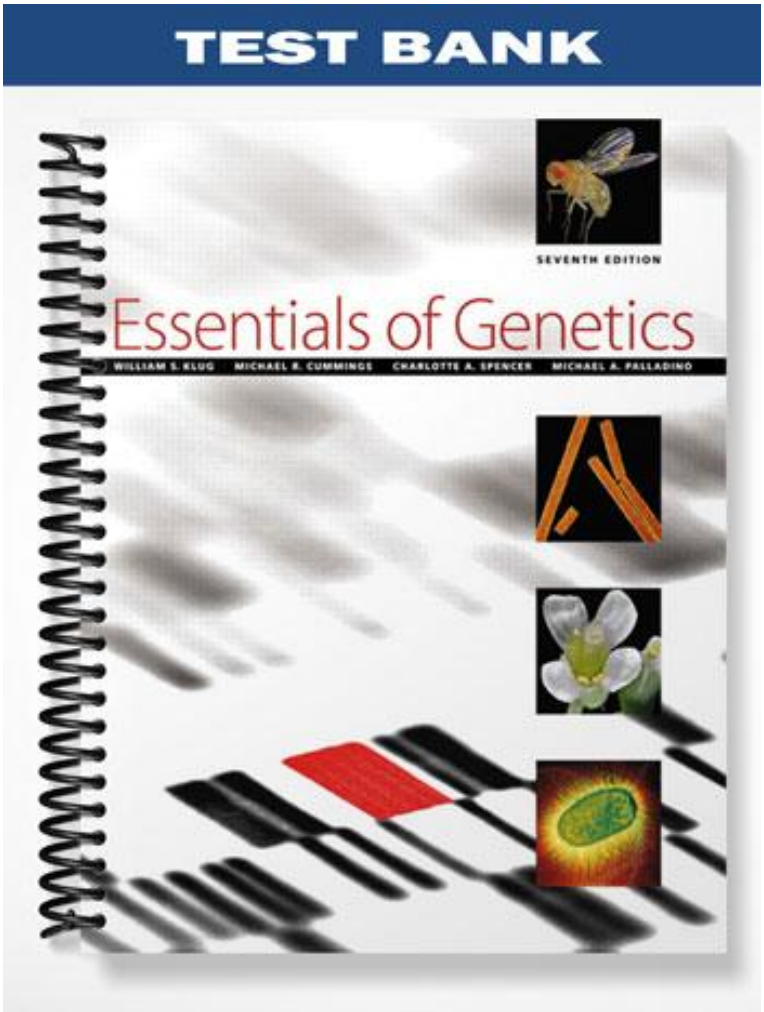
TEST BANK


SEVENTH EDITION
Essentials of Genetics
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MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) If a typical somatic cell has 64 chromosomes, how many chromosomes are expected in each gamete of that organism? 1) _____

A) 128 B) 16 C) 32 D) 8 E) 64

Answer: C

2) In an organism with 52 chromosomes, how many bivalents would be expected to form during meiosis? 2) _____

A) 52 B) 208 C) 13 D) 104 E) 26

Answer: E

3) In a healthy male, how many sperm cells would be expected to be formed from (a) 400 primary spermatocytes? (b) 400 secondary spermatocytes? 3) _____

A) (a) 800 (b) 800
B) (a) 100 (b) 800
C) (a) 1600 (b) 1600
D) (a) 1600 (b) 800
E) (a) 400 (b) 400

Answer: D

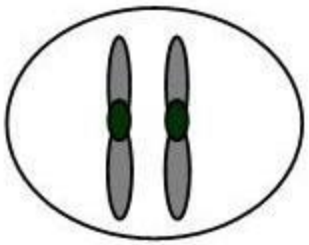
4) In a healthy female, how many secondary oocytes would be expected to form from 100 primary oocytes? How many first polar bodies would be expected from 100 primary oocytes? 4) _____

A) 200; 300 B) 50; 50 C) 100; 100 D) 100; 50 E) 200; 50

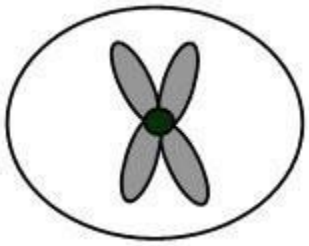
Answer: C

5) The ant *Myrmecia pilosula* is found in Australia and is named bulldog because of its aggressive behavior. It is particularly interesting because it carries all its genetic information in a single pair of chromosomes. In other words, $2n = 2$. (Males are haploid and have just one chromosome.) Which of the following figures would most likely represent a correct configuration of chromosomes in a metaphase I cell of a female? 5) _____

