**Note that these questions DO NOT represent a "practice test". They are simply those questions from last year's term test that are relevant for this year. Answers are in italics.**

1. Picture a cell in its final round of the cell cycle before entering meiosis. Which of the following would be **more plentiful at the end** of S phase relative to the beginning?

A. new combinations of alleles.
B. homologous pairs.
***C. chromatids.***
D. replication "bubbles".

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2. The lecture on mitosis used some striking, multicoloured, images created by a microscopy technique called "immunofluorescence". This technique uses a specially fluorescent antibody that binds onto specific proteins in a cell.

   Which protein must an antibody bind to in order to identify the mitotic spindle?

A. keratin
***B. tubulin***
C. actin
D. chromatin

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3. Despite appearing regularly as "X" shapes in biology textbooks, chromosomes only take on such morphology when they are highly condensed.

   During which phase of the mitotic cell cycle would you most likely observe "X" shaped chromosomes?

A. G2 of interphase
B. prophase
***C. metaphase***
D. anaphase

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4.What role do kinetochores play in the "inheritance of sameness"?

***A. They provide a site of attachment for microtubules to separate chromatids properly.***
B. They ensure that mistakes made during DNA replication are repaired.
C. They prevent cycling of $G_2$ cells into mitosis until all chromosomes are replicated.
D. They provide multiple locations for replication to begin on very long chromosomes.

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5. The common goldfish has 50 pairs of homologous chromosomes. How many chromatids would there be in a cell at metaphase of meiosis II?

A. 200
***B. 100***
C. 50
D. 25

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6. The goldenrod gall was dissected in class to reveal a white insect larva. What biological principle was this demonstration illustrating?

A. Plants have stem cells.
***B. Plant cells can be stimulated to re-enter the cell cycle from $G_0$.***
C. Plant cells and insect cells have the same cell cycle checkpoints.
D. When infected by insect larvae, plant cells can shorten their S phase and replicate DNA quickly.

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7. If a given haplotype is found at a specific locus on a particular chromosome, then what would you expect to find at this same locus on the corresponding homologous chromosome?

A. Nothing. Organisms have only one copy of each haplotype.
***B. The same genes in the same order, but perhaps a different allele for each.***
C. The same alleles, but in a different combination.
D. A different collection of genes coding for the same traits.

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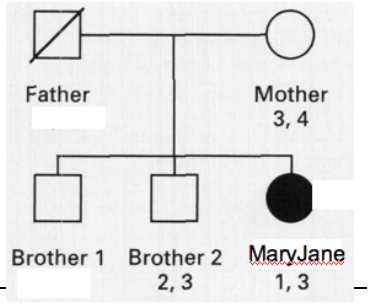
8. For the pedigree of MaryJane's family given at right, what is the likelihood that "Brother 1" has the HLA genotype 1,3?




***A. 1/4***
B. 2/4
C. 2/3
D. 3/4
E. Can't tell without knowing genotype of deceased father.

---

9. Recall that histocompatability data revealed MaryJane to be composed of two separate cell lines originally derived from two separate fertilizations. She was therefore a tetragametic chimera. She had given birth to at least one child derived from each of the two cell lines.

If you could observe MaryJane's cells going through meiosis to make gametes, what would you see?

A. Twice as many chromosomes pairing in meiosis I.
B. Twice as many gametes produced; twice as many eggs released each month.
C. Twice as many alleles in each gamete.
***D. Nothing unusual.***

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10. This picture of a "humanzee" is a fake image making fun of the possibility of creating a human/chimp hybrid.

How would a human/chimp hybrid be **different** from a human/chimp chimera?

***A. Only the hybrid would have human and chimp chromosomes in the same cell.***
B. Only the chimera would show a smooth blend of human and chimp characteristics such as skin colour.
C. Only the hybrid could make functional gametes.
D. Only the chimera would be diploid.
E. Only the hybrid would resemble Greg Thorn.

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11. If a mutant strain of bacteria is auxotrophic, what is it **unable** to do?

