CBSE CLASS X

Science (086)

ANSWER KEY

AI-generated question paper

Code: NJ7KOV	Questions: 14	Maximum Marks: 28	Generated: 2026-06-25 17:33

SELECTIONS USED

Subject	Science
Lessons	8 Heredity
Level of understanding	Initial understanding
Question selection	Curated chapter coverage (~3 questions per section)
Model	claude-sonnet-4-6

Composition — Difficulty: 4 straightforward · 9 medium · 1 deep | Types: 10 Short · 4 Very short

Q1. medium · initial-understanding · § Introduction **[2]**

Give one reason why offspring produced by sexual reproduction show more variation than those produced by asexual reproduction.

◆ **Heredity**

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Model Answer

In sexual reproduction, DNA comes from **two parents**, combining their genetic material. This mixing produces new combinations of traits in offspring. In asexual reproduction, only one parent is involved and offspring arise mainly from DNA copying, introducing only minor errors. Thus, sexual reproduction generates far greater variation.

Source: Chapter 8, Section 8.1 — Accumulation of Variation During Reproduction

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Explanation

The key point examiners look for is **two parents → mixing/combining of DNA → more variation**. Contrast this with asexual reproduction where variation arises only from small copying errors. Mentioning both sides strengthens the answer for full 2 marks. Avoid vague statements like "more diversity"; be specific about *why* (combining genetic material from two individuals).

Q2. medium | initial-understanding | § 8.1 ACCUMULATION OF VARIATION DURING REPRODUCTION **[3]**

Which type of reproduction — asexual or sexual — produces greater variation among offspring, and why?

◆ **Heredity**

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Model Answer

Sexual reproduction produces greater variation among offspring.

Reasons:

1. Sexual reproduction involves **two individuals**, so the offspring inherits DNA from both parents, creating new combinations of traits.
2. Traits can be **inherited separately**, giving rise to new combinations not present in either parent.
3. During asexual reproduction, offspring are nearly identical to the parent (e.g., sugarcane field shows very little variation), whereas sexually reproducing organisms like human beings show quite distinct variations among individuals.

Thus, modes of sexual reproduction allow greater variation to be generated, which helps in survival of the species.

Source: Chapter 7 (What you have learnt), Chapter 8 (Introduction)

Explanation

- Examiners expect you to **name** the type (sexual) and give **at least 2 clear reasons** for full marks.
- Key points to include: involvement of two parents → DNA from both → new trait combinations; contrast with asexual reproduction (near-identical offspring).
- The sugarcane vs. humans example from the textbook introduction is a great supporting point — use it to show you've read the chapter.
- Avoid vague statements; say *why* two parents lead to more variation (new DNA combinations, separate inheritance of traits).

Q3. medium | initial-understanding | § 8.1 ACCUMULATION OF VARIATION DURING REPRODUCTION **[2]**

What determines which variations in a population are preserved over generations, and how does this process affect a species over time?

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Model Answer

Environmental conditions determine which variations are preserved. Individuals with variations suited to the current environment survive and reproduce, passing those traits to the next generation — a process called **natural selection**.

Over time, this leads to accumulation of beneficial variations, gradually changing the species. For example, heat-resistant bacteria survive a heat wave and multiply, while others die out.

Source: Chapter 8, Section 8.1 — Accumulation of Variation During Reproduction

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Explanation

- The key phrase examiners look for is **"selection of variants by environmental factors"** — this is directly from the textbook.
- Mention a **concrete example** (heat-resistant bacteria) to secure both marks.
- Avoid over-explaining heredity or DNA copying — the question is about *which* variations are preserved and the *long-term effect* on the species.
- Two clear points = 2 marks: (1) environment selects variants, (2) effect on species over time.

Q4. medium | initial-understanding | § 8.2 HEREDITY **[3]**

In Mendel's cross between tall and short pea plants, all F1 plants were tall, but short plants reappeared in the F2 generation. What does this reappearance tell us about the fate of the 'shortness' trait in the F1 generation? Name the terms used for the two traits involved.

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Model Answer

The reappearance of short plants in F2 shows that the 'shortness' trait was **not lost or destroyed** in the F1 generation — it was merely **hidden (unexpressed)**. The F1 plants inherited both the tallness and shortness factors, but only tallness was expressed. When F1 plants self-pollinated, the shortness factor was transmitted to the next generation and reappeared in ¼ of F2 plants.

- The trait that gets expressed (tallness) is called the **dominant trait**.
- The trait that remains hidden (shortness) is called the **recessive trait**.

Source: Chapter 8, Section 8.2.2 – Rules for the Inheritance of Traits

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Explanation

- The key idea examiners expect: the recessive trait is *inherited but not expressed* in F1 — it is carried in the Tt genotype. Students often incorrectly say the trait "disappeared" or "mixed."
- Always name **both** terms (dominant and recessive) with examples — this question specifically asks for both, so leaving either out loses marks.
- The 3-mark split is roughly: 1 mark for explaining shortness was hidden (not lost), 1 mark for it being carried in F1 and reappearing in F2, 1 mark for correctly naming dominant and recessive with the correct trait matched to each term.

