



20 AP-style MCQs across topics 5.1 to 5.5. Practice, review, revisit.

WHAT'S INSIDE

- ✓ 20 MCQs, four options each, in the style of the real AP exam
- ✓ Every question tagged to a Unit 5 topic so you know what to revise
- ✓ Full answer key with a short explanation for every question
- ✓ Mix of standalone and stimulus-style stems, matching real AP question formats

HOW TO USE IT

- 1. Untimed pass.** Work through slowly, aiming for around 90 seconds per question. Read every option before you commit.
- 2. Timed pass.** Redo the pack in 30 minutes. That matches AP exam pace (1.5 minutes per MCQ) and builds stamina.
- 3. Review.** Check the answer key and mark every miss. Revise those topics on Cognito, then retry after a week.

TOPICS COVERED

- **5.1** Meiosis
- **5.2** Meiosis and Genetic Diversity
- **5.3** Mendelian Genetics
- **5.4** Non-Mendelian Genetics
- **5.5** Environmental Effects on Phenotype

STRUGGLING WITH A TOPIC?



Any topic tricky? Scan the QR to jump straight to the Unit 5 notes on Cognito. For the full AP Biology course (all 8 units, lessons, quizzes, flashcards and past-paper FRQs), head to **cognitoedu.link/ap-bio-notes**. Rework the questions you got wrong a week later to lock the concepts in.

AP EXAM CONTEXT

8-11%

UNIT WEIGHT (MCQ SECTION)

60

MCQS ON THE REAL EXAM

1.5m

AVERAGE TIME PER MCQ

AP BIOLOGY

Unit 5: Heredity

SECTION I • MULTIPLE CHOICE

Time—30 minutes

20 Questions

Directions: Each of the questions or incomplete statements below is followed by four suggested answers or completions. Select the one that is best in each case and mark it clearly on your answer sheet or circle your choice below.

- Which best describes the chromosome content of a human somatic cell compared with a human gamete produced by meiosis?
 - Somatic cell has 46 chromosomes; gamete has 23 chromosomes.
 - Both have 46 chromosomes because meiosis does not change chromosome number.
 - Somatic cell has 23 chromosomes; gamete has 46 chromosomes.
 - Both have 23 chromosomes because meiosis has already occurred in both.
- Which two events in meiosis I are the largest sources of genetic diversity in the resulting gametes?
 - Chromosome duplication during meiosis I in the primary spermatocyte.
 - Crossing over between homologous chromosomes and independent assortment of homologs.
 - Random fertilization of gametes to form the zygote.
 - Sister chromatid separation and centromere splitting during meiosis II.

Questions 3, 4 refer to the following information.

In garden peas, purple flowers (P) are dominant over white (p). A heterozygous plant (Pp) is crossed with a homozygous white plant (pp) and the offspring genotypes and phenotypes are recorded.

Table 1. Offspring of Pp × pp cross

Offspring genotype	Predicted ratio	Observed count (n = 200)
Pp (purple)	1	96
pp (white)	1	104

- Using the offspring counts in Table 1 and the expected 1:1 ratio, what is the chi-square (χ^2) statistic for the fit? (df = 1; critical value at $\alpha = 0.05$ is 3.84.)
 - 0.32
 - 0.64
 - 3.84
 - 8.0
- Which claim about the Pp parent is best supported by Table 1?
 - The Pp parent produces P and p gametes in roughly equal proportions.
 - The p allele is dominant over the P allele in this cross.
 - The purple color must be lethal, because fewer purple offspring appeared.
 - Purple flower color in these peas is controlled by two independently assorting genes, not one.

