

**Biology Topic 6 AQA Exam Questions: Inheritance, Variation, and Evolution  
Mark Scheme:**

**Q1.**

- (a) DNA (1)
- (b) Nucleus (1)

**[Total: 2 marks]**

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**Q2.**

- (a) 46 (1)
- (b) 23 (1)

**[Total: 2 marks]**

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**Q3.**

- (a) Offspring receive a mix of genes from both parents (1); This causes variation in genetic material (1)
- (b) Meiosis (1)

**[Total: 3 marks]**

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**Q4.**

- (a) Genetically identical / clones (1); Same genetic information as the parent (1)
- (b) Bacteria / strawberries / some plants / yeast (any one) (1)

**[Total: 3 marks]**

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**Q5.**

- (a) A section of DNA (1); That codes for a specific protein / characteristic (1)

**[Total: 2 marks]**

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**Q6.**

- (a) An allele that is always expressed / shows even if only one copy is present (1); It masks the effect of a recessive allele (1)
- (b) An allele that is only expressed if two copies are present (1); Its effect is hidden if a dominant allele is present (1)

**[Total: 4 marks]**

**Q7.**

(a) Ear lobes / dimples / tongue rolling / inherited disorders like cystic fibrosis (any one correct example) (1)

**[Total: 1 mark]**

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**Q8.**

(a) Capital letters for dominant (1); Lowercase letters for recessive (1)

(b) Homozygous (1)

**[Total: 3 marks]**

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**Q9.**

(a) 1 in 4 / 25% (1)

(b) To identify carriers / prevent inherited disease (1); Allows informed decisions to be made (1)

**[Total: 3 marks]**

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**Q10.**

(a) Testing embryos for genetic disorders (1); Before implantation or during pregnancy (1)

(b) Ethical concerns / may lead to termination / 'designer babies' / risk to embryo (any one) (1)

**[Total: 3 marks]**

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**Q11.**

(a) Eye colour / blood group / natural hair colour (any one) (1)

(b) Language / scars / tattoos / dyed hair / pierced ears (any one) (1)

**[Total: 2 marks]**

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**Q12.**

(a) Change in protein / disorder / cancer / enzyme stops working / no effect (any valid effect) (1)

(b) Neutral (1)

**[Total: 2 marks]**

**Q13.**

- (a) Individuals with advantageous traits survive and reproduce (1); Pass on genes to offspring (1)  
(b) No evidence / no understanding of genes / religious beliefs (any two) (2)

**[Total: 4 marks]**

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**Q14.**

- (a) Hard parts don't decay (1); Replaced by minerals (1); Preserved in rock layers (1)

**[Total: 3 marks]**

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**Q15.**

- (a) Choosing parents with desired characteristics (1); Breeding them to produce offspring with those traits (1)  
(b) Reduces genetic variation / inbreeding risks / genetic disorders (any one) (1)

**[Total: 3 marks]**

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**Q16.**

- (a) Changing an organism's DNA (1); By transferring genes from another organism (1)  
(b) Higher yield / resistant to pests or drought / improved nutrition (any one) (1)

**[Total: 3 marks]**

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**Q17.**

- (a) Disease / environmental change / new predators / competition (any one) (1)

**[Total: 1 mark]**

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**Q18.**

- (a) Grouping organisms by similarities and differences (1); To understand evolutionary relationships (1)  
(b) Domain (1)

**[Total: 3 marks]**

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**Q19.**

(a) A classification system that uses three groups (1); Archaea, Bacteria, Eukaryota (1)

**[Total: 2 marks]**

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**Q20.**

(a) Comparing DNA sequences (1); More similar sequences suggest closer relationship (1)

**[Total: 2 marks]**

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**Q21.**

(a) Compare chromosome numbers (1); Different species have different numbers / chromosomes don't pair in reproduction (1)

**[Total: 2 marks]**

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**Q22.**

(a) Overuse kills non-resistant bacteria (1); Resistant bacteria survive and reproduce (1); Spread of resistance increases (1)

**[Total: 3 marks]**

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**Q23.**

(a) To understand how diseases are inherited / for prevention (1)

(b) Allows targeted treatments / gene therapy / better diagnosis (any one valid method) (2)

**[Total: 3 marks]**

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**Q24.**

(a) A group of similar organisms (1); That can breed to produce fertile offspring (1)

**[Total: 2 marks]**

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**Q25.**

(a) Mapping all the genes / DNA in humans (1); Helps understand genetic diseases (1)

**[Total: 2 marks]**

**Q26. DNA is the genetic material found in cells.**

(a) Describe the structure of DNA.

