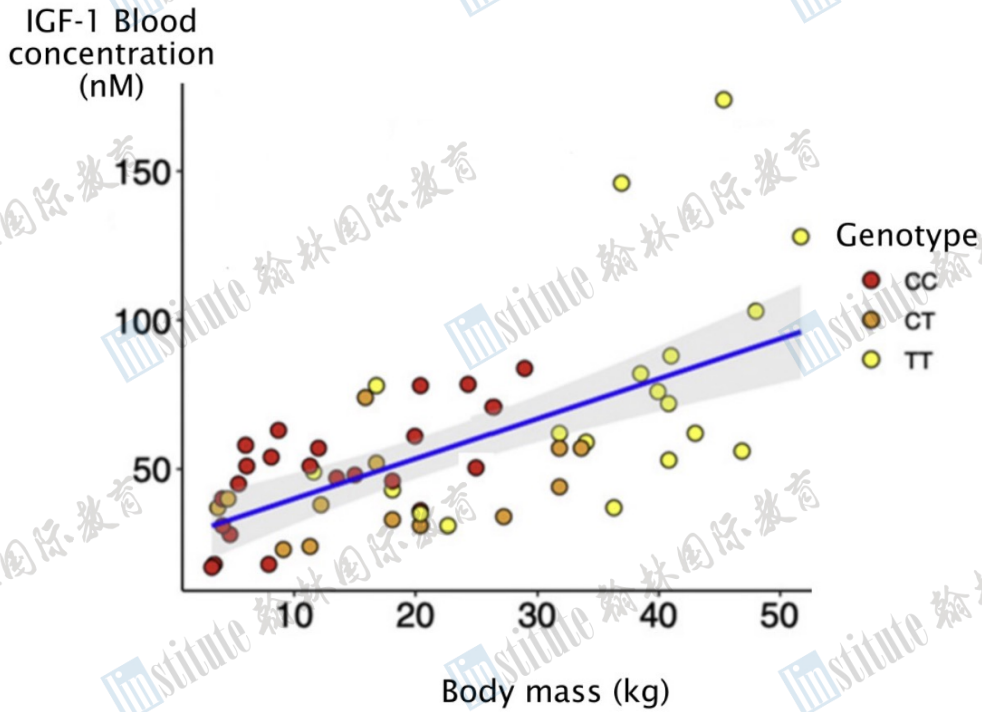
Oxygen transport in humans.

FXO605

Domestic dogs (*Canis lupus familiaris*) are a subspecies of grey wolves (*Canis lupus*). Dogs are unique for their extremely large range of body sizes.

Scientists sequenced a region of DNA around the IGF1 (insulin-like growth factor 1) gene in thousands of dogs. They found a frequent C vs T mutation.

The genotype of IGF1 was plotted against dog body mass, and against levels of IGF in serum (blood).



Which of these hypotheses are supported by this data?

3 marks

- [ ] The T allele is fully dominant to the C allele, which is fully recessive, in controlling dog size.
- [ ] IGF1 controls the majority of size variation of dogs.
- [ ] The C/T SNP must only influence body size through changing levels of IGF1 in serum.
- [x] IGF1 alleles *cause* some degree of body size change.