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5. In a $Pp \times Pp$ monohybrid cross where P is fully expressed over p, what phenotypic ratio is expected in the offspring?
 (A) 3 with the P phenotype : 1 with the p phenotype
 (B) 1 P-phenotype : 1 p-phenotype (test-cross ratio)
 (C) 9 : 3 : 3 : 1 (dihybrid F₂ ratio)
 (D) All offspring show the P phenotype only
6. In peas, yellow seeds (Y) are dominant to green (y). A cross of $Yy \times Yy$ produced 405 yellow seeds and 145 green seeds. What is the ratio of yellow to green, and does it match the Mendelian expectation?
 (A) 1:1; matches a test cross expectation.
 (B) 2.8:1; matches the 3:1 monohybrid F₂ expectation.
 (C) 9:1; does not match any Mendelian expectation for a monohybrid cross of $Yy \times Yy$ parents.
 (D) 1:2.8; matches a codominance expectation.
7. Which conclusion about genes A and B is best supported by Table 2?
 (A) Genes A and B are tightly linked on the same chromosome, so alleles co-segregate together.
 (B) Allele A is lethal when combined with allele B in the same gamete.
 (C) Allele a is dominant over allele A.
 (D) Genes A and B assort independently, so gametes appear in a 1:1:1:1 ratio.
8. Which claim about the $AaBb$ parent is best supported by the near-equal offspring counts in Table 2?
 (A) It produces only two gamete types, either AB and ab or Ab and aB, in equal proportions.
 (B) It cannot produce any recombinant gametes.
 (C) It produces gametes with only one gene, not two.
 (D) It produces four gamete types (AB, Ab, aB, ab) in roughly equal numbers.

Questions 7, 8 refer to the following information.

In fruit flies, two genes (A and B) are being studied. A dihybrid $AaBb$ was test-crossed with an $aabb$ individual. The four offspring phenotypic classes were counted.

Table 2. Offspring of $AaBb \times aabb$ test cross (n = 400)

Phenotype	Predicted %	Observed count
AB	25	98
Ab	25	102
aB	25	104
ab	25	96

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9. In a zygote with three copies of a particular autosome, one of the parents' gametes contributed two copies of that chromosome instead of the usual one. Which error in meiosis most likely produced that gamete?
- (A) An unequal crossover in prophase I that duplicated a small segment of one chromatid.
- (B) A translocation that moved part of one chromosome onto a non-homologous chromosome.
- (C) Nondisjunction, so homologous chromosomes (or sister chromatids) failed to separate.
- (D) A chromosome deletion that removed part of one chromatid during prophase I.

Question 10 refers to the following information.

In a snapdragon plant, red flowers (RR) crossed with white flowers (rr) produce pink F1 offspring. F1 plants were self-crossed and the F2 offspring were counted.

Table 3. F2 offspring of pink × pink snapdragons (n = 200)

Phenotype	Genotype	Observed count
Red	RR	48
Pink	Rr	104
White	rr	48

10. What is the best explanation for the pink phenotype of Rr snapdragons?
- (A) One R allele produces enough red pigment to completely mask the effect of the recessive r allele.
- (B) The r allele produces pink pigment when in the heterozygous state only.
- (C) One R allele makes about half as much red pigment as two R alleles, giving a lighter color.
- (D) The R and r alleles combine to form a new pink pigment.

Questions 11, 12 refer to the following information.

In humans, the ABO blood group has three alleles: I^A , I^B , and i (which is recessive to both). A father with genotype $I^A i$ and a mother with genotype $I^B i$ had four children.

Table 4. Observed blood types in one family

Blood type	Genotype	Observed (n = 4)
A	$I^A i$	1
B	$I^B i$	1
AB	$I^A I^B$	1
O	ii	1

11. Based on the parental genotypes given in the preamble to Table 4, what is the probability that the parents' next two children will both be type O?
- (A) 1/16
- (B) 1/8
- (C) 1/4
- (D) 1/2

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12. Which feature of the I^A and I^B alleles best explains why heterozygous $I^A I^B$ individuals have type AB blood?
- (A) I^A masks I^B completely, so $I^A I^B$ individuals express only the A antigen.
- (B) The alleles are codominant; both antigens appear on the red blood cell surface.
- (C) I^B is expressed only in males, so $I^A I^B$ males show B and $I^A I^B$ females show A.
- (D) One of the two alleles is silenced at random in each red blood cell.

Questions 13, 14 refer to the following information.

