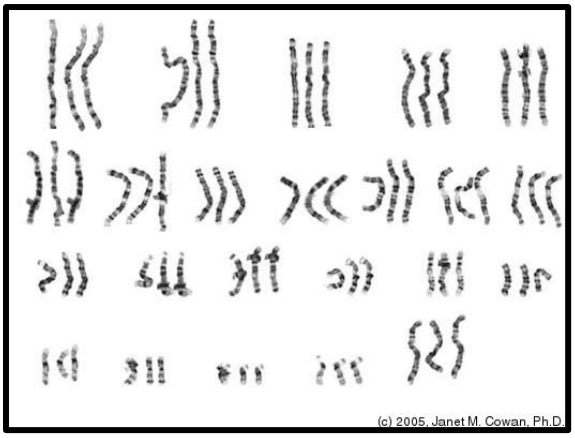
This collection of questions provides examples of questions from previous term tests for practice and feedback. It is not intended to reflect the expected length, difficulty or distribution of questions for the upcoming test. This is NOT therefore, a "sample exam".

1. The very unusual human karyotype at right was prepared from cells in mitotic metaphase from a baby that, sadly, only survived a few minutes after birth.

   Assuming that chromosomes have normal structure for metaphase, what is the coefficient of C for this cell?



A. 12
B. 6
C. 3
D. 2

---

2. Although all members of a given species carry the "same" genome, their actual individual sequences may differ significantly at localized areas. One such difference, copy number variation (CNV), results in different individuals carrying different numbers of copies of a given sequence.

   Which of the following mechanisms is most likely to result in formation of CNV?

A. Proofreading by DNA polymerase.
B. Ligation of Okazaki fragments.
C. Recombination during meiosis.
D. Excision repair of thymine dimers.

---

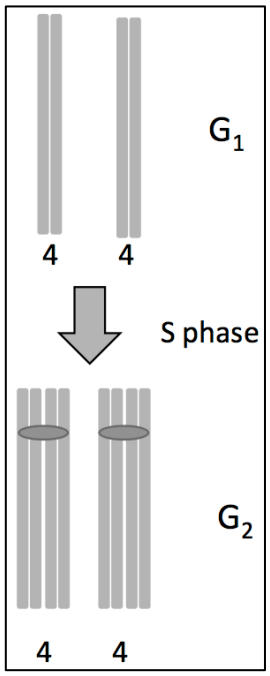
3. Recall that, during DNA replication, RNA primers are removed and replaced with DNA through the action of DNA Polymerase I.
   Consider an RNA primer with the sequence 5' AUGCCAUC 3'.

   Which of the following sequences of DNA would replace this RNA primer?

A. 5' ATGCCATC 3'
B. 5' CTACCGTA 3'
C. 5' TACGGTAG 3'
D. 5' GCTGGCAT 3'

---

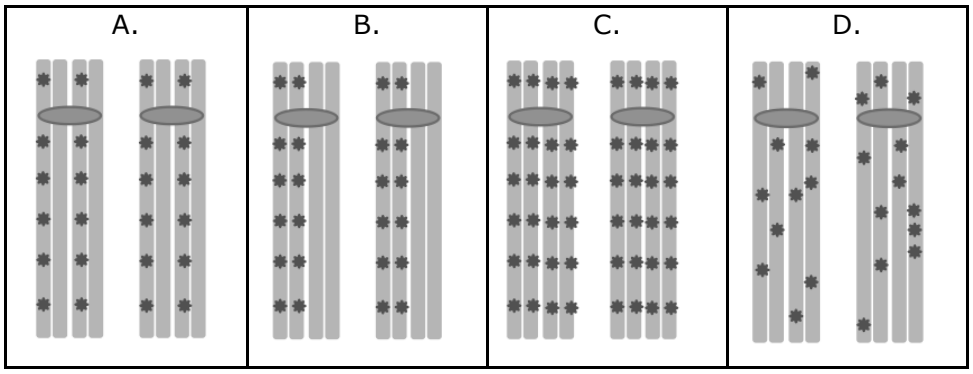
4. The figure at right is a cartoon illustration of the replication of one pair of homologous chromosomes (4) during S-phase in a chicken cell.