A. Change one allele to another by mutation.
B. Recombine with other mutant strains.
C. Resist infection by bacterial viruses.
***D. Manufacture certain amino acids.***

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12. Transformation is one of the mechanisms by which DNA from a bacterial donor comes into close proximity with that of a recipient.

How does the donor DNA get into the recipient cell?

***A. It is taken up directly from the environment.***
B. It is carried by a transposon.
C. It is pulled through cell-to-cell contact by an F factor.
D. It is transported inside the head of a virus.

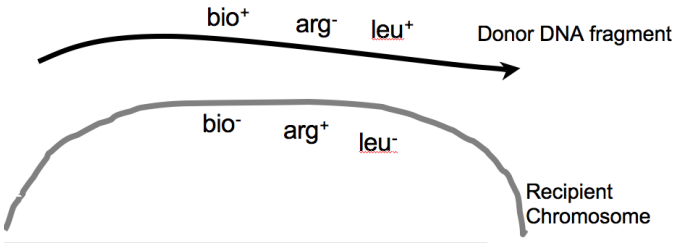
---

13. Which of the following is **not** a feature of bacterial genetic exchange mediated by the F factor?

A. Cell to cell contact.
B. Integration into bacterial chromosome.
C. Transfer of donor chromosomal alleles into recipient cell.
***D. Death of the donor cell.***

---

14. Given the donor and recipient genotypes at right, how many recombination events would be necessary to create a **bio$^+$ arg$^+$ leu$^+$** recipient?




A. 1
B. 2
***C. 4***
D. 6
E. 8

---

15. During conjugation, the circular chromosome of a bacterial donor is replicated by a "rolling circle" mechanism that is different than the usual DNA replication "bubble" that occurs during binary fission.

How is the synthesis of chromosomal DNA during conjugation different than synthesis of chromosomal DNA during binary fission?

***A. During conjugation, the "origin" of replication is on the F factor; during binary fission, the "origin" of replication is on the bacterial chromosome.***
B. During conjugation, only one strand, the one in the recipient, is replicated; during binary fission both strands are replicated at both ends of the bubble.
C. During conjugation, no RNA primers are needed; during binary fission a primer is needed for each Okazaki fragment.
D. During conjugation, the two replication forks are in different cells; during binary fission the two forks are in the same cell.

16. In the life cycle of a typical flowering plant, which stage is both multicellular and diploid?

A. gamete
B. gametophyte
C. spore
***D. sporophyte***
E. Both C and D are correct.

---

17. Sometimes meiosis II is said to be "just like mitosis". Which of the following characteristics is common to both meiosis II and mitosis?

A. Separation of identical chromatids into separate cells.
***B. Chromosome number is the same before and after cell division.***
C. No immediately preceding S phase.
D. Separation of homologues into different daughter cells.

---

18. The synaptonemal complex is a protein structure that forms between homologous chromosomes as they pair for recombination during meiosis. At which particular stage of meiosis would you expect to see this complex?

A. S Phase
***B. Prophase I***
C. Metaphase I
D. Metaphase II

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19. Consider an organism with the following genotype **AABbCc** (homozygous for one gene, heterozygous for two genes). If all three genes are on different chromosomes, how many different combinations of alleles will be created by independent assortment?

A. 2
B. 3
***C. 4***
D. 6
E. 8

---

20. Although recombination events can occur at any spot along paired homologues, sequences closer to the end of chromatids are more likely to recombine than those nearer the centromeres.

What would be the effect of this difference in recombination frequency along the length of chromatids?

A. There would tend to be more telomere repeats nearer the ends of chromatids.
B. Genes would be further apart nearer the ends of chromatids.
***C. Map distances (centimorgans) between genes would be longer nearer the ends of chromatids.***
D. Genes nearer the ends of chromatids would suffer more mutation.

---

21. Imagine that, in a terrible case of bad luck, both copies of chromosome 4 inherited by your father carried serious mutations (affecting different genes.). However, in a case of tremendous good luck, genetic recombination created a "repaired" chromosome 4, having neither of the original mutations. You now carry this repaired, mutation-free, chromosome 4.

When did the recombination take place to create the repaired chromosome?