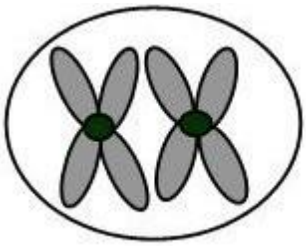
A)



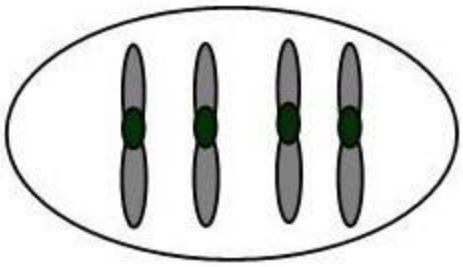
B)



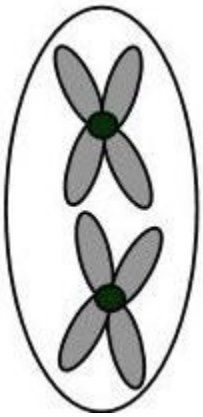
C)



D)



E)



Answer: C

6) For the purposes of this question, assume that a G1 somatic cell nucleus in a female *Myrmecia pilosula* contains 2 picograms of DNA. How much DNA would be expected in a metaphase I cell of a female? 6) _____

A) 32 picograms
B) 4 picograms
C) 8 picograms
D) 16 picograms
E) not enough information to answer this question

Answer: B

7) *Myrmecia pilosula* consists of several virtually identical, closely related species, with females having chromosome numbers of 18, 20, 32, 48, 60, 62, and 64. If one crossed a female of species (A) with 32 chromosomes and a male species (B) with 9 chromosomes (males are haploid, and each gamete contains the *n* complement), how many chromosomes would one expect in the body (somatic) cells of the female offspring? 7) _____

A) 32 B) 9 C) 25 D) 4.5 E) 41

Answer: C

8) What is the outcome of synapsis, a significant event in meiosis? 8) _____

A) monad movement to opposite poles
B) dyad formation
C) chiasma segregation

D) side-by-side alignment of homologous chromosomes
E) side-by-side alignment of nonhomologous chromosomes
Answer: D

9) During interphase of the cell cycle, 9) _____
A) RNA replicates.
B) DNA recombines.
C) the nuclear membrane disappears.
D) DNA content essentially doubles.
E) sister chromatids move to opposite poles.
Answer: D

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

10) Assume that the somatic cells of a male contain one pair of homologous chromosomes (e.g., A_aA_b), and an additional chromosome without a homolog (e.g., W). What chromosomal combinations would be expected in the meiotic products (spermatids) of a single primary spermatocyte? (There may be more than one answer.) 10) _____
Answer: A_aW, A_aW, A_b,A_b or A_a,A_a, A_bW, A_bW

11) Trisomy 21 or Down syndrome occurs when there is a normal diploid chromosomal complement of 46 chromosomes plus one (extra) chromosome #21. Such individuals therefore have 47 chromosomes. Assume that a mating occurs between a female with Down syndrome and a normal 46-chromosome male. What proportion of the offspring would be expected to have Down syndrome? Justify your answer. 11) _____
Answer: One-half of the offspring will be expected to have Down syndrome because of 2 X 1 segregation of chromosome #21 at anaphase I.

12) Normal diploid somatic (body) cells of the mosquito *Culex pipiens* contain six chromosomes. Assign the symbols A^mA^p, B^mB^p, and C^mC^p to the three homologous chromosomal pairs. The "m" superscript indicates that the homolog is maternally derived, while the "p" indicates a paternally derived homolog. Assume that in the genus *Culex,* the sex chromosomes are morphologically identical.

(a) For each of the cell types given below, draw and label (with reference to the symbols defined above) an expected chromosomal configuration.