- Point 1: DNA is a polymer made of two strands (1 mark)
- Point 2: The strands are coiled into a double helix (1 mark)
- Point 3: It is made from nucleotides containing a sugar, phosphate, and a base (1 mark)

**Total: 3 marks**

(b) What is a gene?

- Point 1: A gene is a small section of DNA (1 mark)
- Point 2: It codes for a specific protein (1 mark)

**Total: 2 marks**

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**Q27. Human Genome Project**

(a) State one benefit of the Human Genome Project.

- Point 1: Helps identify genes linked to inherited diseases (1 mark)
- Point 2: Aids in development of personalised medicine (1 mark)

**Total: 2 marks**

(b) Give one ethical concern about genome analysis.

- Point 1: Could lead to discrimination based on genetic information (e.g. insurance/employment) (1 mark)
- Point 2: Privacy concerns regarding genetic data (1 mark)

**Total: 2 marks**

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**Q28. Genetic diagrams**

(a) What do the letters in a genetic diagram represent?

- Point: Different alleles of a gene (1 mark)

**Total: 1 mark**

(b) Punnett square for recessive disorder

- Point 1: Correct gametes from both parents (e.g. R and r) (1 mark)
- Point 2: Correct offspring combinations (e.g. RR, Rr, rr) (1 mark)
- Point 3: Identification that 1 in 4 (25%) offspring are affected (rr) (1 mark)

**Total: 3 marks**

**Q29. Alleles and characteristics**

(a) What is a dominant allele?

- Point 1: An allele that is expressed (1 mark)
- Point 2: Even if only one copy is present (1 mark)

**Total: 2 marks**

(b) Why a person with one dominant and one recessive allele shows dominant trait?

- Point 1: Dominant allele masks the effect of the recessive allele (1 mark)
- Point 2: Only one dominant allele needed for characteristic to be shown (1 mark)

**Total: 2 marks**

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**Q30. Variation**

(a) Give two causes of variation

- Point 1: Genetic differences (e.g. mutations, alleles) (1 mark)
- Point 2: Environmental factors (e.g. diet, climate) (1 mark)

**Total: 2 marks**

(b) Differences in identical twins

- Point 1: Same genes but different environments (1 mark)
- Point 2: Environmental influence leads to phenotypic variation (1 mark)

**Total: 2 marks**

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**Q31. Evolution and natural selection**

(a) What is evolution?

- Point 1: Gradual change in species over time (1 mark)
- Point 2: Due to natural selection (1 mark)

**Total: 2 marks**

(b) Describe the process of natural selection.

- Point 1: Variation exists in population due to mutations (1 mark)
- Point 2: Individuals with advantageous traits survive and reproduce (1 mark)
- Point 3: Alleles passed on to next generation (1 mark)

**Total: 3 marks**

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**Q32. Fossils and evolution**

(a) Describe how fossils are formed.

- Point 1: From parts that do not decay (e.g. bones) (1 mark)
- Point 2: In conditions that prevent decay (e.g. lack of oxygen) (1 mark)
- Point 3: Replacement by minerals over time (1 mark)

**Total: 3 marks**

(b) Why fossil record is incomplete?

- Point 1: Many early organisms were soft-bodied (1 mark)
- Point 2: Geological activity has destroyed fossils (1 mark)

**Total: 2 marks**

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### Q33. Selective breeding

(a) What is selective breeding?