Q5. straightforward | initial-understanding | § 8.2.1 Inherited Traits **[1]**

A child has the same type of earlobe (free or attached) as one of their parents. What is the term used for the passing of such traits from parents to their offspring?

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Model Answer

The passing of traits from parents to their offspring is called **heredity** (inheritance).

Source: Heredity, Section 8.2

Explanation

The examiner expects the single key term **heredity** (also accept *inheritance*). The passage explicitly states: "The rules of heredity determine the process by which traits and characteristics are reliably inherited." No further elaboration is needed for a 1-mark question.

Q6. straightforward | initial-understanding | § 8.2.2 Rules for the Inheritance of Traits – Mendel's Contributions **[1]**

When Mendel crossed tall and short pea plants, only tall plants appeared in the F1 generation. What does this observation tell us about how the two parental traits interact?

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Model Answer

This shows that the tall trait is **dominant** over the short trait — only one copy of the tall factor is enough to express tallness, masking the recessive short trait completely.

Source: Chapter 8, Section 8.2.2

Explanation

Examiners expect the key terms **dominant** and **recessive** here. The F1 result (all tall, no medium) proves one trait completely masks the other — that is the definition of dominance. Avoid saying the short trait "disappeared"; it was inherited but not expressed.

Q7. medium | initial-understanding | § 8.2.2 Rules for the Inheritance of Traits – Mendel's Contributions **[2]**

In Mendel's experiment, when F1 tall plants were self-pollinated, one quarter of the F2 offspring were short. What does the reappearance of the short trait in F2 prove about the F1 tall plants?

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Model Answer

The reappearance of short plants in F_2 proves that the F_1 tall plants were **not pure tall** — they had inherited **both** the tallness and shortness traits. The shortness trait was present but not expressed (recessive) in F_1. This shows that two copies of a factor (gene) controlling a trait are present, where 'T' (tallness) is dominant and 't' (shortness) is recessive, giving F_1 genotype **Tt**.

Source: Chapter 8, Section 8.2.2

Explanation

- The key point examiners want: F_1 plants **carried both traits** (Tt), but only expressed the dominant one.
- Second key point: shortness is **recessive** — it reappears only when both copies are 't' (tt) in F_2.
- Mention **dominant/recessive** terminology and the idea of **two copies of genes** — these fetch marks.
- Avoid saying "the trait disappeared in F_1" without explaining it was hidden, not gone.

Q8. medium | initial-understanding | § 8.2.2 Rules for the Inheritance of Traits – Mendel's Contributions **[2]**

When Mendel's F1 tall round-seeded pea plants were self-pollinated, some F2 offspring showed combinations of traits not seen in either parent plant. What principle of inheritance does this demonstrate?

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Model Answer

This demonstrates **Mendel's Law of Independent Assortment**. When F1 tall round-seeded plants were self-pollinated, F2 offspring showed new combinations — tall wrinkled and short round — because the traits for height and seed shape are inherited independently of each other, allowing factors (genes) to recombine freely during reproduction.

Source: Chapter 8, Section 8.2.2

Explanation

- The key phrase in the question is "combinations not seen in either parent" — this is the hallmark of Independent Assortment, not just Dominance/Recessiveness.
- Examiners expect you to **name the law**, explain it means traits are inherited separately, and give the new combinations (tall wrinkled / short round) as evidence.
- Don't confuse this with the Law of Segregation (which explains dominant/recessive in monohybrid crosses). Dihybrid = Independent Assortment.

Q9. deep | initial-understanding | § 8.2.2 Rules for the Inheritance of Traits – Mendel's Contributions **[3]**

(a) Every sexually reproducing organism carries two copies of the gene for each trait. Why must each germ cell carry only one copy of each gene?
(b) A pea plant with genotype Tt is tall, even though it also carries the allele for shortness. How do you explain this?

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Model Answer

(a) Sexually reproducing organisms have two copies of each gene (one from each parent). During fertilisation, two germ cells (gametes) fuse to form the new individual. If each germ cell carried two copies, the offspring would have four copies, and copy number would keep doubling each generation. Therefore, each germ cell must carry only **one copy** of each gene so that the offspring, after fusion of two gametes, has the correct two copies.

(b) The allele for tallness (T) is **dominant** over the allele for shortness (t). Even though the plant carries the recessive allele (t), the dominant allele (T) expresses itself and masks the effect of the recessive allele. Hence the plant appears tall.