Mitotic metaphase
Metaphase of meiosis I
Metaphase of meiosis II

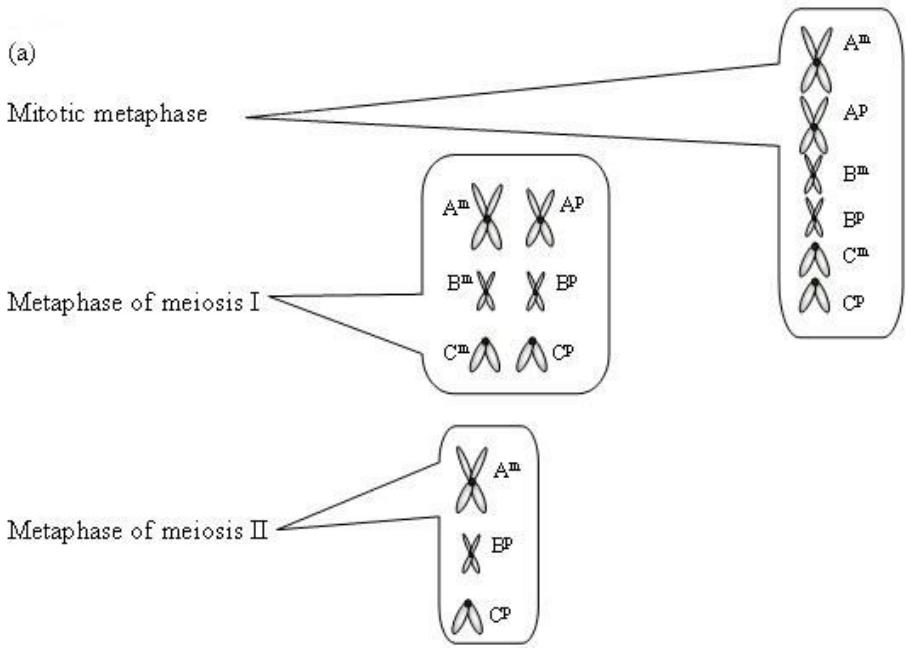
(b) The stage at which "sister chromatids go to opposite poles" immediately follows which of the above stages?

(c) Assuming that all nuclear DNA is restricted to chromosomes and that the amount of nuclear DNA essentially doubles during the S phase of interphase, how much nuclear DNA would be present in each cell listed above? *Note*: Assume that the G1 nucleus of a mosquito cell contains 3.0×10^{-12} grams of DNA.

(d) Given that the sexes of *Culex* are determined by alleles of one gene, males heterozygous, *Mm*, and females homozygous, *mm*, illustrate a labeled chromosomal configuration (involving the symbols A^mA^p, B^mB^p, and C^mC^p and the *M* locus) in a primary spermatocyte at metaphase. Assume that the *M* locus is on the A^mA^p chr the centromere. om oso me and tha t cro ssin g ove r has not occ urr ed bet we en the *M* loc us and

12) _____

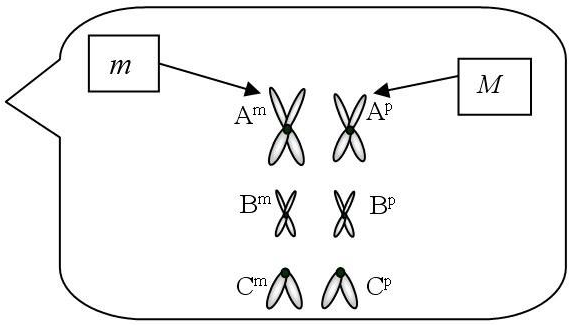
Answer:



(b) metaphase of meiosis II and mitotic metaphase

(c) 6, 6, 3

(d)



13) *Drosophila melanogaster*, the fruit fly, has a 2*n* chromosome number of 8. Assume that you are microscopically examining the mitotic and meiotic cells of this organism. You note that in the female that two chromosomal pairs are metacentric and two pairs are acrocentric.

(a) Draw the chromosomal configurations as you would expect to see them at the stages listed:

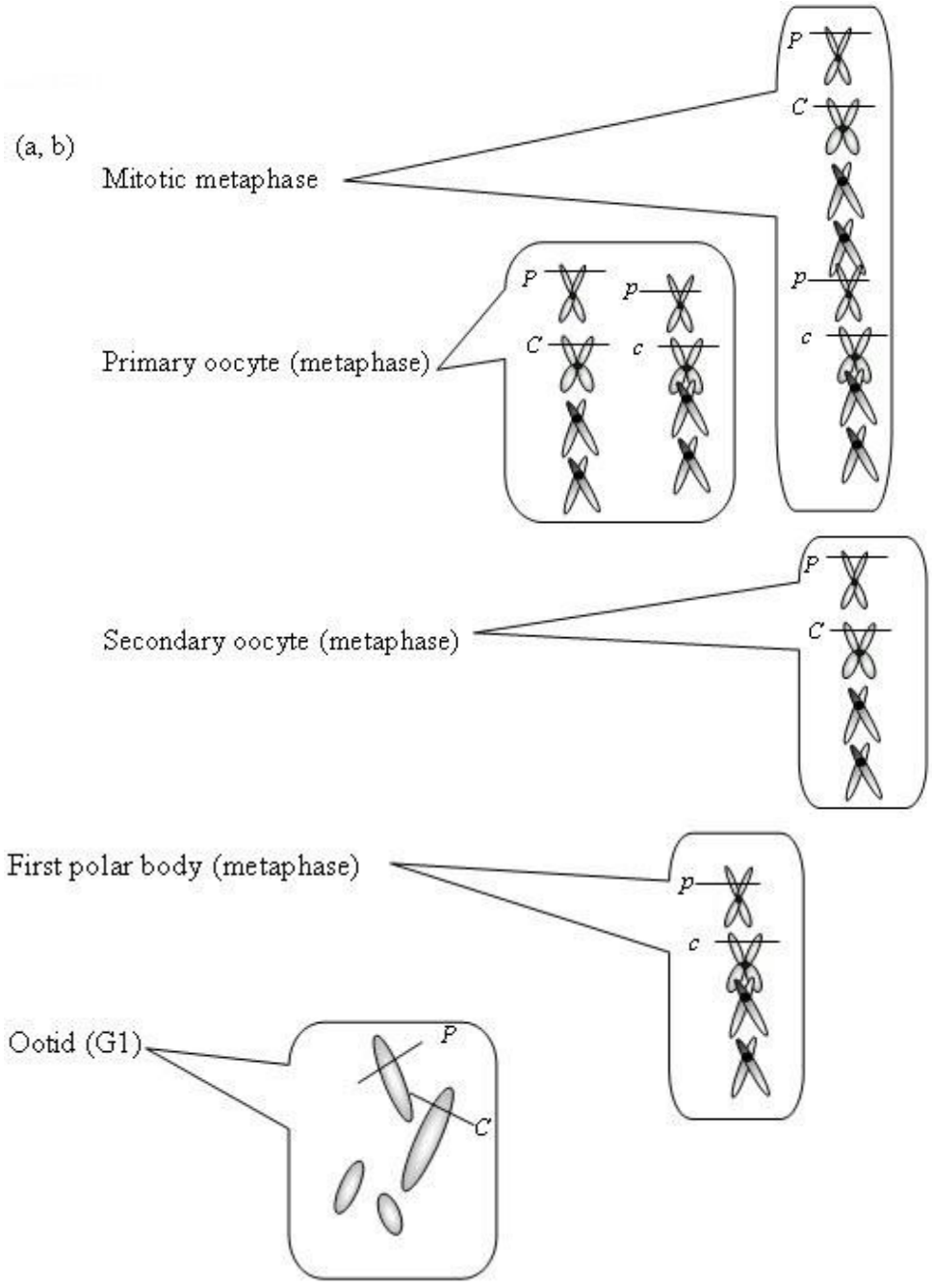
Mitotic metaphase	First polar body (metaphase)
Primary oocyte (metaphase)	Ootid (G1)
Secondary oocyte (metaphase)	

(b) Given that the above-mentioned cells are from individuals heterozygous for two independently segregating, autosomal loci, *plum eyes* and *curled wings*, place appropriate symbols (of your designation) on chromosomes in the drawings you made in part (a) above. Assume no crossing over; there may be more than one correct answer in some cases.

(c) Assuming that the individuals mentioned above contains about 8.0 picograms of DNA, how much nuclear DNA would you expect in each of the cells mentioned above?