FXO605

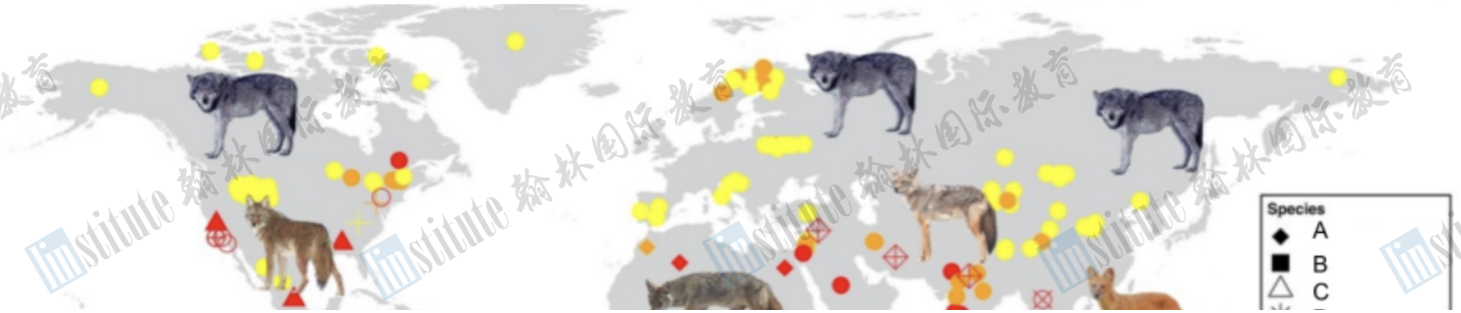
Next, scientists sequenced IGF1 in individuals from species across the canid (dog) family.

Key:
A Golden Wolf
B Hunting Dog
C Andean Fox
D Black Jackal
E Island Fox

Next, scientists sequenced IGF1 in individuals from species across the canid (dog) family.

Key:
A Golden Wolf
B Hunting Dog
C Andean Fox
D Black Jackal
E Island Fox
F Coyote
G Dhole
H Ethiopian Wolf
I Golden Jackal
J Grey Fox
K **Grey Wolf**
L Red Wolf
M Striped Jackal

Colours give the specimen's genotype according to the previous graph.



UKBC

Yinuo Miao - Time spent on paper: 04:09

Which of these hypotheses is most likely?

2 marks

- The most recent common ancestors of domestic dogs were homozygous for the T allele.
- The most recent common ancestors of domestic dogs were heterozygous for the T/C alleles.
- The most recent common ancestors of domestic dogs were homozygous for the C allele.

Which of these hypotheses is most likely?

2 marks

- The C mutation in domestic dogs appeared recently, and separately to the C allele found in other canid species.
- The T mutation first appeared in wolves.
- The T allele is older than the C allele.

L Red Wolf
M Striped Jackal

Colours give the specimen's genotype according to the previous graph.

FXO605

Which of these hypotheses is most likely?

Overall, >20% of the original neanderthal genome survives as alleles in the modern human gene pool.

However, modern humans do **not** contain any Neanderthal alleles in either their y-chromosomes, or their mitochondria.

FXO605

Which of these are *possible* explanations for these observations?

4 marks

- [ ] The only fertile offspring of *H. sapiens* and *H. neanderthalensis* were daughters of neanderthalensis men and sapiens women.
- [ ] The only fertile offspring of *H. sapiens* and *H. neanderthalensis* were sons of neanderthalensis women and sapiens men.

UKBC

FXO605

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4 marks

- [x] The only fertile offspring of *H. sapiens* and *H. neanderthalensis* were daughters of neanderthalensis men and sapiens women.
- [ ] The only fertile offspring of *H. sapiens* and *H. neanderthalensis* were sons of neanderthalensis women and sapiens men.
- [ ] The only fertile offspring of *H. sapiens* and *H. neanderthalensis* were daughters of neanderthalensis women and sapiens men.
- [x] Genetic drift: the Neanderthal Y and mitochondrial DNA was lost from the modern human gene pool by chance.
- [x] Natural selection: sapiens' Y and mitochondrial DNA was 'fitter' than neanderthalensis'.

FXO605

In 2020, the first Y-chromosomes from many *H. sapiens*, *H. neanderthalensis* and Denisovans (extremely ancient *H.*

UKBC

FXO605

In 2020, the first Y-chromosomes from many *H. sapiens*, *H. neanderthalensis* and Denisovans (extremely ancient *H. sapiens*) across the world were sequenced.

The Neanderthal Y-chromosomes were very similar to modern humans', whereas every other Neanderthal chromosome is much more similar to Denisovans' than modern humans'.

UKBC

Yinuo Miao - Time spent on paper: 04:50

FXO605

Which hypothesis is most likely about the spread of Y-chromosomes?