Look carefully to notice that each vertical line represents *one backbone* of a double helix.

Aminopurine is a base analogue that is incorporated into elongating DNA strands (instead of Adenine) by DNA polymerases. Imagine that our chicken cell is fed aminopurine during S-phase.

Which of the following illustrations most accurately represents the expected distribution of aminopurine (*) in replicated chromosomes following S-phase?



---

5. Picture a young man who gets a lungful of engine exhaust by walking past an idling bus. Mutagenic chemicals in the exhaust travel through his bloodstream to a kidney cell where they result in a mutation that eventually induces the cell to become cancerous. Its many descendant daughter cells create a localized tumor.

   If this young man conceives a child with a woman who does not have cancer, which of the following statements about the inheritance of the mutation is most likely to be true?

A. The child will inherit the mutation.
B. The child will not inherit the mutation.
C. The child might inherit the mutation, depending on which of the father's chromosomes is inherited.
D. The child might inherit the mutation; but only if it is dominant.

---

6. Imagine that a malfunctioning tanning bed accidentally exposes actively cycling cells in your body to excessive UV irradiation.

   Which of the following consequences is most likely?

A. Mutations will result from repair of double-strand breaks in chromosomes.
B. Photolyase will go to work repairing thymine dimers.
C. Affected cells will arrest at the G1/S cell cycle checkpoint.
D. Mobile elements will insert at new locations in the genome.

---

7. Which of the following descriptions of the action of kinetochore motor proteins is correct?

A. Motor proteins pull the centromere along the chromosome.
B. Motor proteins pull the tubulin away from spindle fibers.
C. Motor proteins pull the chromatid along the spindle fiber.
D. Motor proteins pull the spindle poles away from each other.

---

8. Would blocking DNA polymerase III interfere with the mechanism of adding double-stranded telomere repeats to the ends of chromosomes? Why (not)?

A. Yes, DNA Pol III fills in missing DNA by extending the new 3'OH created by telomerase.
B. Yes, DNA Pol III adds new DNA once telomerase extends the template strand.
C. No, telomerase is a kind of DNA polymerase so no others are needed.
D. No, only DNA Pol I is needed (to remove the last RNA primer).

---

9. Teenage Mutant Ninja Turtles gained their superhero powers after exposure to mutagenic chemicals. Lets assume that one of those chemicals was "ninjine" a tautomerically unstable analogue of cytosine.

   If the template DNA sequences below were replicated in the presence of ninjine, which one of them would be most likely to give rise to a mutation (following subsequent rounds of replication)?

