111

UNIVERSITY OF WESTERN ONTARIO

BIOLOGY 022

October 27, 2007 **Time: 2½ Hours**

Student No. _____ Test Room _____ Row _____

INSTRUCTIONS - FOLLOW THE CHECK LIST!

(√)	On your Scantron sheet	
	Print name	Print clearly
	Signature	Do your best
	Instructor	Haffie, Fenton
	Course	Bio 22
	Student number	Print clearly/ Bubble neatly
	Exam Code	**111 – Very important**
	Section	Leave it blank
	Answer Sheet	Leave it blank

Fill the bubbles completely
- Use **HB pencil only**
- No stray marks or doodles
- Make all erasures complete

Yes - Calculators are permitted (non-programmable only)

No – Borrowing is not allowed

(√)	On your Test Book	
	Student number	No names please
	Test Room	The room you're in right now
	Row number	We will tell you this
	Indicate your answers in the test book. Leave no questions blank.	

Do not write your name on the cover
Your Scantron answers will be emailed to your UWO email account within a week.
Review copies of this test will posted on WebCT for study purposes..

1) Please place your ID prominently on your desk and sign the attendance sheet when it comes to you.

2) There are **56** questions in this test. Check your paper carefully.

3) There is only **one** fully correct answer for each question. Part marks may be awarded. **Answer all questions**. We do not subtract wrong from right.

4) Indicate your answers in **both** the test paper **and** on the Scantron.

5) It is your responsibility to transfer all answers from the test book to the Scantron sheet **within the 2½hour test period.**

6) When finished, **please stay seated** and raise your hand. We will collect both your test book and your Scantron sheet. Test books will be returned to you in tutorial.

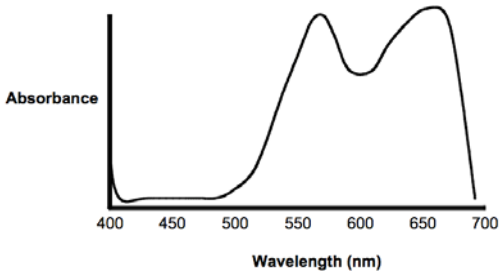
Warning The Scantron marking program has a cheating analysis feature that compares answer patterns for all papers. It alerts us to similarities. We then check seating arrangements.

Do not sit near your study partners or write the same test codes. Keep your work directly in front of you. Please help us avoid any and all misunderstandings during these tests.

Comments: Please defend your arguments **on this page only**. Comments will not be accepted after the test.

Circle the best single letter choice for each of the following questions before transferring your answers to your computer sheet.

1. What colour is the pigment that was used to produce the following absorption spectrum?



A. Red
B. Blue
C. Green
D. Yellow
E. Orange-red

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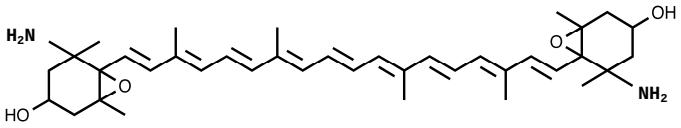
2. Which part of this pigment molecule is critical to light absorption?



A. The ring structures at both ends.
B. The nitrogen groups at both ends.
C. The ring structures plus the hydroxyl (OH) groups.
D. The stretch of carbons between the two ends.
E. The entire molecule is critical for light absorption.

~~3. Cataracts are areas of cloudy protein deposits in the lens of an eye. Which of the following organisms could not suffer from cataracts?~~

~~A. human~~
~~B. octopus~~
~~C. squid~~
~~D. planarian~~
~~E. dragonfly~~

---

4. The eyes of humans and squid both resemble a camera in that they can focus an image on photoreceptor cells in the retina. This similarity suggests that human and squid eyes have

A. developed through expression of similar genes (e.g. *pax6*).
B. evolved from a common ancestor.
C. the same relative location of photoreceptor and nerve cells.
D. the same photoreceptor opsins to detect colour.
E. the ability to correct for the bending of light rays underwater.

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5. In a mimetic assemblage of organisms (different species that look similar), the "model" can be dangerous because it

A. tastes bad.
B. is brightly coloured.
C. contains toxins.
D. can bite or sting.
E. C and D only are correct

---

6. The "stacked disks" seen in the chloroplast and in the rod cell are both believed to be a solution to the problem of how to increase the

A. amount of rough ER in the cell.
B. range of wavelengths of light that can be detected by photoreceptors.
C. energy available from photons absorbed by photoreceptors.
D. available surface area for light-absorbing photoreceptors.
E. absorption spectrum of the light hitting the cell.

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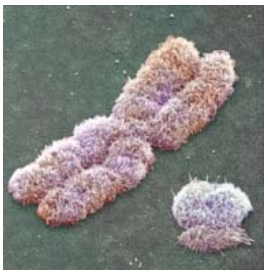
7. This image shows a human X and Y chromosome during metaphase of mitosis.
Which of the following statements is true?



A. The image shows a total of 2 double-stranded DNA molecules.
B. These two chromosomes paired during prophase of mitosis.
C. None of the DNA sequences on the X are also found on the Y.
D. All male animals have an X and Y chromosome.
E. There are two copies of the "red" opsin gene in the picture.

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8. Which of the following characteristics of *Drosophila* (fruit flies) makes this insect a popular choice as a genetic model system relative to other eukaryotes?

