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Meiosis

Exam — Cell Division

Challenging Pre-med style questions on meiosis, ploidy, chromatids/DNA molecules, crossing over, segregation, and independent assortment

24 items — Printable Exam

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1 **Which event occurs in meiosis I but NOT in mitosis of a diploid eukaryotic cell?**

A Separation of sister chromatids at anaphase

B Pairing (synapsis) of homologous chromosomes and crossing over in prophase I

C Replication of DNA before division

D Formation of a spindle made of microtubules

E Alignment of chromosomes at the cell equator

2 **Crossing over in meiosis typically occurs:**

A Between sister chromatids of the same chromosome during prophase I

B Between non-sister chromatids of homologous chromosomes during prophase I

C Between non-homologous chromosomes during metaphase II

D Between maternal and paternal chromosomes in G1

E Between duplicated sister chromatids during cytokinesis

3 **A diploid species has $2n = 4$. In a primary spermatocyte at metaphase I of meiosis, how many chromosomes and chromatids are present in the cell?**

A 2 chromosomes and 2 chromatids

B 2 chromosomes and 4 chromatids

C 4 chromosomes and 4 chromatids

D 4 chromosomes and 8 chromatids

E 8 chromosomes and 8 chromatids

4 **The same species ($2n = 4$) completes meiosis I. Immediately after cytokinesis at the end of meiosis I, how many chromosomes and chromatids are present in EACH daughter cell?**

A 2 chromosomes and 2 chromatids

B 2 chromosomes and 4 chromatids

C 4 chromosomes and 4 chromatids

D 4 chromosomes and 8 chromatids

E 1 chromosome and 2 chromatids

5 **A diploid species has $2n = 6$. In a secondary oocyte at metaphase II, how many chromosomes and chromatids are present in that cell?**

A 3 chromosomes and 3 chromatids

B 3 chromosomes and 6 chromatids

C 6 chromosomes and 6 chromatids

D 6 chromosomes and 12 chromatids

E 12 chromosomes and 12 chromatids

6 **At which point in meiosis is a cell first considered haploid (n), rather than diploid (2n)?**

A Immediately after DNA replication in the pre-meiotic S phase

B During prophase I when homologous chromosomes pair

C During metaphase I when homologous pairs line up at the equator

D After completion of meiosis I, when homologous chromosomes are in different nuclei

E Only after completion of meiosis II

7 Which statement best distinguishes meiosis I from meiosis II?

A Meiosis I separates sister chromatids, whereas meiosis II separates homologous chromosomes

B Meiosis I is reductional, halving the chromosome set by separating homologous chromosomes; meiosis II is equational, separating sister chromatids

C DNA replication occurs in both meiosis I and meiosis II

D Crossing over occurs mainly in meiosis II

E Meiosis II doubles the chromosome number, whereas meiosis I halves it

8 For an autosomal gene with alleles A and a in a heterozygous individual (Aa), which meiotic event most directly explains Mendel's law of segregation?

A Replication of the DNA during S phase

B Pairing of homologous chromosomes in prophase I

C Separation of homologous chromosomes carrying A and a at anaphase I

D Separation of sister chromatids at anaphase II

E Random fusion of gametes at fertilisation

9 Which event in meiosis is the physical basis of Mendel's law of independent assortment for genes located on different chromosome pairs?

A Random fusion of sperm and egg at fertilisation

B Random orientation of each pair of homologous chromosomes on the metaphase I plate

C Random positions of crossing-over events along a chromosome in prophase I

D Random segregation of sister chromatids at anaphase II

E Random occurrence of mutations during DNA replication

10 **A diploid species has $2n = 8$ (four pairs of homologous chromosomes). Ignoring crossing over, how many genetically distinct gamete types can be produced by independent assortment of maternal and paternal chromosomes?**

A 4

B 8

C 16

D 32

E 64

11 **A diploid individual has genotype AaBb, where genes A and B are on different chromosome pairs (unlinked). Assuming normal meiosis, which gamete genotypes and ratios are expected?**

A Only AB and ab, in a 1:1 ratio

B Only Ab and aB, in a 1:1 ratio

C AB, Ab, aB and ab, each with equal probability (1:1:1:1)

D AB with 1/2 probability, and ab, Ab, aB each with 1/6 probability

E A and a only, because B and b segregate in somatic cells

12 **An individual has genotype AB/ab for two genes that lie close together on the SAME chromosome (cis arrangement), and we assume NO crossing over occurs between them. Which gametes can be produced with respect to these genes, and in what ratio?**

A Only AB gametes

B Only Ab gametes

C AB and ab gametes in a 1:1 ratio

D AB, Ab, aB and ab gametes in a 1:1:1:1 ratio

E Ab and aB gametes in a 1:1 ratio

13 **Consider an individual with genotype AB/ab for two linked genes on one pair of homologous chromosomes. Suppose that in EVERY meiosis there is exactly ONE crossover between the A and B loci in each tetrad, and all chromatids are equally likely to be included in gametes. What proportion of gametes will carry recombinant haplotypes (Ab or aB)?**

A 0%

B 25%

C 50%

D 75%

E 100%

14 **Which statement correctly describes SOURCES of genetic variation in sexually reproducing organisms?**

A Crossing over occurs during fertilisation, while independent assortment occurs in mitosis

B Independent assortment and crossing over both occur during meiosis; random fertilisation then combines gametes to produce additional variation

C Independent assortment occurs only when chromosomes fail to pair in meiosis I

D Crossing over reduces genetic variation by making chromatids more similar

E Random fertilisation has no effect on genetic variation if independent assortment already occurred