Source: Chapter 8, Section 8.2 Heredity

Explanation

- Part (a) tests understanding of why meiosis halves the chromosome number — so fertilisation restores the correct diploid number. The key logic is: germ cell (n) + germ cell (n) → offspring (2n).
- Part (b) tests the concept of **dominance vs. recessiveness**. Always use the correct terms "dominant" and "recessive" — examiners look for these specific words.
- Budget roughly 1 mark for (a)'s logic and 1 mark for the conclusion; 1 mark for (b)'s explanation of dominance.

Q10. straightforward | initial-understanding | § 8.2.3 How do these Traits get Expressed? **[1]**

What is a gene?

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Model Answer

A gene is a functional unit of DNA on a chromosome that carries information for inheritance of a specific trait from parents to offspring.

Source: Chapter 8, Section 8.2 Heredity; Chapter 7, Section 7.1

Explanation

- Examiners expect you to link **gene → DNA → trait/inheritance** in one line.
- The passage states that chromosomes contain DNA, which is the "information source" for making proteins and inheriting features — a gene is the specific unit of that information for one trait.
- Avoid vague answers like "genes are in cells." Always mention **DNA**, **chromosome**, and **trait/inheritance** for full credit.

Q11. medium | initial-understanding | § 8.2.3 How do these Traits get Expressed? **[3]**

Using the example of plant height, explain how a gene controls a physical characteristic.

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Model Answer

A gene is a segment of DNA that controls the production of a specific protein, which in turn determines a physical trait.

In pea plants, the gene for height exists in two forms (alleles): **T** (tall) and **t** (short). The allele T directs the production of a protein (enzyme) that promotes normal growth, making the plant tall. Allele t does not produce this functional protein, so the plant remains short.

Since T is **dominant**, even one copy (Tt) makes the plant tall. Both copies must be tt for the plant to be short. Thus, the gene controls the characteristic by determining which protein is made.

Source: Chapter 8, Section 8.2.2

Explanation

- Examiners expect three clear points for 3 marks: (1) what a gene does (controls protein production), (2) how the specific alleles T and t work, and (3) the dominant/recessive relationship explaining the final trait.
- Avoid writing a full essay — keep it tight and use the terms **dominant**, **recessive**, **allele** for full credit.
- The phrase "protein that promotes growth" is key — it links the gene directly to the physical characteristic, which is what the question asks.

Q12. medium | initial-understanding | § 8.2.3 How do these Traits get Expressed? **[2]**

Why does each germ cell carry only one copy of each gene? What would happen if germ cells had the same number of gene copies as ordinary body cells?

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Model Answer

Germ cells are formed by **meiosis**, a special cell division that halves the chromosome number. So each germ cell carries only one copy (half set) of each gene.

If germ cells had the same number of gene copies as body cells, then after fertilisation (fusion of two germ cells), the new individual would have **twice** the DNA of the previous generation. This would keep doubling each generation, disrupting the control of the cellular apparatus by DNA.

Source: Chapter 7, Section 7.3.1 — Why the Sexual Mode of Reproduction?

Explanation

- The key term to use is **meiosis** — examiners expect it.
- Two points carry 1 mark each: (1) why germ cells have half the DNA, and (2) the consequence if they didn't (doubling of DNA each generation).
- Avoid vague answers like "to maintain balance" — be specific: *fusion of two germ cells would double the DNA content each generation*.

Q13. straightforward | initial-understanding | § 8.2.4 Sex Determination **[1]**

How many pairs of chromosomes are present in a typical human cell? How many of these pairs are sex chromosomes?

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Model Answer

A typical human cell has **23 pairs** of chromosomes (46 total). Of these, **1 pair** consists of sex chromosomes (XX in females, XY in males).

Explanation

The passage states humans have 22 pairs of autosomes plus one pair of sex chromosomes, totalling 23 pairs. Examiners expect both numbers clearly stated. This is a common 1-mark question — one crisp sentence suffices.

Source: Chapter 8, Section 8.2.4 Sex Determination

Q14. medium | initial-understanding | § 8.2.4 Sex Determination **[2]**

A couple is expecting a baby. The mother contributes an X chromosome to the child. Explain how the father's contribution determines whether the child will be a boy or a girl.

◆ Heredity

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Model Answer

The father has two sex chromosomes: X and Y. During reproduction, he can pass either an X or a Y chromosome to the child. Since the mother always contributes an X chromosome, if the father contributes an **X chromosome**, the child will be a **girl (XX)**. If the father contributes a **Y chromosome**, the child will be a **boy (XY)**. Thus, the father's contribution determines the sex of the child.

Source: Chapter 8, Section 8.2.4 – Sex Determination

Explanation

- The examiner wants you to clearly state that the father is either XY and can pass X or Y, while the mother always passes X.
- Mention both outcomes (XX = girl, XY = boy) explicitly — each is worth marks.
- Do not say the mother determines sex; the passage clearly states sex is determined by the paternal chromosome.
- The phrase "father's contribution determines the sex" should appear in your answer to directly address the question.

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