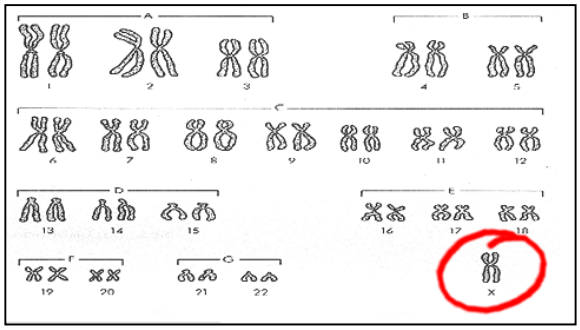
A. When your father was a newly fertilized zygote.
B. When you were a newly fertilized zygote.
C. When you made gametes by meiosis.
***D. When your father made gametes by meiosis.***

---

22. This karyotype is for a woman with Turner's Syndrome. Notice the one X chromosome rather than the usual two. Assume that this person arose from fusion of a normal gamete with an aneuploid gamete that was missing the X chromosome. This aneuploid gamete must have resulted from a failure to partition chromosomes properly at some point during meiosis in the woman's parents.

When might this failure in chromosome partitioning have occurred that resulted in the aneuploid gamete lacking the X chromosome?

1. meiosis I in this woman's mother.
2. meiosis I in this woman's father.
3. meiosis II in this woman's mother.
4. meiosis II in this woman's father.

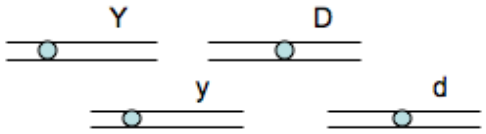


A. 1, 2 and 3
B. 1 and 3
C. 2 and 4
D. 4 only
***E. 1, 2, 3 and 4 are correct***

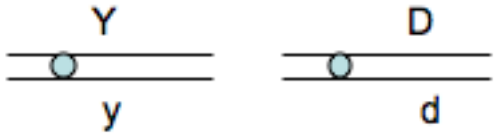
---

23. Which of the following images depicts the chromosomes in a $G_2$ cell from a diploid organism with 4 chromosomes and a genotype of **YyDd**?
Note that each line represents one double helix of DNA; each circle is a centromere.

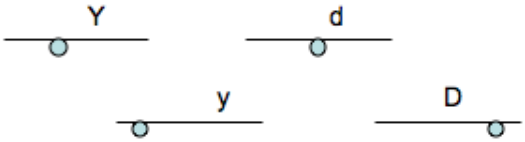
***A.***



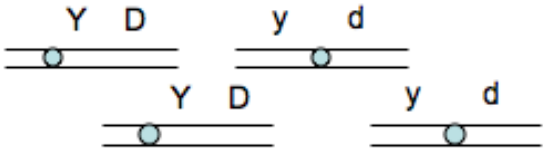

B.




C.




D.

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24. Consider an organism with the genotype **AA Bb Cc DD** (two genes homozygous, two genes heterozygous). If all four genes are carried on the same chromosome, how many different gametes could this organism make?

A. 2
***B. 4***
C. 6
D. 8
E. 9

---

25. A recessive mutant allele, black, causes a very dark body in *Drosophila* (fruit flies) when homozygous. The normal colour is grey.

What will be the expected distribution of offspring from a cross of a black female with a grey male (whose father was black)?

***A. 1/2 black: 1/2 grey***
B. all black
C. all grey
D. 3/4 grey: 1/4 black
E. Can't tell without knowing the genotype of the grey male's mother.

---

26. Mendel found that full pods (**C**) were dominant to constricted pods (**c**), while round seeds (**R**) were dominant over wrinkled seeds (**r**) in pea plants. (Recall that all of the traits studied by Mendel assort independently.)

What is the likelihood that a dihybrid full, round plant (**Cc Rr**) would be produced from parents with the genotypes **Cc Rr** and **Cc rr**?

A. 1/2
***B. 1/4***
C. 1/8
D. 9/16

---

27. A research article mentioned in class claimed that the "wrinkled seed" allele (**r**) used by Mendel results from a transposon inserting into the gene coding for a particular starch branching enzyme.