3 marks

- ○ Only certain combinations of parent-child sexes were fertile.
- ○ Genetic drift explains the patterns.
- ✓ Natural selection: the modern human Y-chromosome was fitter than the Neanderthal Y-chromosome.
- ○ This finding does not provide evidence in favour of any particular hypothesis.
- ○ The Y-chromosome of any hominin is only compatible with one species and cannot be spread by cross breeding.

FXO605

← BACK
NEXT QUESTION →

FLAG

Human blood contains red blood cells, plasma (a fluid rich in antibodies), and platelets. Platelets are membrane-bound fragments that bud off specialized cells and help blood clotting.

All human cells express A, B or O antigens on their surface, each from an allele of the ABO gene. The O antigen can be thought of as being absent.

For blood donations, red blood cells can be highly purified, then donated. Platelets cannot be highly purified and are usually donated within a significant amount of donor plasma.

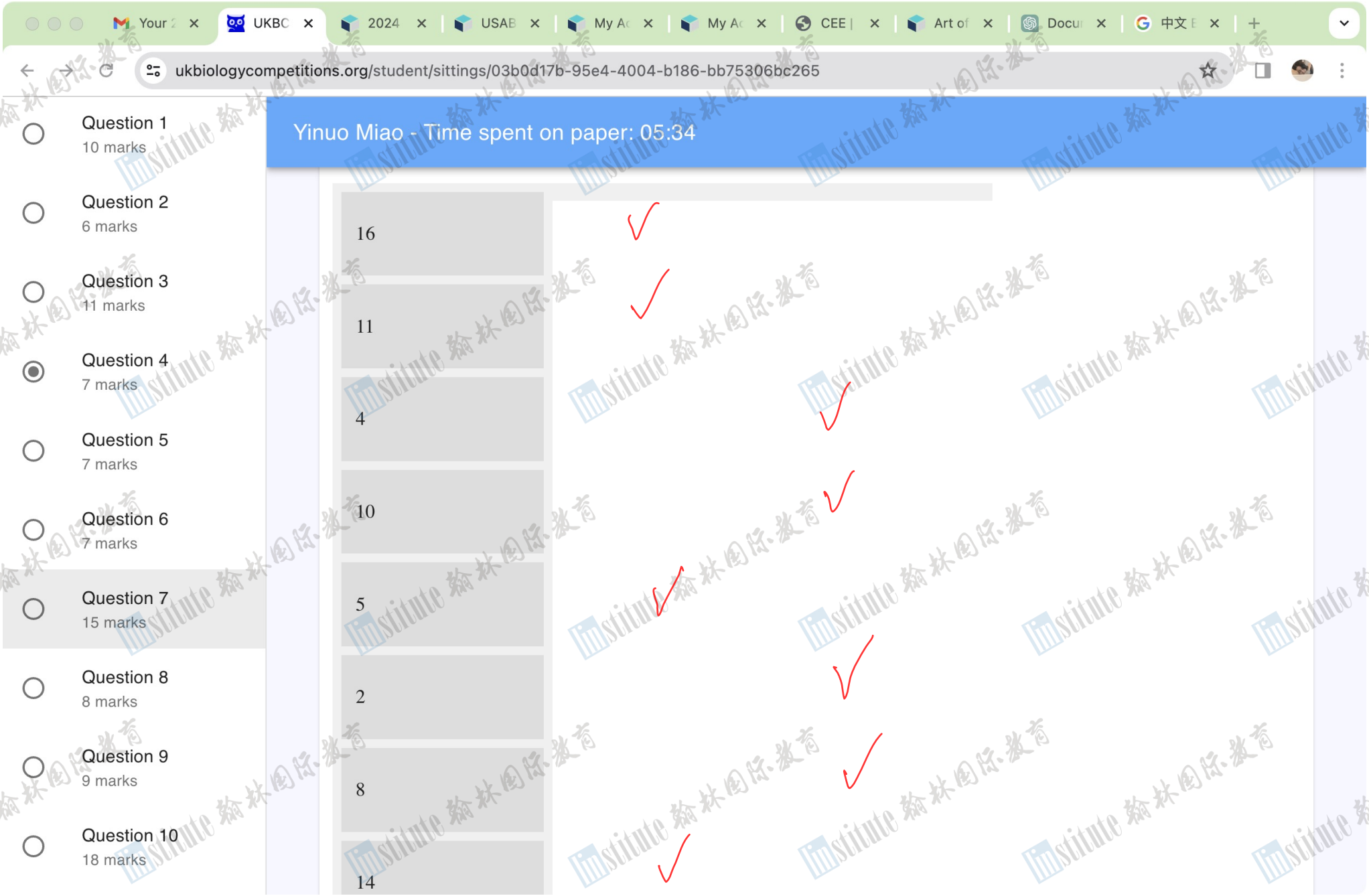
If antibodies bind to either donor or recipient red blood cells, they are attacked and the byproducts rapidly kill the recipient. If antibodies bind to platelets, not very much happens but the platelets might not last quite as long.