13) _____

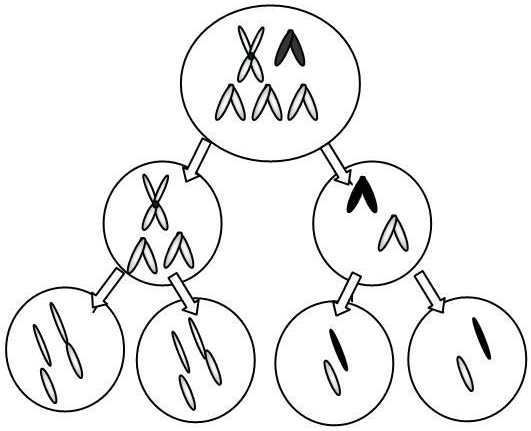
Answer:



(c) 8, 8, 4, 4, 2

14) Down syndrome, or trisomy 21, in humans is caused by an extra copy of the relatively small, acrocentric chromosome #21. Including only chromosome #21, the X chromosome (medium in size and somewhat metacentric), and the Y chromosome (small and acrocentric), draw one possible array of chromosomes in the four sperm cells produced by the complete meiosis of one primary spermatocyte. For the purposes of this question, assume that males with Down syndrome produce normal ratios of sperm cells. (More than one answer is possible.) 14) _____

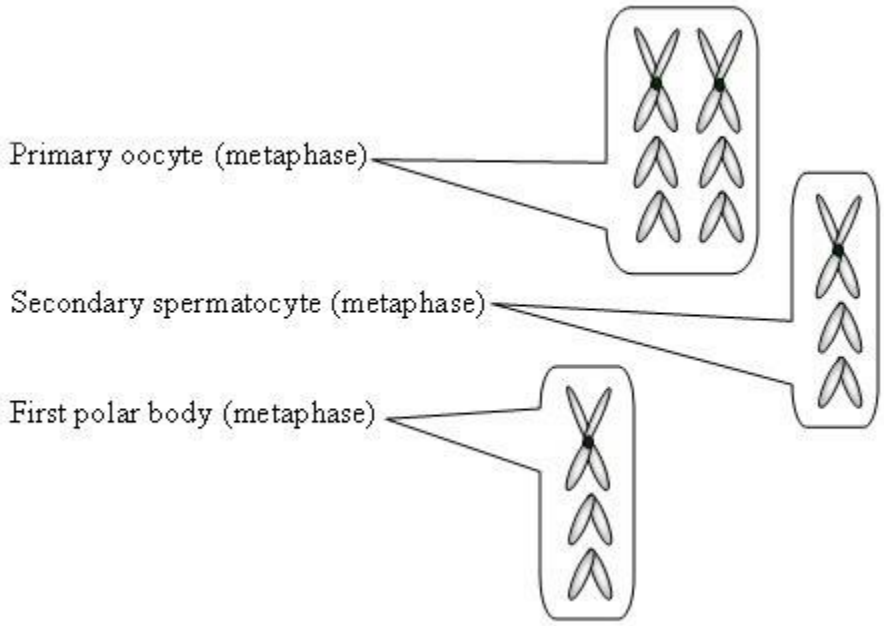
Answer:



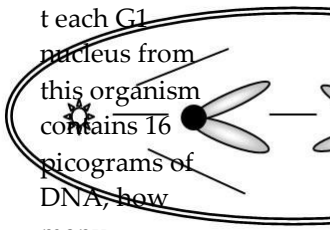
15) Assume that an organism has a diploid chromosome number of six. Two chromosomal pairs are telocentric, and the other pair is metacentric. Assume that the sex chromosomes are morphologically identical. Draw chromosomes as you would expect them to appear at the following stages: 15) _____

Primary oocyte (metaphase)
Secondary spermatocyte (metaphase)
First polar body (metaphase)

Answer:



16) The sketch below depicts a cell from an organism in which $2n = 2$ and each chromosome is metacentric.



(a) Circle the correct stage for this cell in this sketch:
Anaphase of mitosis
Anaphase of meiosis I
Anaphase of meiosis II
Telophase of mitosis

(b) Given that each G1 nucleus from this organism contains 16 picograms of DNA, how many picograms of chromosomal DNA would you expect in the cell shown

above? 16) ___
___
___
___
_

Answer: (a) Anaphase of meiosis II
(b) 16

17) There is about as much nuclear DNA in a primary spermatocyte as in _____ (how many) spermatids? 17) _____
Answer: 4

18) You may have heard through various media of an animal alleged to be the hybrid of a rabbit and a cat. Given that the cat (*Felis domesticus*) has a diploid chromosome number of 38 and a rabbit (*Oryctolagus cuniculus*) has a diploid chromosome number of 44, what would be the expected chromosome number in the somatic tissues of this alleged hybrid? 18) _____
Answer: 41