The Himalayan phenotype in rabbits is temperature-sensitive: fur on the extremities (ears, feet, nose, tail) is dark, while fur on the body (which is warmer) is white. Genetically identical Himalayan rabbits were raised at three temperatures for 8 weeks and the fur color at body and extremities was recorded.

Table 5. Fur color of Himalayan rabbits vs. temperature

Ambient temperature (°C)	Body fur	Extremity fur
10	Dark	Dark
20	White	Dark
30	White	White

13. Which claim is best supported by Table 5?
- (A) Fur color is determined only by genotype and is completely unaffected by the ambient temperature at all.
- (B) The rabbit's genotype changes at higher temperatures, producing different fur colors.
- (C) The same genotype can produce different phenotypes depending on the environment.
- (D) Extremity fur is always dark because it always has a different genotype from body fur.
14. The Himalayan phenotype is caused by a temperature-sensitive enzyme in the pigment pathway. Which best explains why the extremities are darker than the body in the 20°C rabbit?
- (A) Extremities of the rabbit have more melanocytes per unit area than the body has in this breed.
- (B) The enzyme is destroyed by cold, so extremities are darker.
- (C) Body fur receives more light, which bleaches the color.
- (D) Extremities are cooler, so the enzyme keeps its shape and produces pigment.

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15. In humans, hemophilia A is X-linked recessive. A carrier mother ($X^H X^h$) and an unaffected father ($X^H Y$) plan to have a child. What is the probability that a given child of theirs will be an affected male?
- (A) 0
(B) $1/4$
(C) $1/2$
(D) $3/4$
16. A father with red-green color blindness (X-linked recessive) and an unaffected non-carrier mother have children. Which of their children are expected to be color blind?
- (A) All of the sons.
(B) All of the daughters.
(C) None of the children.
(D) Half of the sons and half of the daughters.

Questions 17, 18 refer to the following information.

A pedigree tracks a rare disorder through three generations. Filled symbols are affected, open symbols are unaffected; squares are male, circles are female. Generation I: Man I-1 (unaffected, open square) × Woman I-2 (unaffected, open circle). Generation II: They have three children, II-1 (affected male, filled square), II-2 (unaffected female, open circle), II-3 (unaffected female, open circle). II-2 marries II-4 (unaffected male, open square, unrelated). II-3 marries II-5 (unaffected male, open square, unrelated). Generation III: II-2 × II-4 have four children, III-1 (affected male), III-2 (unaffected female), III-3 (unaffected male), III-4 (affected male). II-3 × II-5 have three children, III-5 (unaffected female), III-6 (affected male), III-7 (unaffected female). Summary counts across the whole pedigree:

