MARK SCHEME

AQA GCSE Biology · Paper 2: Homeostasis & Response, Inheritance, Variation & Evolution, Ecology

Higher Tier — Separate Science · Total: 100 marks

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This mark scheme is designed for use by examiners. Alternative correct answers should be accepted. Marks in brackets [1] indicate one mark. Points separated by / indicate alternatives. Underlined words are essential. ★ indicates Higher Tier only marks.

Question 1 [4 marks]

(a) [1 mark]

Which hormone is released by alpha cells in the pancreas when blood glucose falls?

• B. Glucagon [1]

(b) [1 mark]

Which of the following correctly describes natural selection?

• B. Organisms with advantageous mutations survive and reproduce more [1]

(c) [1 mark]

Which process in the nitrogen cycle converts nitrates back into nitrogen gas?

• C. Denitrification [1]

(d) [1 mark]

A cross between two heterozygous parents (Aa × Aa) is expected to produce offspring in which ratio o…

• C. 3:1 [1]

Total for question 1: 4

Question 2 [8 marks]

The diagram below shows a reflex arc.

(a) [3 marks]

Describe the sequence of events in a reflex arc when a person touches a hot surface. Name the types …

• Heat stimulus detected by thermoreceptors in skin [1]

• Sensory neurone carries impulse to spinal cord; relay neurone in spinal cord; motor neurone carries impulse to effector muscle [1]

• Muscle contracts / hand withdraws — this bypasses the brain so is faster than a voluntary response [1]

(b) [3 marks]

Explain how a nerve impulse is transmitted across a synapse.

• Electrical impulse reaches pre-synaptic terminal → triggers release of neurotransmitters from vesicles [1]

• Neurotransmitters diffuse across the synaptic cleft [1]

• Neurotransmitters bind to complementary receptors on post-synaptic membrane → new electrical impulse generated [1]

(c) ★ [2 marks]

★ Explain why signals at a synapse can only travel in one direction.

• Neurotransmitters are only released from the pre-synaptic terminal [1]

• Complementary receptors only exist on the post-synaptic membrane [1]

Total for question 2: 8

Question 3 [10 marks]

Type 1 and Type 2 diabetes are both conditions affecting blood glucose control but have different causes and treatments.

(a) [4 marks]

Describe how blood glucose concentration is restored to normal when it rises above the set point aft…

• Beta cells in the pancreas detect the rise and secrete insulin into the blood [1]

• Insulin causes body cells to take up glucose from blood; liver converts glucose to glycogen (glycogenesis) [1]

• Blood glucose concentration falls back towards the set point [1]

• This is negative feedback — the response (insulin release) opposes the original change (rise in blood glucose) [1]

(b) [4 marks]

Compare Type 1 and Type 2 diabetes in terms of cause, mechanism and treatment.

• Type 1: autoimmune — immune system destroys pancreatic beta cells → no insulin produced [1]

• Type 1 treatment: insulin injections / insulin pump [1]

• Type 2: body cells become resistant to insulin — cells do not respond properly [1]

• Type 2 treatment: diet, exercise and weight loss (medication as last resort) [1]

(c) ★ [2 marks]

★ Explain why blood glucose control is described as a negative feedback system. Use the role of glu…

• When blood glucose FALLS below the set point, alpha cells release glucagon → glycogen → glucose → blood glucose rises back to set point [1]

• The response (glucagon release) directly OPPOSES the original change (low blood glucose) — this is the definition of negative feedback [1]

Total for question 3: 10

Question 4 [10 marks]

Figure 2 shows the concentrations of four hormones during the menstrual cycle.

(a) [4 marks]

Describe the roles of FSH, oestrogen, LH and progesterone in controlling the menstrual cycle.

• FSH (pituitary): stimulates follicle/egg to mature and stimulates oestrogen production from ovaries [1]

• Oestrogen: repairs and thickens uterus lining; at high levels triggers LH surge [1]

• LH surge (pituitary, ~day 14): triggers ovulation (release of mature egg from ovary) [1]

• Progesterone (corpus luteum): maintains uterus lining; falls if no pregnancy → menstruation [1]

(b) [3 marks]

Explain how the combined oral contraceptive pill prevents pregnancy.

• The pill contains oestrogen and/or progesterone [1]

• These hormones inhibit FSH release from the pituitary gland [1]

• Without FSH, no follicle matures and ovulation does not occur → pregnancy is impossible [1]

(c) ★ [3 marks]

★ Describe the process of IVF. Evaluate ONE advantage and ONE limitation.

• FSH given to stimulate multiple egg production → eggs collected → fertilised by sperm in laboratory → embryo cultured → implanted in uterus [1]

• Advantage: allows couples with fertility problems to have biological children / can screen embryos for genetic disorders [1]

• Limitation: low success rate (~25-30% per cycle) / expensive / ethical concerns about unused embryos / risk of multiple births [1]

Total for question 4: 10

Question 5 [11 marks]

This question is about inheritance in humans.