19) The horse (*Equus caballus*) has 32 pairs of chromosomes, whereas the donkey (*Equus asinus*) has 31 pairs of chromosomes. How many chromosomes would be expected in the somatic tissue of a mule? 19) _____
Answer: 63

20) Name two evolutionarily significant benefits of meiosis that are not present in mitosis. 20) _____
Answer: reshuffling of homologous chromosomes and crossing over

21) How many haploid sets of chromosomes are present in a diploid individual cell with a chromosome number of 46? 32? 21) _____
Answer: 2; 2

22) How many haploid sets of chromosomes are present in an individual cell that is tetraploid (4*n*)? 22) _____
Answer: 4

23) The nucleolus organizer (NOR) is responsible for production of what type of cell structure? 23) _____
Answer: ribosome

24) In the mitotic cell cycle, what is meant by the S phase? 24) _____
Answer: The S phase is the period in which chromosomal DNA is replicated.

25) What is meant by the term *chiasma*? 25) _____
Answer: area where chromatids intertwine during meiosis

26) List four terms used to describe the normal morphologies, with respect to arm ratio, of eukaryotic chromosomes. 26) _____
Answer: metacentric, submetacentric, acrocentric, telocentric

27) Name two cellular organelles, each having genetic material, which are involved in either photosynthesis or respiration. 27) _____
Answer: chloroplasts and mitochondria

28) Homologous chromosomes are those that can be matched by virtue of their similar structure and function within a nucleus. What chromosomes making up a genome do not follow the same characteristics of homology? 28) _____
Answer: sex-determining chromosomes

29) After what meiotic stage (meiosis I or II) would one expect monads to be formed? 29) _____
Answer: meiosis II

30) List, in order of appearance, all the cell types expected to be formed during (a) spermatogenesis and (b) oogenesis. 30) _____
Answer: (a) spermatogonia, primary spermatocyte, secondary spermatocyte, spermatid, spermatozoa
(b) oogonium, primary oocyte, secondary oocyte and first polar body, ootid and second polar body

31) List in order of occurrence the phases of (a) mitosis and (b) prophase I of meiosis. 31) _____
Answer: (a) prophase, prometaphase, metaphase, anaphase, telophase
(b) leptonema, zygonema, pachynema, diplonema, diakinesis

32) Two terms, *reductional* and *equational*, generally refer to which stages of meiosis (I or II)? 32) _____
Answer: meiosis I and meiosis II, respectively

33) In which stage of the cell cycle is G0 located? 33) _____
Answer: G1

34) When cells withdraw from the continuous cell cycle and enter a "quiescent" phase, they are said to be in what stage? 34) _____
Answer: G0

35) The house fly, *Musca domestica*, has a haploid chromosome number of 6. How many chromatids should be present in a diploid, somatic, metaphase cell? 35) _____
Answer: 24

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

36) A chromosome may contain one or two chromatids in different phases of the mitotic or meiotic cell cycle. 36) _____
Answer: True False

37) If a typical G1 nucleus contains 2C (two complements) of DNA, a gamete that is haploid (*n*) contains 1C DNA. 37) _____
Answer: True False

38) If a typical G1 nucleus is 2*n* and contains 2C (two complements) of DNA, a prophase I cell is 2*n* and contains 4C DNA. 38) _____
Answer: True False

39) During meiosis, chromosome number reduction takes place in anaphase II. 39) _____
Answer: True False

40) S phase is the part of interphase when DNA duplication takes place. 40) _____
Answer: True False

41) The centromere of a chromosome separates during anaphase. 41) _____
Answer: True False