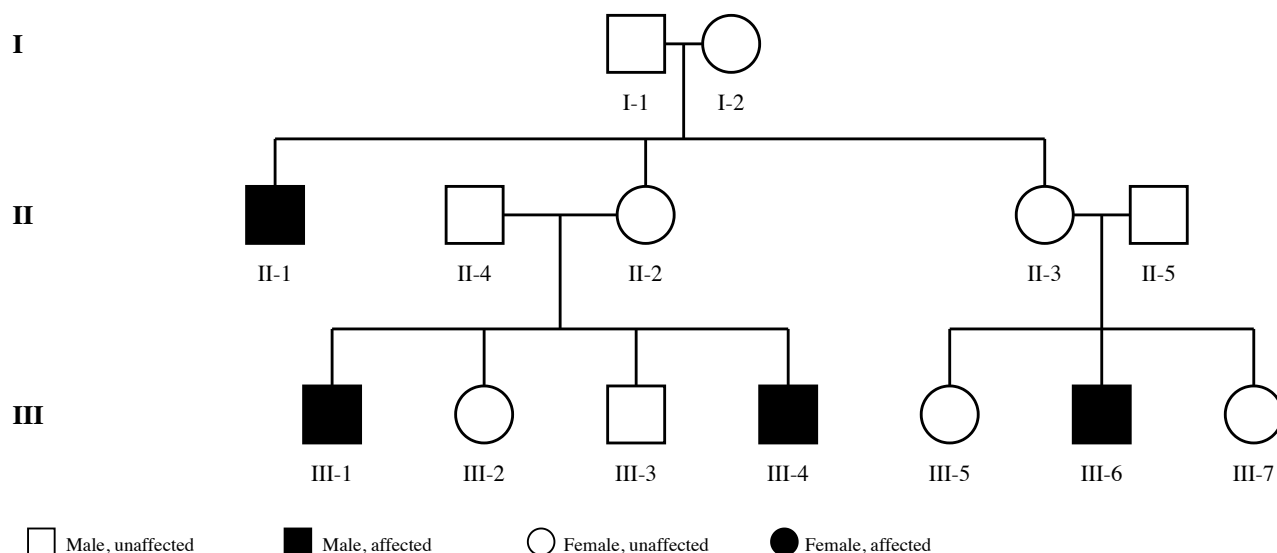


Table 6. Affected and unaffected individuals in the pedigree

Generation	Males (affected / total)	Females (affected / total)
I	0 / 1	0 / 1
II	1 / 3	0 / 2 (both are unaffected)
III	3 / 4	0 / 3

17. Which inheritance pattern is most consistent with the pedigree data summarized in Table 6?
- (A) Autosomal dominant, appearing in every generation and in males and females equally often.
(B) Autosomal recessive, requiring both parents to be carriers before affected children appear.
(C) Y-linked, transmitted only from father to son.
(D) X-linked recessive, appearing mostly in males and passing through unaffected carrier mothers.

AP BIOLOGY · Unit 5: Heredity · Section I (continued)

18. In the pedigree, II-2 is an unaffected woman whose sons III-1 and III-4 are both affected. Which claim about II-2's genotype is best supported?
- (A) She must be homozygous affected for the disease allele.
 - (B) She must be heterozygous for the disease allele, since her sons inherit it from her but she is unaffected.
 - (C) She cannot carry the disease allele, because she is not affected.
 - (D) She must have inherited a Y chromosome from her father that carries the disease allele.

Questions 19, 20 refer to the following information.

Two genes were followed in a fruit fly test cross of $AaBb \times aabb$. Instead of 25% in each class, the following counts were observed among 1,000 offspring.

Table 7. Test-cross offspring counts (n = 1,000)

Phenotype	Observed count
AB	410
ab	420
Ab	85
aB	85

19. What is the recombination frequency between genes A and B in Table 7?
- (A) 8.5%
 - (B) 17%
 - (C) 34%
 - (D) 50%
20. Which conclusion about genes A and B is best supported by Table 7?
- (A) The genes are on different chromosomes and assort independently.
 - (B) The genes are on the same chromosome and are tightly linked with no crossing over.
 - (C) The genes are linked on the same chromosome; about 17% of gametes are recombinant, so they are ~17 map units apart.
 - (D) The genes are 83 map units apart, essentially independent in behavior.

Q1. Answer: A

Topic 5.1 · Meiosis

Human somatic cells are diploid ($2n = 46$) with 23 homologous pairs. Meiosis halves this to a haploid gamete ($n = 23$) so that fertilization restores the diploid count. B is wrong because meiosis reduces chromosome number by half. C reverses the ratio. D applies only to gametes.

Q2. Answer: B

Topic 5.2 · Meiosis and Genetic Diversity

Crossing over during prophase I recombines alleles between homologous chromosomes, and independent assortment during metaphase I randomly orients each pair, producing 2^{23} combinations in humans. These two processes generate most of the diversity in the resulting gametes. A describes chromosome duplication (in S phase), which itself does not shuffle alleles. C acts at fertilization, after meiosis is complete. D happens in meiosis II and does not shuffle alleles.