A. GCGGCCGGGCCGCGCG
B. ATGGTTGCCTTAGCCGT
C. GAGAGGAAGAGGAGAG
D. CTTTCCTTCTCTCTTCCT

---

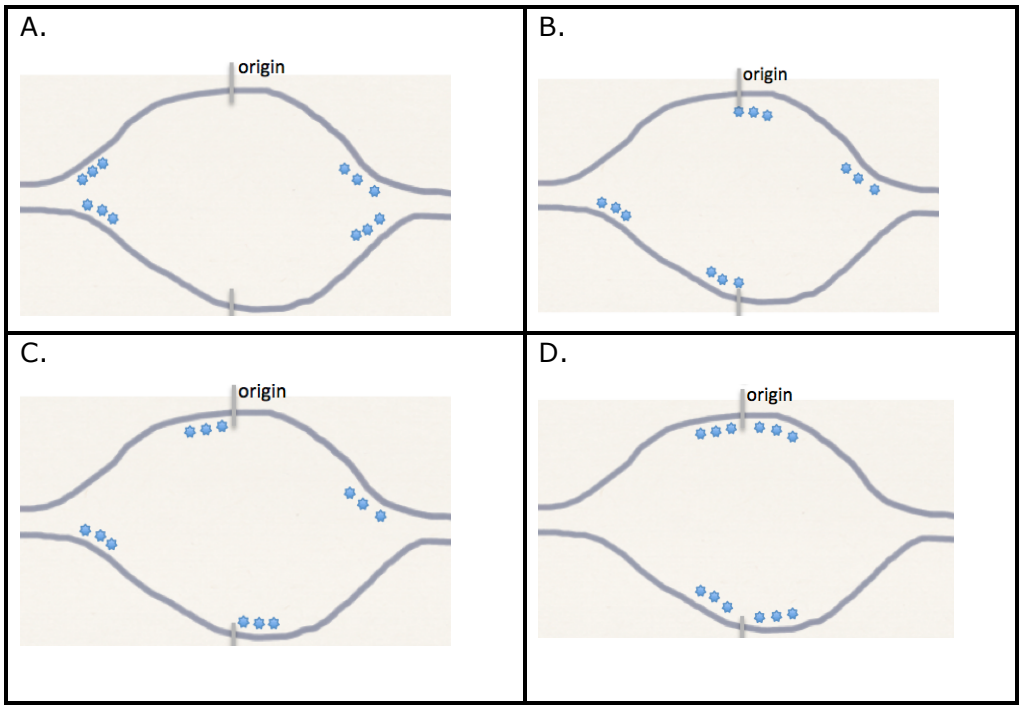
10. Which of the following mechanisms of DNA repair does not involve creating new covalent sugar-phosphate bonds in the backbone of DNA in order to restore proper base pairing?

A. Non-homologous end joining repair (NHEJ) of double-strand breaks.
B. Excision repair of mismatched bases.
C. Proof-reading of mismatched bases.
D. Photolyase repair of thymine dimers.

---

11. Imagine for the moment that it is possible to attach a fluorescent "tag" to RNA bases such that RNA primers appear to "light up" in a replication bubble while the DNA bases remain dark and invisible.

    If the grey line is the "old DNA" and the stars are tagged RNA, which of the following sketches of a replication bubble has lighted up the location of RNA primers correctly?



---

12. Recall that the white-eye allele of *Drosophila* is sex-linked and recessive. Also recall that departure from the usual chromosome segregation during meiosis can give rise to zygotes that are XXY. (In flies, these zygotes will develop as females.)

    If a white-eyed female mated with a red-eyed male and had a red-eyed female progeny that was XXY, where did the unusual chromosome segregation occur?

A. Meiosis I in the white-eyed mother.
B. Meiosis I in the red-eyed father.
C. Meiosis II in the white-eyed mother.
D. Meiosis II in the red-eyed father.

---

13. The "I'm not dead yet (INDY)" gene is on chromosome 3 in fruit flies (mutations in this gene extend lifespan).

    If there are four different alleles of the INDY gene in a given population of flies, what is the maximum number of different gametes an individual fly could produce?

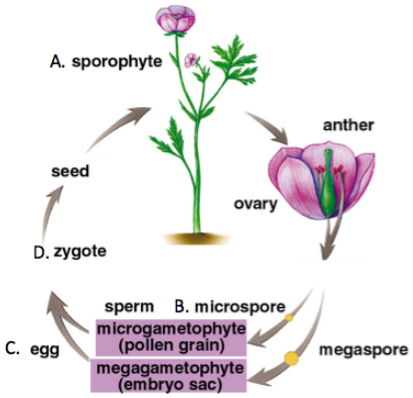
A. 8
B. 4
C. 2
D. 1

---

14. Although the figure at right is not identical to the one used in class, it shows the life cycle of typical flowering plants.

    Note that the figure distinguishes the male and female spores as microspores and megaspores, respectively.

    Which of the labels (A,B,C,D) identifies the stage that undergoes recombination of DNA on homologous chromosomes?



---

15. A newly discovered snail in Taiwan has been named *Aegista diversifamilia* in honor of human same-sex families. (I am not making this up.) *A. diversifamilia* is hermaphroditic. That is, individual snails have both male and female reproductive physiology and make both male and female gametes.