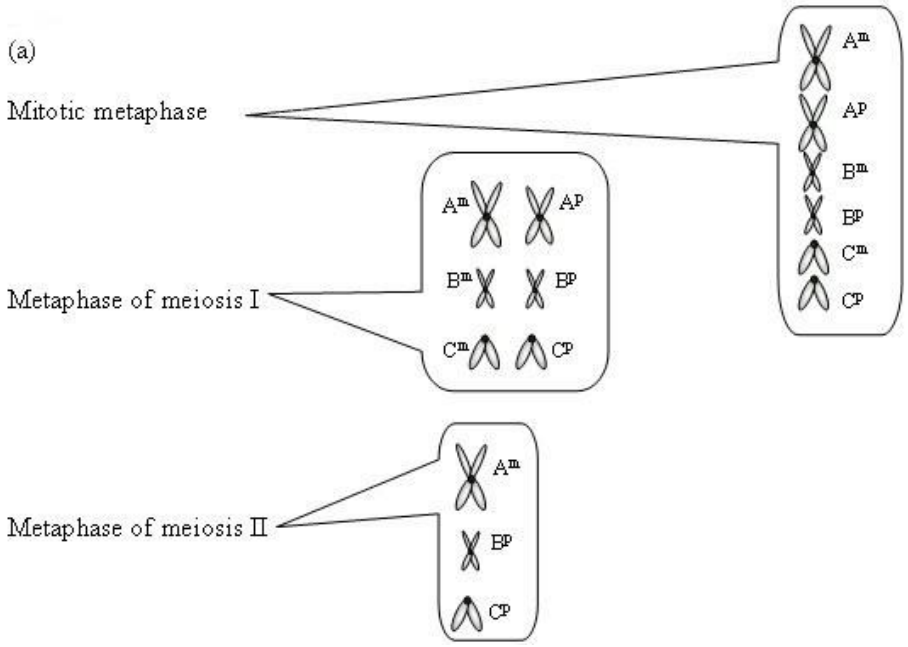
42) A bivalent at pachytene contains four chromatids. 42) _____
Answer: True False

43) The meiotic cell cycle involves two cell divisions but only one DNA replication. 43) _____
Answer: True False

44) An organism with a haploid number of 10 will produce 1024 combinations of chromosomes at the end of meiosis. 44) _____
Answer: True False

45) An organism with a diploid chromosome number of 46 will produce 2^{23} combinations of chromosomes at the end of meiosis. 45) _____
Answer: True False

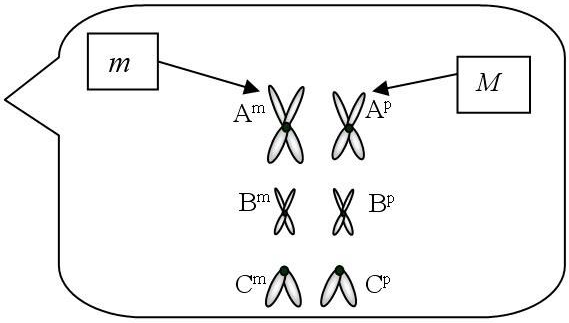
1) C
2) E
3) D
4) C
5) C
6) B
7) C
8) D
9) D
10) A_aW, A_aW, A_b,A_b or A_a,A_a, A_bW, A_bW
11) One-half of the offspring will be expected to have Down syndrome because of 2 X 1 segregation of chromosome #21 at anaphase I.
12)



(b) metaphase of meiosis II and mitotic metaphase

(c) 6, 6, 3

(d)



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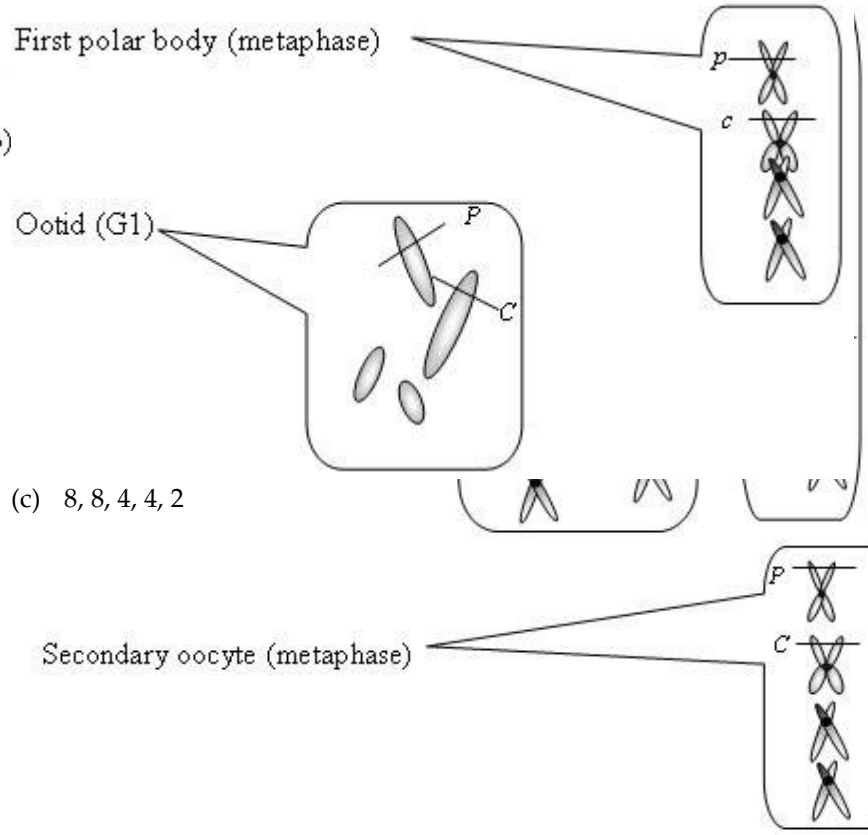
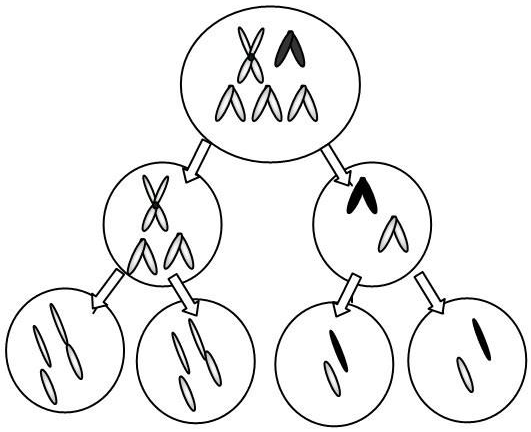