Q3. Answer: A

Topic 5.3 · Mendelian Genetics

Expected counts are 100 : 100 for 200 offspring. $\chi^2 = \sum (O - E)^2 / E = (96 - 100)^2 / 100 + (104 - 100)^2 / 100 = 0.16 + 0.16 = 0.32$. Because 0.32 is well below the critical value of 3.84 at $df = 1$, the data fit the 1:1 expectation. B doubles the correct value. C is the critical value itself, not the test statistic. D is far above the critical value and would suggest strong deviation, which the counts do not show.

Q4. Answer: A

Topic 5.3 · Mendelian Genetics

Half of the offspring are Pp (purple) and half are pp (white). Because the pp parent contributes only p, the heterozygous parent must produce P and p gametes in equal proportions, which is Mendel's Law of Segregation. B is contradicted by 'P dominant.' C invents lethality with no support (both counts are near 100). D adds a second gene not shown by the data.

Q5. Answer: A

Topic 5.3 · Mendelian Genetics

A Pp × Pp cross produces PP, Pp, Pp, pp in equal probability. Because P is fully expressed over p, PP and Pp look the same (P phenotype), giving 3 P : 1 p. B is a test cross (Pp × pp). C is a dihybrid F2 ratio. D would require at least one PP parent.

Q6. Answer: B

Topic 5.3 · Mendelian Genetics

405 to 145 is a ratio of 2.79:1, close to the 3:1 (or 412.5 to 137.5) expected from a Yy × Yy monohybrid F2. This is within normal sampling error of a Mendelian 3:1. A is a test-cross ratio. C describes a made-up ratio. D reverses the expected ratio and misnames codominance.

Q7. Answer: D

Topic 5.2 · Meiosis and Genetic Diversity

The four offspring classes appear at roughly equal frequency (98, 102, 104, 96 out of 400), which is the 1:1:1:1 pattern expected when both genes segregate independently. That fits Mendel's Law of Independent Assortment for two unlinked genes. A predicts an excess of parental types with reduced recombinant classes. B (a lethal AB combination) would suppress the AB class, but AB is present at ~25%. C contradicts the stimulus, which specifies A as dominant.

Q8. Answer: D

Topic 5.2 · Meiosis and Genetic Diversity

The four phenotypic classes in the test-cross offspring directly reveal the gamete types from the dihybrid parent, because the aabb parent contributes only ab. Four roughly equal classes means AB, Ab, aB, ab gametes at roughly 25% each. A ignores independent assortment. B contradicts the two 'recombinant-looking' classes. C confuses gene number with gamete content.

Q9. Answer: C

Topic 5.2 · Meiosis and Genetic Diversity

Nondisjunction is the failure of homologous chromosomes to separate in meiosis I, or of sister chromatids to separate in meiosis II. Either error leaves one daughter cell with two copies of the chromosome and the other with none. If the disomic gamete is later fertilized by a normal gamete, the zygote has three copies (trisomy). A duplicates only a small segment, not a whole chromosome. B changes chromosome structure but not copy number. D removes DNA rather than adding a whole extra chromosome.

Q10. Answer: C

Topic 5.4 · Non-Mendelian Genetics

In incomplete dominance, the heterozygote has an intermediate phenotype because gene dosage matters: one functional copy of R makes about half as much red pigment as two copies, which the eye reads as pink. A describes complete dominance. B invents a new pigment for the r allele. D describes a fusion product that does not occur; the phenotype is quantitative.

Q11. Answer: A

Topic 5.3 · Mendelian Genetics

Each child of an $I^A i \times I^B i$ cross has a 1/4 chance of being type O (ii). Because meioses in the two conceptions are independent events, the probability of two type-O children in a row is $(1/4)(1/4) = 1/16$. B (1/8) would need one type-O child $\times$ a 1/2 chance for a second, which does not match. C (1/4) is the probability for a single type-O child, not two in a row. D (1/2) is not a probability for any single ABO outcome in this cross.

Q12. Answer: B

Topic 5.4 · Non-Mendelian Genetics

I^A and I^B are codominant: each allele codes for a functional glycosyltransferase that adds a different sugar to the H antigen. Both A and B antigens end up on the red blood cell surface in an $I^A I^B$ individual, producing the AB phenotype. A describes complete dominance. C invents sex-limited dominance. D describes X-inactivation, not ABO.