During a *red blood cell* donation, which combinations of blood donation are okay?

	Recipient AB	Recipient A	Recipient B	Recipient O
Donor **AB**	1	2	3	4
Donor **A**	5	6	7	8
Donor **B**	9	10	11	12
Donor **O**	13	14	15	16

3 marks

Unsorted	Good for patient	Bad for patient
16		
11		
4		
10		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Question 7
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Question 8
8 marks
Question 9
9 marks
Question 10
18 marks
Yinuo Miao - Time spent on paper: 05:34
16
11
4
10
5
2
8
14

FXO605

During a *platelet* donation, which combinations of blood donation are okay?

	Recipient AB	**Recipient A**	**Recipient B**	**Recipient O**
Donor **AB**	1	2	3	4
Donor **A**	5	6	7	8
Donor **B**	9	10	11	12
Donor **O**	13	14	15	16

5 marks

Unsorted | Quite good for patient | Bad for patient | Very good for patient

15

14

8

Reactions to badly ABO-matched blood transfusions are very quick even though the recipient may not have ever received a donation before.

Which definitions describe this kind of immunity?

3 marks

- [ ] Adaptive
- [x] Innate
- [ ] Humoral
- [ ] Cross-reactivity between antigens
- [ ] Autoimmunity
- [x] Non-specific immunity
- [ ] Passive immunity

FXO605

All human cells can also express immune-triggering rhesus (Rh+) antigens on their surface, or express less immunogenic rhesus antigens (Rh-).

People become rhesus intolerant if they are exposed to miss-matched material.

FXO605

Foetal blood cells may leak into the blood stream of a pregnant mother. All mothers pass their circulating antibodies to the developing foetus through their placenta.

What situations increase the chance of the baby being harmed by blood group incompatibility with the mother?

4 marks

Unsorted

More likely baby is harmed Less likely baby is harmed

Question 1
10 marks

Question 2
6 marks

Question 3
11 marks

Question 4
7 marks

Question 5
7 marks

Question 6
7 marks

Question 7
15 marks

Question 8
8 marks

Question 9
9 marks

Question 10
18 marks

Yinuo Miao - Time spent on paper: 06:33

4 marks

Unsorted	More likely baby is harmed	Less likely baby is harmed
The father is Rh+ and the mother is Rh- (the foetus is unknown).		
A newborn very sick due to blood-group incompatibility is breast fed by its mother.		
The Rh- mother previously had an abortion of a Rh+ foetus.		
This is the first pregnancy.		
A drug is used to cover-up rhesus antigens.		
The mother is Rh+.		

