

New Pancreatic Islets**1 (2p)** maximum score 2

The answer must show that in the thymus

- due to exposure to insulin the right T cells are selected / the T cells 'learn' what is foreign / T cells that could mount an autoimmune response against insulin do not mature 1
- so that (beta) cells that produce insulin (in the pancreas) are not attacked by the immune system 1

2 (2p) D**3 (2p)** maximum score 2

The answer must show that

- (due to a lack of insulin) transport of glucose from the blood to the cells is hindered / the cells take up less glucose / (more) glucose is excreted 1
- hence burning fat / protein is necessary (causing her to lose weight) 1

Note: For the answer that insufficient energy / building blocks is / are available for production of cells while the breakdown of cells still continues, the second score point is awarded.

4 (2p) C**5 (2p)** maximum score 2

1 false; 2 false; 3 true

3 correct answers: 2 points

2 correct answers: 1 point

less than 2 correct answers: 0 points

6 (2p) maximum score 2

- insulin 1
- antibodies/cytokines/complement proteins 1

Note:

When the two correct answers are switched, 1 point is awarded.

For the answer that immune system cells can't pass pores, no points are awarded.

7 (2p) maximum score 2

The answer must show that beta cells

- must be able to quickly notice an increased/changed blood glucose concentration 1
- in order to release insulin on time / normalize the blood glucose level 1

X Chromosome Inactivation

8 (2p) A

9 (2p) B

10 (2p) A

11 (2p) D

12 (2p) maximum score 2

1 Q

2 P

3 S

4 R

4 correct number-letter combinations: 2

3 or 2 correct number-letter combinations: 1

less than 2 correct number-letter combinations: 0

13 (2p) C

14 (1p) maximum score 1

in the uterus / womb

15 (1p) maximum score 1

The phenotype / gene expression is affected without changing the DNA / genotype.

16 (1p) maximum score 1

In (most) female patients the defect only occurs in some cells (like a mosaic) while in men it occurs in all cells (causing the symptoms to be more severe).

Blue Algal Blooms

17 (2p) D

18 (1p) maximum score 1

Cyanobacteria can make use of a larger part of the light spectrum (compared to green algae without these pigments) / they can also absorb light with wavelengths between 525 en 625 nm / also make use of green/yellow/orange light.

19 (2p) A

20 (2p) maximum score 2

examples of a right answer:

- Because the blue algae cannot move to deeper layers with the vertical current, the temperature remains favorable for blue algal growth

- Because cyanobacteria can float at the surface, they are able to absorb more light for photosynthesis
 - Because the blue algae do not diffuse to greater depths, the surface more easily gets a high concentration of algae.
- The algae stay in the relatively warm/light upper layer 1
 - Which is favorable for photosynthesis/growth / causing a high local concentration 1

21 (2p) C

22 (2p) maximum score 2

The answer must show that

- by sinking down, the fixed carbon is taken out of the atmosphere 1
- when remains are broken down, CO₂ will once again return to the atmosphere 1

23 (2p) B

24 (3p) maximum score 3

The answer must show that

- during eutrophication there is more N available in the water 1
- due to the enhanced greenhouse effect, the seawater gets warmer / due to increased greenhouse gases/CO₂ in the atmosphere / more HCO₃⁻ in the seawater, there is more carbon available 1
- resulting in more microcystins produced (by more cyanobacteria or more per cyanobacterium) 1

25 (2p) A

26 (3p) maximum score 3

The answer must show that

- there is depolarisation in the muscle fiber, but no repolarisation (because the neurotransmitter is not broken down) 1
- causing muscles to stay contracted 1
- which leads to breathing problems if it affects the muscles involved in respiration 1

Note: For another potentially dangerous consequence at the organism level, such as exhaustion due to convulsions or overall cramping, the third point is also awarded.

Man or Woman?

27 (1p) maximum score 1

The allele for ARD in her great-grandfather may have passed to Calliope, via her grandparents (4 & 5) and both parents (7 & 8) 1

28 (1p) maximum score 1

The aberrant (X chromosomal) allele would have led to infertility in her great-grandfather / a female phenotype, so her grandparents would not have been born (and Calliope would not have existed).

29 (2p) C

Isolation Affects the Evolution of Bacteria Populations

30 (1p) maximum score 1

examples of a correct cause

- dehydration
- poisoning (by its own waste products)
- acidification

Note: For the answer 'there will be a lack of oxygen' no points are awarded

31 (2p) C

32 (2p) maximum score 2

The answer must show that

- mutations cause new genotypes / genetic variation 1
- the bacteria that are better adapted to the (experimental) conditions will increase in numbers faster relative to the rest of the population because they divide more quickly / because their daughter cells have a greater chance of surviving (than the other cells) 1

33 (2p) A

34 (2p) D

35 (1p) maximum score 1

In one group of bacteria, other mutations have accumulated than in the other group (over the course of the 900 days of transferring).

Folic Acid Enrichment Impedes Diagnosis of Nerve Damage

36 (3p) maximum score 3

- an essential amino acid must be part of the diet / cannot be made by the body / cannot be produced by transamination (in the liver) 1
- the contradiction is that methionine apparently *can* be synthesized in the body 1
- when there is a consistently low production of methionine (through the conversion of homocysteine into methionine) and it therefore needs to be in the diet 1

37 (1p) maximum score 1

examples of a correct answer:

- Methionine is the first amino acid to be built into the amino acid chain that get formed on a ribosome
- The start codon is read first and that means methionine is built into a protein.
- Methionine is part of the amino acid chain of the myelin basic protein.

Note: For the answer that methionine acts as a start codon no points are awarded.

38 (2p) maximum score 2

- Schwann cells 1
- The impulses are slowed down / there is no saltatory conduction 1

39 (2p) C

40 (2p) maximum score 2

the answer must show that

- extra folic acid intake leads to more tetrahydrofolate, so sufficient blood cells will be formed (and there is no reason to suspect a vitamin B12 deficiency) 1
- while a vitamin B12 deficiency leads to the formation of less (S-adenosyl)methionine and therefore less myelin (which can cause unnoticed nerve damage) 1