(a) [2 marks]

Polydactyly (extra digits) is caused by a dominant allele (D). A person with polydactyly has the gen…

• Heterozygous (Dd): produces D and d gametes in equal proportions [1]

• 50% of children from Dd × dd cross will inherit D allele and have polydactyly; 50% will be dd and unaffected [1]

(b) [3 marks]

Describe the difference between mitosis and meiosis. Include the number and type of cells produced b…

• Mitosis: produces 2 genetically IDENTICAL diploid cells — for growth/repair [1]

• Meiosis: produces 4 genetically DIFFERENT haploid cells — for sexual reproduction (gametes) [1]

• Meiosis creates variation through crossing over and independent assortment [1]

(c) [4 marks]

Explain how natural selection can lead to the development of antibiotic resistance in bacteria. Use …

• Random mutations create variation in bacterial population — some mutations confer resistance to antibiotics [1]

• When antibiotic used: non-resistant bacteria die; resistant bacteria SURVIVE [1]

• Resistant bacteria reproduce and pass on resistance alleles to offspring (inheritance) [1]

• Over many generations, the frequency of the resistance allele increases — population becomes resistant [1]

(d) ★ [2 marks]

★ Describe how speciation can occur when two populations of the same species become geographically …

• Geographic isolation prevents interbreeding — populations evolve independently under different selection pressures / different mutations arise [1]

• Over many generations, genetic differences accumulate until populations can no longer interbreed to produce fertile offspring → new species [1]

Total for question 5: 11

Question 6 [10 marks]

Scientists are studying the impact of deforestation on biodiversity and the carbon cycle.

(a) [4 marks]

Explain the effects of deforestation on the carbon cycle and on biodiversity.

• Deforestation removes trees that absorb CO■ by photosynthesis — less CO■ removed from atmosphere [1]

• Burning trees releases stored carbon as CO■ → increases atmospheric CO■ [1]

• Habitat destruction → loss of food, shelter and breeding sites for many species [1]

• Many species may become extinct → significant reduction in biodiversity [1]

(b) [4 marks]

Describe the process of eutrophication, explaining how it leads to the death of aquatic organisms.

• Fertilisers (nitrates/phosphates) wash from farmland into water bodies [1]

• Algae grow rapidly (algal bloom) and cover the water surface, blocking sunlight [1]

• Aquatic plants below the surface die → bacteria decompose dead matter, using up dissolved oxygen [1]

• Dissolved oxygen levels fall → fish and other aquatic organisms suffocate [1]

(c) ★ [2 marks]

★ Explain what is meant by a "positive feedback loop" in the context of global warming. Give ONE ex…

• Positive feedback: a change triggers a response that amplifies (makes worse) the original change [1]

• Example: global warming → Arctic permafrost melts → methane released → more warming → more melting [1]

Total for question 6: 10

Question 7 [11 marks]

A woodland ecosystem contains oak trees, caterpillars, blue tits (birds), and sparrowhawks.

(a) [1 mark]

Write a food chain for this woodland ecosystem.

• Oak trees → caterpillars → blue tits → sparrowhawks [1] (arrows must point in direction of energy flow)

(b) [3 marks]

The biomass of oak trees in the woodland is 10,000 kg. The biomass of caterpillars is 1,000 kg. Expl…

• Only ~10% of energy/biomass transfers from one trophic level to the next [1]

• Energy is lost through: respiration (released as heat) [1]

• Movement / excretion / indigestible material in faeces that is not consumed [1]

(c) [3 marks]

Explain the role of decomposers in the carbon cycle.

• Decomposers (bacteria and fungi) break down dead organic matter [1]

• They respire, releasing CO■ back into the atmosphere [1]

• They also release mineral ions (e.g. nitrates) back into the soil, making them available for plant uptake [1]

(d) ★ [4 marks]

★ Describe the nitrogen cycle. Your answer should include the names of four types of bacteria and t…

• Nitrogen-fixing bacteria: convert atmospheric N■ into ammonia/nitrates in soil or legume root nodules [1]

• Nitrifying bacteria: convert ammonia → nitrites → nitrates in soil (available for plant uptake) [1]

• Decomposers: break down dead organisms and excretion, releasing ammonia (ammonification) [1]

• Denitrifying bacteria: convert nitrates back into N■ gas, returning nitrogen to the atmosphere [1]

Total for question 7: 11

Question 8 [6 marks]

(a) [6 marks]

Evaluate the use of genetic engineering to produce organisms with desirable traits. In your answer, …

• Benefit: production of human insulin by bacteria — safer than animal-derived insulin, produced in large quantities cheaply [1]

• Benefit: herbicide-resistant/pest-resistant GM crops — higher yield, fewer pesticides needed [1]

• Benefit: golden rice — GM to produce vitamin A — could address nutritional deficiency [1]

• Concern: GM genes could transfer to wild plants through cross-pollination → unknown ecological consequences [1]

• Ethical concern: "unnatural" manipulation of organisms / corporate ownership of seeds / unknown long-term effects on health [1]

• Counter-argument: genetic engineering is carefully regulated; risk of GM to environment may be outweighed by food security benefits [1]

Note: Award marks for any 6 valid evaluative points, including developed arguments and counter-arguments. QWC: for 5-6 marks, answer should be well-organised and use scientific vocabulary throughout.

Total for question 8: 6