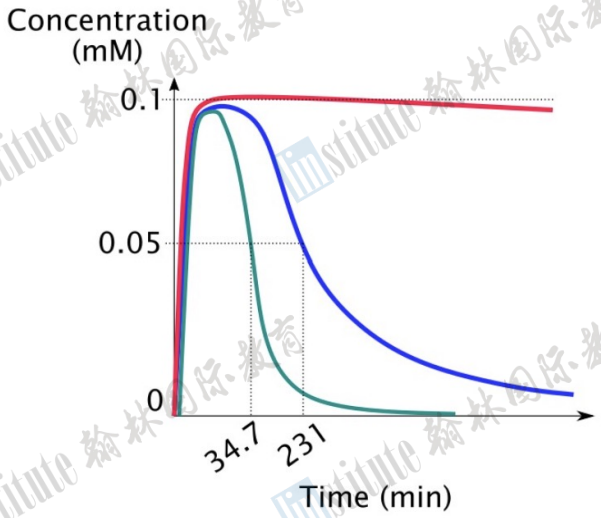
- Inulin is a soluble inert (non-reactive, non-toxic) 4 kDa (small) polymer.
- Dextran is a soluble inert 500 kDa (very large) polymer.

Both are handled by the kidney as you would expect for **non**-actively transported molecules of their size.

Para-aminohippurate (PAH) is unusual because it is completely removed from plasma as it moves past a nephron (i.e. it is actively transported into the urine).

All molecules were tagged with different colour fluorescent dyes and intravenously injected into pigs. The injection was a one-off and contained 0.75 millimoles of each molecule.

Plasma concentration of each molecule over time was then measured with a fibreoptic fluorescence imager inserted into a blood vessel.



Question 1
10 marks

Question 2
6 marks

Question 3
11 marks

Question 4
7 marks

Question 5
7 marks

Question 6
7 marks

Question 7
15 marks

Question 8
8 marks

Question 9
9 marks

Question 10
18 marks

The equation for exponential decay is

- $A = A_0e^{-kT}$

Which can be rearranged as

- $K = \ln(A_0/A)/T$

Where

- A = the amount remaining
- A_0 = the initial amount
- k is the chance that each molecule is lost per unit time (i.e. proportion of blood filtered per minute).
- T = time

Note: $\ln(2) \sim 0.693$

FXO605

Calculate the plasma volume of the pig.

Give your answer in litres to one decimal place.

It doesn't matter if you type the unit, L, or not.

3 marks

7.5

For subsequent parts, take the plasma volume of the pig to be 10 litres.

FXO605

Calculate the renal plasma flow of the pig (how much plasma flow the kidneys receive).

Give your answer in l/min to tone decimal place.

It doesn't matter if you type the unit, l/min, or not.

2 marks

7.21

FXO605

Calculate the glomerular filtration rate of the pig (how much plasma the Bowman's capsule excretes before any reabsorption).

Give your answer in l/min to two decimal places.

It doesn't matter if you type the unit, l/min, or not.

3 marks

0.14

Yinuo Miao - Time spent on paper: 07:54

FLAG

- Humans have about 20,000 protein-coding genes.
- Assume the average (mean) human protein weighs 50 kDa.
- The average amino acid weighs 110 Da.

Use this information to estimate the total length, in base pairs, of coding sequence in the human genome.
Give your answer to the nearest million base-pairs. (It does not matter if you type the unit, 'Mbp' million base pairs or not).

4 marks

27

FXO605

An alien plant has 100 million base pairs of protein-coding sequence in its genome.

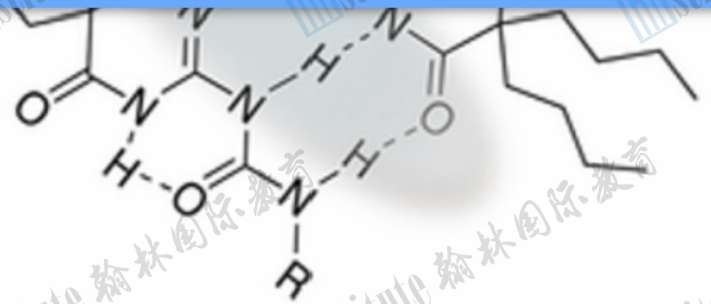
The alien uses 20 different amino acids (like us) but has 3 different DNA base pairs (A/T, G/C and X/Y).