- Point 1: Choosing parents with desired characteristics (1 mark)
- Point 2: Breeding them over several generations (1 mark)

**Total: 2 marks**

(b) Disadvantage

- Point 1: Reduced gene pool/inbreeding (1 mark)
- Point 2: Increased risk of genetic disorders (1 mark)

**Total: 2 marks**

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### Q34. Genetic engineering

(a) Benefit

- Point 1: Increased yield/disease resistance in crops (1 mark)
- Point 2: Can reduce need for chemical inputs (e.g. pesticides) (1 mark)

**Total: 2 marks**

(b) Risk

- Point 1: Unknown effects on ecosystems (1 mark)
- Point 2: Possible allergic reactions or gene transfer (1 mark)

**Total: 2 marks**

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### Q35. Antibiotic resistance

(a) How resistance develops

- Point 1: Random mutation occurs (1 mark)
- Point 2: Resistant bacteria survive and reproduce (1 mark)
- Point 3: Resistance allele becomes more common (1 mark)

**Total: 3 marks**

(b) Reducing spread in hospitals

- Point 1: Use antibiotics appropriately (1 mark)
- Point 2: Improve hygiene measures (1 mark)

**Total: 2 marks**

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### **Q36. Extinction**

(a) Definition

- Point: When no individuals of a species remain alive (1 mark)

**Total: 1 mark**

(b) Causes

- Point 1: New predators or disease (1 mark)
- Point 2: Habitat destruction or climate change (1 mark)

**Total: 2 marks**

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### **Q37. Classification**

(a) Scientist: Carl Linnaeus (1 mark)

(b) Binomial name: Homo sapiens (1 mark)

(c) Reason for changes: New DNA evidence/technological advances (1 mark)

**Total: 3 marks**

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### **Q38. Genetic engineering in medicine**

(a) Example: Producing insulin using genetically modified bacteria (1 mark)

- Or: Gene therapy for inherited diseases (1 mark)

**Total: 2 marks**

(b) Why still experimental

- Point 1: May have side effects or unintended consequences (1 mark)
- Point 2: Not yet proven fully safe or effective (1 mark)

**Total: 2 marks**

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### **Q39. Adaptations**

(a) Adaptation definition

- Point 1: A feature that increases chance of survival/reproduction (1 mark)
- Point 2: In a specific environment (1 mark)

**Total: 2 marks**

(b) Structural adaptation example

- Point 1: Thick fur for insulation (1 mark)
  - Point 2: Or large surface area to volume ratio in desert animals (1 mark)
- Total: 2 marks**
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#### Q40. Mutations

(a) Definition

- Point 1: A change in the DNA sequence (1 mark)
  - Point 2: May occur spontaneously or due to external factors (1 mark)
- Total: 2 marks**

(b) Phenotype

- Point 1: Most mutations do not affect protein function (1 mark)
  - Point 2: So they do not change the phenotype (1 mark)
- Total: 2 marks**

#### Q41. DNA mutation

(a) What is a mutation? (2 marks)

- A mutation is a **change in the sequence of DNA bases** (1)
- This can occur **spontaneously** or due to **exposure to radiation/chemicals** (1)  
*Alternative: "A change in the genetic code" (1) + cause or effect (1)*

(b) Describe how a mutation can affect the function of a protein. (2 marks)

- A mutation may **change the amino acid sequence** of the protein (1)
  - This may alter the **shape** or **function** of the protein (1)  
*Alternative: "The protein may not work properly" or "It could become non-functional" (1)*
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#### Q42. Genetic engineering in agriculture

(a) Describe one way genetic engineering is used in agriculture. (2 marks)

- Genes for **resistance to pests/herbicides** are inserted into crop plants (1)

- This leads to **improved yield** or **reduced need for chemical use** (1)

(b) Benefit and risk (2 marks)

- **Benefit:** Increased crop yield / improved nutrition / disease resistance (1)
  - **Risk:** Unknown health effects / reduced biodiversity / ethical concerns (1)
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### Q43. Selective breeding

(a) Explain the process of selective breeding in animals. (3 marks)

- Animals with **desired characteristics** are chosen (1)
- These are **bred together** (1)
- Offspring with the best traits are **selected and bred again over generations** (1)

(b) One disadvantage of selective breeding. (1 mark)

- Can lead to **inbreeding** and increase the risk of **genetic disorders** (1)  
*Alternative: Reduced genetic variation (1)*
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### Q44. Fossils and evolution