Why is this new "wrinkled" allele (**r**) recessive to the "round" allele (**R**) such that **Rr** plants have "round" seeds?

A. Insertion of the transposon increases the amount of DNA in the **r** allele. Therefore, it cannot pair properly with the **R** allele during meiosis in **Rr** plants.
B. The **r** allele arose from a mutation. Mutations are rare; therefore the new allele is rare. Rare alleles are recessive. Therefore, **Rr** plants would be "round".
C. In **Rr** plants, insertion of the transposon causes the **r** allele to make an abnormal product that is inhibited by the normal product produced by the **R** allele.
***D. Insertion of the transposon makes it impossible for the r allele to produce a functional enzyme product. However, the single R allele makes enough functional enzyme product to make Rr plants "round".***

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28. In a classic case of one gene affecting the expression of another, recessive alleles at the "Bombay" gene (**hh**) inhibit the expression of the alleles of the ABO blood type gene. As a result, affected people (**hh**) all show "O" blood type regardless of their $\mathbf{i^A}$, $\mathbf{i^B}$ and **i** alleles. Individuals with at least one normal Bombay allele (**H**) express their blood type alleles as expected.

For two parents, both with AB blood ($\mathbf{i^A\ i^B}$) and heterozygous for the Bombay allele (**Hh**), what is the chance that they will have a child with Type A blood?

A. 0
B. 1/16
***C. 3/16***
D. 6/16
E. 12/16

---

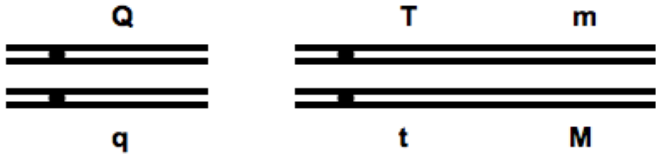
29. When homozygous, a certain mutation in a *Drosophila* gene, called "drop dead", results in flies that begin to walk erratically, fall over, and then die rapidly. Heterozygous flies are normal.

What would be the proper notation for the **wild-type allele** of this gene?

***A. $drd^+$***
B. drd
C. $Drd^+$
D. Drd

30. For the chromosomes shown below, which pair of genes is "linked in trans"?

A. Q/q and T/t
B. Q/q and M/m
***C. T/t and M/m***
D. B and C are both correct.




31. In rabbits, black colour (**B**) is dominant to brown (**b**), while full colour (**C**) is dominant to chinchilla (**c**). The genes controlling these traits are linked. Black, full colour rabbits that are heterozygous for both traits are crossed with brown, chinchilla rabbits. The results are shown below:

| Number | Phenotype |
|---|---|
| 16 | brown, chinchilla |
| 19 | black, full |
| 31 | brown, full |
| 34 | black, chinchilla |

What is the map distance (cM) separating these two genes?

***A. 35***
B. 0.35
C. 65
D. 0.65

32. The hypothesis that "life exists on other planets" is

A. falsifiable, but not verifiable.
***B. verifiable, but not falsifiable.***
C. both falsifiable and verifiable.
D. neither falsifiable nor verifiable.

33. According to Karl Popper, which of the following are necessary for a hypothesis to be considered "scientific"?

A. It must be correct.
***B. It must be falsifiable.***
C. It must be verifiable.
D. It must be published in a scientific journal.
E. It must have already been tested at least twice.

34. Many scientific theories include both a pattern and a process. On which PROCESS was Darwin's theory of evolution based?

***A. Descent with modification from a common ancestor***
B. Inheritance of acquired traits
C. Natural selection

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35. In an effort to provide a wider pool of professional basketball players, imagine that the NBA begins an ambitious program to increase human height. The program provides all North American children with an excellent, high quality diet.

How will this program affect the **heritability** of height in North America?

***A. It will increase.***
B. It will decrease.
C. It will not change.

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36. In Darwin's finches, knowing the beak depth of both parents allows us to predict beak depth of their offspring reasonably well, but not perfectly. Why not?

A. Parents and offspring often share similar environments.
B. Beak depth has a heritability of zero.
***C. Beak depth has an environmental, as well as a genetic, component.***
D. Beak depth is not variable in this population.

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