Calculate the maximum total length of protein sequence (in amino acids) this alien could encode.

Give your answer to the nearest million amino acids. (It does not matter if you type the unit, 'million amino acids', or not).

50

3 marks



2 marks

- ATTATAAAATAAT
- GCGCGCCCCGGCG
- GCGG
- ATGCYGAYTCTX
- XYXYYXYXXYXXY

FXO605

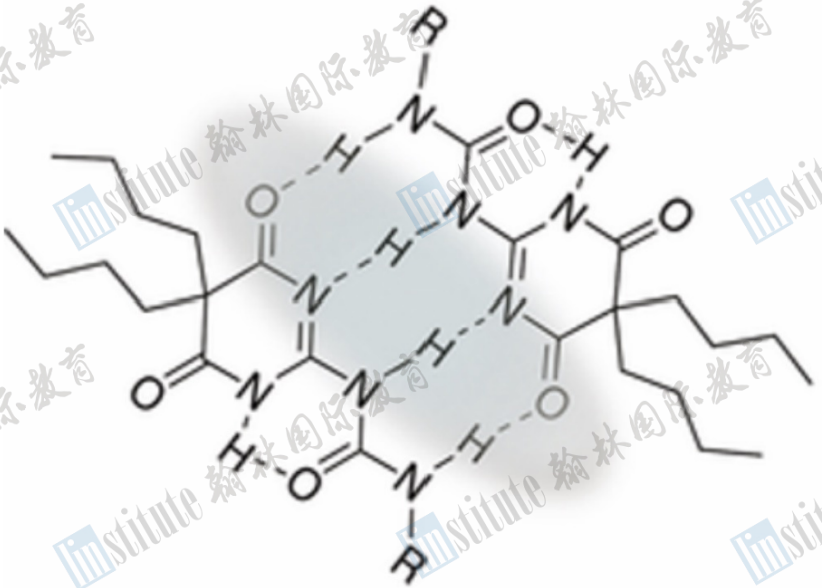
Give your answer to the nearest million amino acids. (It does not matter if you type the unit, 'million amino acids', or not).

3 marks

FXO605

The chemical structure of an X/Y base pair is shown.

Which DNA sequence has the highest melting temperature?



When dead/damaged red blood cells are recycled, the haem they contain must be detoxified.

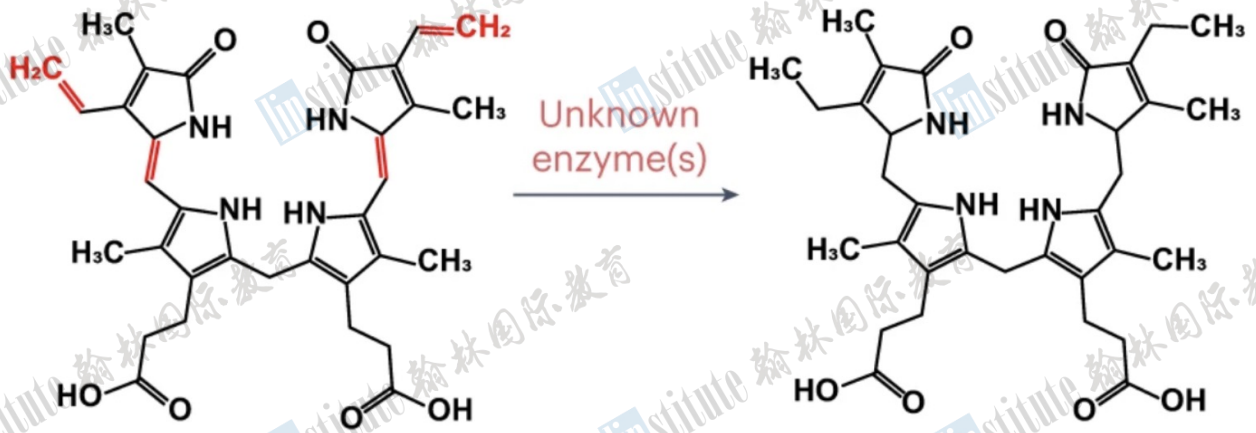
An outline of the haeme degradation pathway:

- Haeme → → bilirubin → urobilinogen → urobilin

Urobilin makes urine yellow.

