

**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, CO<sub>2</sub> 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/CO<sub>2</sub> in the atmosphere / more HCO<sub>3</sub><sup>-</sup> 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 lead 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