(a) What is a fossil? (2 marks)

- Fossils are the **remains or traces of ancient organisms** (1)
- They are **found in rocks** (1)

(b) Describe one way fossils can form. (2 marks)

- From **hard parts** of organisms that do not decay (e.g. bones, teeth) (1)
  - When parts are replaced by **minerals** / preserved in **amber, ice, or peat** (1)
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### Q45. Natural selection and evolution

(a) What is natural selection? (2 marks)

- Organisms with the **most advantageous characteristics** survive (1)
- These organisms **reproduce** and pass on beneficial genes (1)

(b) How natural selection leads to evolution. (3 marks)

- Variation exists due to mutations (1)
  - Best-adapted organisms survive and reproduce (1)
  - Beneficial alleles become more common over generations (1)
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### Q46. The Human Genome Project

(a) What is the genome of an organism? (1 mark)

- The **entire genetic material / DNA** of an organism (1)

(b) One benefit of mapping the human genome. (2 marks)

- Helps identify **genes linked to inherited diseases** (1)
  - Can lead to **targeted treatments or gene therapy** (1)
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### Q47. Reproduction types

(a) One difference between sexual and asexual reproduction. (1 mark)

- Sexual reproduction involves **two parents**, asexual involves **one** (1)  
*Alternative: Sexual → variation; Asexual → clones (1)*

(b) One advantage of asexual reproduction. (2 marks)

- Only one parent needed (1)

- Quicker / produces many offspring rapidly (1)
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### Q48. Causes of variation

(a) Two causes of variation. (2 marks)

- **Genetic** differences (1)
- **Environmental** influences (1)

(b) Human height interaction. (2 marks)

- Height is controlled by **genes** (1)
  - Affected by **nutrition** or other environmental factors (1)
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### Q49. Chromosomes and alleles

(a) Where are chromosomes found? (1 mark)

- In the **nucleus** of cells (1)

(b) What is an allele? (2 marks)

- A **version or form of a gene** (1)
  - Alleles may be **dominant or recessive** (1)
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### Q50. Inherited disorders

(a) One disorder caused by a dominant allele. (1 mark)

- **Polydactyly** (1)

(b) Carrier passing on recessive allele. (2 marks)

- A carrier has **one recessive allele** but does not show symptoms (1)
  - Can pass on the allele if the **other parent is also a carrier** or has it (1)
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### Q51. Mitosis vs. meiosis

(a) One difference between mitosis and meiosis. (1 mark)

- Mitosis produces **identical cells**, meiosis produces **genetically different gametes** (1)

(b) Why gametes from meiosis aren't identical. (2 marks)

- **Chromosomes are shuffled / recombined** during meiosis (1)
  - This causes **genetic variation** in gametes (1)
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### Q52. Genetic diagrams

(a) Punnett square showing two heterozygous parents ( $Rr \times Rr$ ): (2 marks)

Correct Punnett square showing:

RR, Rr, Rr, rr (1)

At least one parent correctly labelled + correct genotype outcomes (1)

(b) Probability of an affected offspring. (1 mark)

- **1 in 4** or **25%** or **0.25** (1)
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### Q53. Genetic technologies

(a) One concern about genetic modification. (1 mark)

- **Ethical issues** / interference with nature / long-term effects unknown (1)

(b) One reason people support GM in medicine. (2 marks)

- Can help **treat inherited diseases** (1)

- May allow **personalised medicine / improve quality of life** (1)
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### Q54. Speciation

(a) What is speciation? (1 mark)

- The formation of **new species** from existing ones (1)

(b) Isolation leading to speciation. (3 marks)

- **Populations become separated** (e.g. geographically) (1)
  - Different **mutations** occur and are selected for (1)
  - Over time, populations become so different they **cannot interbreed** (1)
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### Q55. Extinction

(a) Two reasons why a species may go extinct. (2 marks)

- **New predators**
- **Disease**  
*Also accept: habitat destruction, competition, climate change (1 each)*

(b) Why extinction can happen rapidly. (2 marks)

- If environment changes **suddenly** or dramatically (1)
- Species may not have time to **adapt or reproduce** (1)