If bilirubin cannot be processed into urobilinogen, it builds up in the blood. This can cause jaundice (a person turning yellowish) and is toxic.

The enzyme which converts bilirubin to urobilinogen (see image) was unknown until 2024.



What features does the unknown enzyme have?

3 marks

Catalyses a reduction reaction.	☑ True	☐ False
Probably uses ATP.	☑ True	☐ False
Probably uses NADH or FADH/$FADH_2$.	☑ True	☐ False
Catalyses a condensation reaction.	☐ True	☑ False

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Scientists showed **only** gut bacteria produce the unknown enzyme.

How could this be proved?

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- ○ Bacteria grown in the lab are able to convert bilirubin to urobilinogen.
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- ✓ Rats grown in sterile conditions with their entire gut microbiome killed are unable to convert bilirubin to urobilinogen.
- Bioinformatic analyses show humans do **not** have genes which look like those that could convert bilirubin to urobilinogen.
- Urobilinogen is useful for bacteria to use in some of their reactions.

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Gut bacteria were grown on bilirubin agar plates which turn fluorescent in the presence of urobilinogen.
(The numbers match species on a later diagram)

Yinuo Miao - Time spent on paper: 09:27

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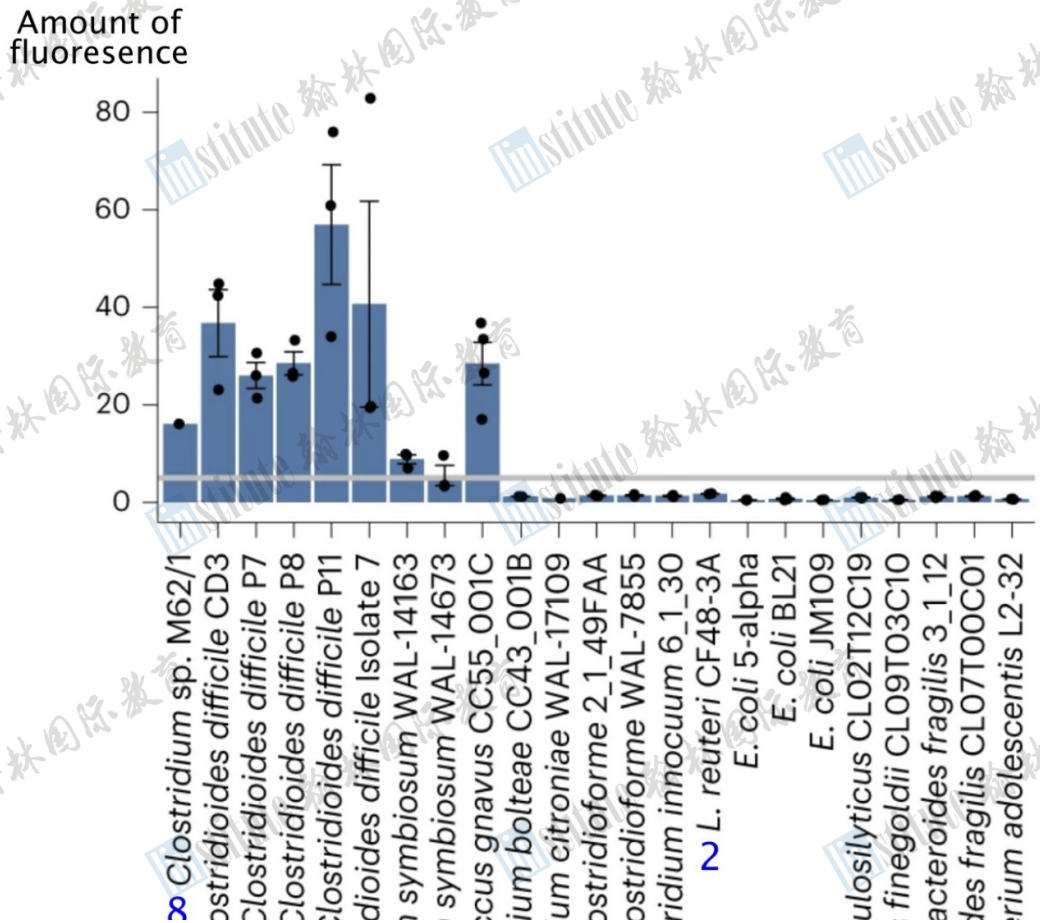