15 **In a diploid organism with $2n = 10$, a germ-line cell has completed DNA replication and is at metaphase I of meiosis. How many DNA molecules (chromatids) are present in this cell?**

A 5

B 10

C 20

D 40

E 80

16 **In the same species ($2n = 10$), how many chromosomes and DNA molecules (chromatids) are present in EACH gamete immediately after meiosis II?**

A 5 chromosomes and 10 DNA molecules

B 5 chromosomes and 5 DNA molecules

C 10 chromosomes and 10 DNA molecules

D 10 chromosomes and 5 DNA molecules

E 5 chromosomes and 20 DNA molecules

17 **In a diploid organism, metaphase of mitosis shows 2n chromosomes aligned at the equator, each composed of two sister chromatids (4n chromatids total). Which stage of meiosis has the same combination of chromosome and chromatid numbers in a single cell at an alignment stage?**

A Prophase I

B Metaphase I

C Metaphase II

D Anaphase II

E Telophase II

18 **Nondisjunction of ONE pair of homologous chromosomes occurs during meiosis I, but meiosis II proceeds normally. For that chromosome pair, which combination of gametes is produced?**

A Four normal gametes

B Three normal gametes and one gamete with an extra chromosome ($n + 1$)

C Two gametes with $n + 1$ and two gametes with $n - 1$ for that chromosome

D One gamete with $n + 1$, one with $n - 1$, and two normal gametes

E Four gametes with $n + 1$

19 **Nondisjunction of ONE pair of sister chromatids occurs during meiosis II, while meiosis I is normal. For that chromosome pair, which combination of gametes is produced?**

A Four normal gametes

B Two gametes with $n + 1$ and two with $n - 1$ for that chromosome

C One gamete with $n + 1$, one with $n - 1$, and two normal gametes

D Three normal gametes and one with n − 1

E Four gametes with n + 1

20 Which statement best describes the effect of crossing over on linked genes (genes on the same chromosome)?

A Crossing over has no effect on linked genes because they always segregate together

B Crossing over tends to create new combinations of alleles on a chromosome and can reduce the strength of linkage between genes

C Crossing over only occurs between non-homologous chromosomes and therefore cannot affect linked genes

D Crossing over always guarantees that genes will assort independently, regardless of their distance apart

E Crossing over doubles the number of chromosomes in a gamete

21 During prophase I, homologous chromosomes undergo several substages. In which substage are homologous chromosomes fully synapsed and crossing over actively occurs?

A Leptotene

B Zygotene

C Pachytene

D Diplotene

E Diakinesis

22 **Which description best defines a chiasma (plural: chiasmata) seen in prophase I and metaphase I?**

A The point where sister chromatids are joined at the centromere

B The attachment site of spindle microtubules on a chromosome

C The visible region where non-sister chromatids of homologous chromosomes have exchanged segments due to crossing over

D The constriction site where cytokinesis begins

E The region of the chromosome that always remains heterochromatic

23 **In a species with $2n = 6$, a primary spermatocyte enters metaphase I with three bivalents (tetrads). After a complete meiosis (I and II), which combination correctly describes chromosome and chromatid numbers in (1) that primary spermatocyte at metaphase I, and (2) one of the four resulting sperm cells?**

A (1) 6 chromosomes, 6 chromatids; (2) 3 chromosomes, 6 chromatids

B (1) 6 chromosomes, 12 chromatids; (2) 3 chromosomes, 3 chromatids

C (1) 3 chromosomes, 6 chromatids; (2) 3 chromosomes, 3 chromatids

D (1) 6 chromosomes, 12 chromatids; (2) 6 chromosomes, 3 chromatids

E (1) 3 chromosomes, 3 chromatids; (2) 6 chromosomes, 6 chromatids

24 **Which statement about Mendel's laws and chromosome behaviour is correct?**

A The law of segregation depends on crossing over between homologous chromosomes

B The law of independent assortment applies strictly to all gene pairs, regardless of their positions

C The law of segregation reflects separation of homologous chromosomes, and the law of independent assortment applies cleanly only to genes on different chromosomes or far apart on the same chromosome

D Both laws depend entirely on random mutation events in meiosis

E The law of segregation is only valid in mitotically dividing cells

Answer Key

#	Ans	Answer Text
1	B	Pairing (synapsis) of homologous chromosomes and crossing over in propha...
2	B	Between non-sister chromatids of homologous chromosomes during prophase ...
3	D	4 chromosomes and 8 chromatids
4	B	2 chromosomes and 4 chromatids
5	B	3 chromosomes and 6 chromatids
6	D	After completion of meiosis I, when homologous chromosomes are in differ...
7	B	Meiosis I is reductional, halving the chromosome set by separating homol...
8	C	Separation of homologous chromosomes carrying A and a at anaphase I
9	B	Random orientation of each pair of homologous chromosomes on the metapha...
10	C	16
11	C	AB, Ab, aB and ab, each with equal probability (1:1:1:1)
12	C	AB and ab gametes in a 1:1 ratio
13	C	50%
14	B	Independent assortment and crossing over both occur during meiosis; rand...
15	C	20
16	B	5 chromosomes and 5 DNA molecules
17	B	Metaphase I
18	C	Two gametes with $n + 1$ and two gametes with $n - 1$ for that chromosome
19	C	One gamete with $n + 1$, one with $n - 1$, and two normal gametes
20	B	Crossing over tends to create new combinations of alleles on a chromosom...
21	C	Pachytene
22	C	The visible region where non-sister chromatids of homologous chromosomes...
23	B	(1) 6 chromosomes, 12 chromatids; (2) 3 chromosomes, 3 chromatids
24	C	The law of segregation reflects separation of homologous chromosomes, an...