(a, b)

(c) 8, 8, 4, 4, 2

14)



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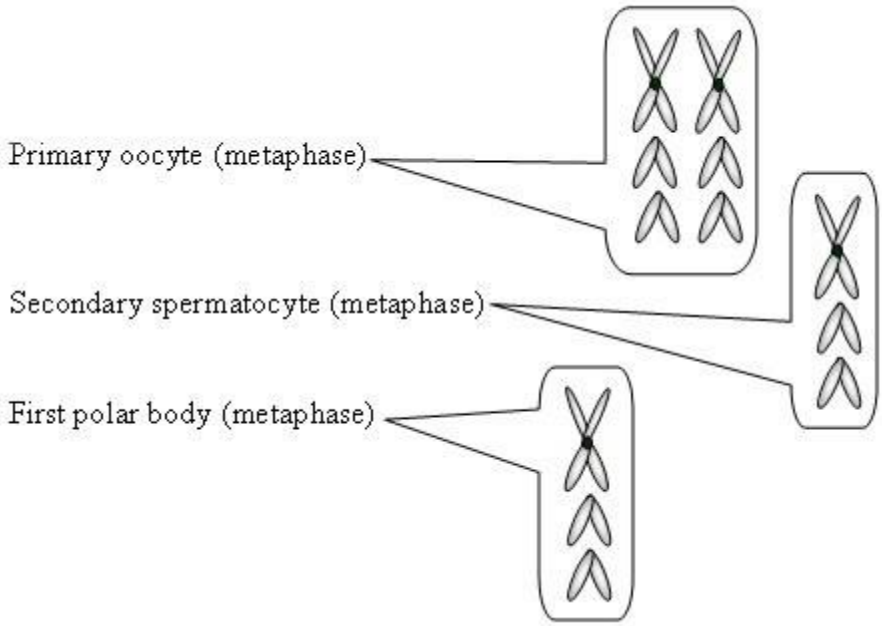

16) (a) Anaphase of meiosis II
(b) 16
17) 4
18) 41
19) 63
20) reshuffling of homologous chromosomes and crossing over
21) 2; 2
22) 4
23) ribosome
24) The S phase is the period in which chromosomal DNA is replicated.
25) area where chromatids intertwine during meiosis
26) metacentric, submetacentric, acrocentric, telocentric
27) chloroplasts and mitochondria
28) sex-determining chromosomes
29) meiosis II
30) (a) spermatogonia, primary spermatocyte, secondary spermatocyte, spermatid, spermatozoa
(b) oogonium, primary oocyte, secondary oocyte and first polar body, ootid and second polar body
31) (a) prophase, prometaphase, metaphase, anaphase, telophase
(b) leptonema, zygonema, pachynema, diplonema, diakinesis
32) meiosis I and meiosis II, respectively
33) G1
34) G0
35) 24
36) TRUE
37) TRUE
38) TRUE
39) FALSE
40) TRUE
41) TRUE
42) TRUE
43) TRUE
44) TRUE
45) TRUE