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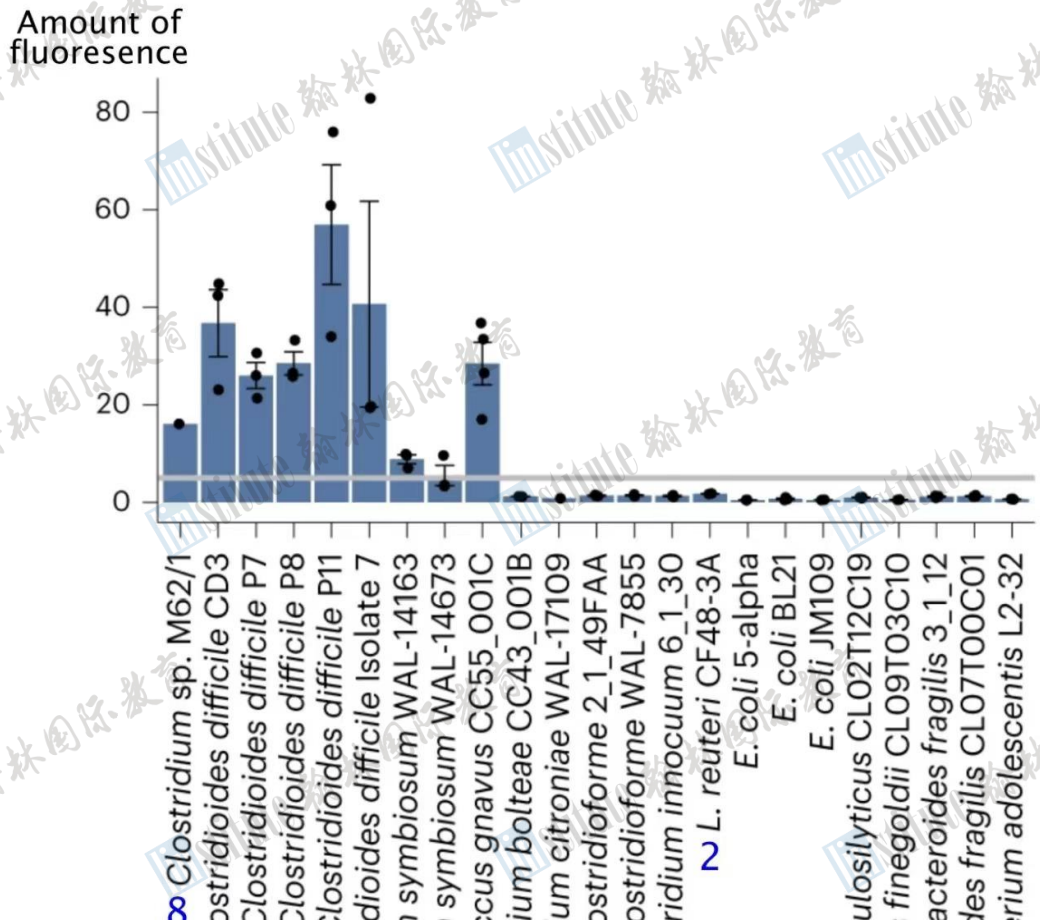

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