Q13. Answer: C

Topic 5.5 · Environmental Effects on Pheno...

All rabbits share the same Himalayan genotype, yet their fur color depends on ambient temperature: warm environments produce white fur everywhere, cold ones dark fur everywhere, and intermediate ones the classic Himalayan pattern. Phenotype is a joint product of genotype and environment. A contradicts the temperature dependence. B misstates the mechanism (genotype does not change). D is contradicted by the 30°C row (extremity fur white).

Q14. Answer: D

Topic 5.5 · Environmental Effects on Pheno...

The pigment-producing enzyme (tyrosinase) is only active below a threshold temperature. Extremities (ears, nose, feet) run cooler than the body core; the enzyme keeps its functional shape there and makes dark pigment. In warmer body regions the enzyme unfolds and produces no pigment. A is not supported. B reverses the effect (heat, not cold, inactivates). C invents a light bleaching effect.

Q15. Answer: B

Topic 5.4 · Non-Mendelian Genetics

The mother contributes X^H or X^h with equal probability (1/2 each); the father contributes X^H or Y with equal probability (1/2 each). To be an affected male the child needs X^h from mother AND Y from father: $(1/2)(1/2) = 1/4$. A ignores the carrier mother. C would be the fraction of sons who are affected among males only, not among all children. D is unsupported by any Punnett arithmetic.

Q16. Answer: C

Topic 5.4 · Non-Mendelian Genetics

The father passes his Y chromosome to sons (no color-blindness allele) and his X (carrying the recessive allele) to every daughter. The mother contributes only wild-type X alleles. Sons inherit their only X from the mother (normal), so none are color blind. Daughters are carriers but not affected. A misroutes the father's X. B ignores that daughters need two copies. D confuses carrier status with affected.

Q17. Answer: D

Topic 5.4 · Non-Mendelian Genetics

The pedigree shows affected males in generations II and III but no affected females, and the trait passes through unaffected mothers (II-2 and II-3, both daughters of the unaffected Gen I couple). Sons of a carrier mother have a 1/2 chance of being affected; III-1, III-4 (from II-2) and III-6 (from II-3) fit that pattern. That heavy male bias with transmission through unaffected females is the signature of X-linked recessive inheritance. Autosomal dominant (A) predicts affected in every generation with roughly equal sexes, which is not what we see. Autosomal recessive (B) would let affected females appear when both parents are carriers. Y-linked (C) requires an affected father passing the Y directly to sons, which the pedigree does not show.

Q18. Answer: B

Topic 5.4 · Non-Mendelian Genetics

Her affected sons each inherited the disease allele from her, since only she could have passed it. She herself is unaffected, so she must be heterozygous: one copy of the disease allele plus one copy of the functional allele. A would make her affected too. C ignores that a heterozygote is unaffected but still transmits. D is wrong because females never receive a Y chromosome; the Y comes from the father only, and does not carry this gene in any case.

Q19. Answer: B

Topic 5.4 · Non-Mendelian Genetics

Recombination frequency = (recombinant offspring) / (total offspring) = $(85 + 85) / 1,000 = 170 / 1,000 = 17\%$. A counts only one of the two recombinant classes ($85/1,000 = 8.5\%$). C (34%) is the fraction of meioses with a crossover between the two loci; each crossover produces only 50% recombinant gametes, so the recombinant gamete frequency is half of that. D (50%) is the value for genes that are unlinked (independent assortment); 17% shows the genes are linked but not tightly.

Q20. Answer: C

Topic 5.4 · Non-Mendelian Genetics

A recombination frequency of 17% is well below the 50% expected for independent assortment, so the genes are linked on the same chromosome. Because 17% of gametes are recombinant, one map unit corresponds to 1% recombination, so the genes are approximately 17 map units apart. A is ruled out by the parental excess (830 vs 170). B contradicts the 170 recombinants. D flips the map distance interpretation: 83 map units would be effectively unlinked and give ~50% recombination, which the data do not show.