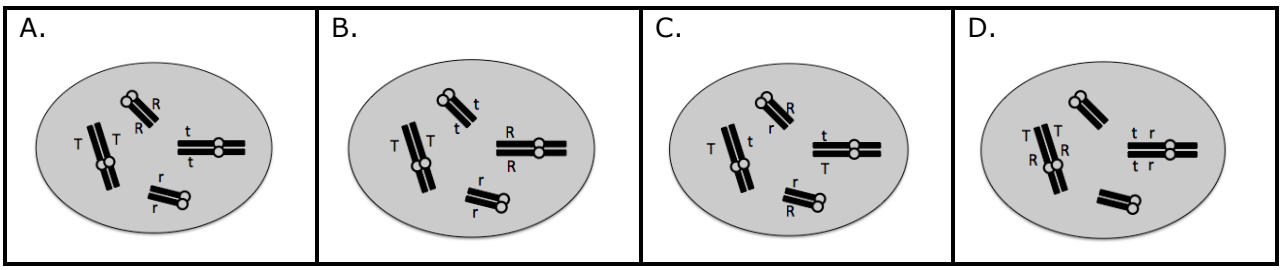
    If a given snail, heterozygous for two independently assorting genes (AaBb) fertilized itself, what fraction of the resulting zygotes would be AaBb like their parent?

A. 1/4
B. 1/3
C. 1/8
D. 1/2

---

16. Mendel crossed homozygous tall plants having smooth seeds (TTRR) with homozygous short plants having wrinkled seeds (ttrr) to create F1 hybrids (TtRr). Crossing these hybrids together revealed that the alleles of these two genes show independent assortment.

    If we pretend that chromosomes remain condensed throughout the cell cycle, which of the following diagrams best illustrates the location of alleles in the TtRr hybrid in G2 of the cell cycle?



---

17. Consider an organism with the following genotype: AaBBCcDDEeFFggHh.

    How many different gametes can be made?

A. 16
B. 8
C. 6
D. 4
E. 2

---

18. Imagine a wild population of goats in which the frequency of a dominant "spotted" allele (T) is 0.1 and the alternative recessive "spotless" allele (L) is 0.9.

    If all genotypes survive and reproduce equally well for many generations, what is the predicted frequency of these two alleles in the future?

A. T = 0.5; L = 0.5
B. T = 0.75; L = 0.25
C. T = 0.1; L = 0.9
D. T = 0.1; L = 0

---

19. What is a melanosome?

A. A melanosome is a cell that produces the melanin that pigments hair and skin.
B. A melanosome is a section of a chromosome that contains the gene coding for melanin production.
C. A melanosome is a protein complex that regulates cyclic AMP levels inside cells in response to hormones.
D. A melanosome is an organelle (containing melanin) that is passed from one cell to another.

---

20. Recall from the SimuText module called "*Mendelian Pigs*" that the fully functional Melanocortin 1 Receptor (MC1R) gene product is "switched off" by protein hormones. This signals a biochemical cascade that stimulates a decrease in intracellular cyclic AMP. In the absence of this stimulation, cAMP levels rise. High levels of cAMP are associated with production of black eumelanin while low levels of cAMP are associated with red phaeomelanin.

    The function of gene products from three MC1R alleles are summarized as follows:

Allele	*Function of gene product*
W	"on" unless switched "off" by binding with protein hormones
B	"always on"; insensitive to protein hormones
R	"always off"; insensitive to protein hormones

    Which of the following predictions is correct?

    1. **RR** homozgotes would be white.
    2. **BR** heterozygotes would be brown.
    3. **WW** homozyotes would have patches of red and black skin.
    4. The **W** allele would be dominant to the **R** allele but recessive to the **B** allele.

A. 1, 2 and 3
B. 1 and 3
C. 2 and 4
D. 4 only
E. All of 1, 2, 3 and 4 are correct.