A. They produce large numbers of gametes.
B. There are males and females.
C. They have compound eyes with many facets.
D. They have a short generation time.
E. They have the same number of chromosomes as humans.

---

9. Although Archaea cells are prokaryotic, they also resemble modern Eukarya cells; both Archaea and Eukarya have

A. ribosomes.
B. circular chromosomes.
C. DNA packaged around histone proteins.
D. membrane-bound organelles.
E. Both A and C are correct.

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10. Transmission electron microscopy

A. uses lasers to illuminate specimens.
B. requires staining specimens with fluorescent dye.
C. shows overall 3-dimensional shape of specimens.
D. requires very thin sections of tissue.
E. Both A and B are correct.

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11. In plant meristem tissue, you would expect to find relatively many cells in

A. G_0
B. meiosis.
C. apoptosis.
D. S phase.
E. Both A and C are correct.

---

12. The golden rod gall was dissected in class (revealing an insect larva) as an illustration of

A. external signals influencing the cell cycle.
B. apoptosis.
C. cyclin/CDK binding
D. uncontrolled (cancerous) growth.
E. gene flow from insects to plants.

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13. The mouse major histocompatability complex (MHC) genes code for cell surface proteins that function with the immune system to establish "self" versus "non-self". Which of the following shows the respective cell structures in the proper order of involvement in the production of MHC proteins?

1. ribosome	2. Golgi apparatus
3. nuclear membrane	4. primase
5. smooth ER	6. plasmodesmata

A. 3 – 1 – 2
B. 3 – 5 – 2 – 6
C. 4 – 3 – 1 – 2
D. 1 – 5 – 2 – 6
E. 3 – 1 – 5

---

14. For a given nucleus, which of the following is higher at the end of S phase than at the beginning?

A. Number of chromosomes.
B. Number of DNA bases.
C. Number of RNA primers.
D. Number of different alleles (ie. A vs. a) for a given gene.
E. A, B and C only are correct.

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15. In dividing animal cells, a drug that blocks the action of microfilaments would likely result in cells that could not complete

A. G1.
B. S.
C. DNA packaging (around histones).
D. anaphase.
E. cytokinesis.

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16. Hair and fingernails contain the protein "keratin". Which sub-cellular component is also made of keratin fibers?

A. nuclear lamin
B. plasma membrane
C. centrosome
D. kinetochore
E. nucleosome

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17. The human telomere repeat is $^{5'}$ TTAGGG $^{3'}$ in DNA. Therefore, the sequence of the RNA template carried by human telomerase must be _____.
(Recall that, in RNA, the base uracil (U) replaces thymine (T).

A. $^{3'}$ GGGAUU $^{5'}$
B. $^{3'}$ UUAGGG $^{5'}$
C. $^{3'}$ CCCUAA $^{5'}$
D. $^{3'}$ CCCTAA $^{5'}$
E. $^{3'}$ AAUCCC $^{5'}$

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18. Which of the following enzymes degrades RNA?

A. primase
B. telomerase
C. DNA polymerase I
D. kinase
E. caspase

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19. Which of the following enzymes can add a DNA base onto the 3' end of an RNA chain?

A. DNA polymerase I
B. telomerase
C. DNA polymerase III
D. primase
E. B and C only are correct.

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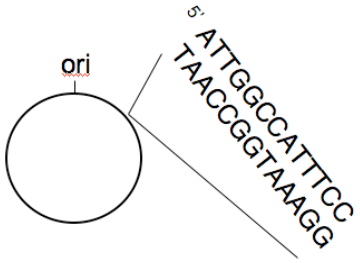
20. The image below shows a sequence of DNA at a particular location on a circular *E. coli* chromosome.

When this DNA is replicated, which nucleotide will be "read" first by DNA polymerase III making the leading strand?



A. A
B. T
C. C
D. G
E. There is no way to tell in advance.

---

21. The replication of prokaryotic chromosomes is fundamentally different from that of eukaryotic chromosomes in that only eukaryotic replication

A. is bidirectional.
B. is semi-conservative.
C. is semi-discontinuous.
D. has more than one replisome replicating at any one time.
E. may involve telomerase.

---

22. The alleles of genes on separate chromosomes assort independently during meiosis. Assuming no crossing-over, the particular combination of alleles destined for any given gamete (ie. AbC vs. aBc) is determined during

A. prophase I.
B. metaphase I.
C. anaphase I.
D. metaphase II.
E. anaphase II.

---

23. Honeybee eggs that are not fertilized develop into fertile, haploid, males called “drones”. Fertilized eggs can develop into diploid females, one of which might become a “Queen”. (Fertilized eggs might also become males but they are taken out and killed by the drones.)

If the Queen has 32 chromosomes in her body cells, how many chromatids would be present in a G_2 drone cell?

A. 8
B. 16
C. 24
D. 32
E. 64

---

24. At first glance, cells in metaphase of Meiosis II might appear to be similar to cells in metaphase of mitosis.

You could distinguish between cells in Meiosis II vs. Mitosis because only

A. mitosis chromosomes would have identical non-sister chromatids.
B. meiosis II cells would have the same number of chromosomes as gametes.
C. meiosis II chromosomes would pair with homologues.
D. meiosis II chromosomes would be replicated.
E. A, B and C only are correct.

---

25. Imagine that you are in a job interview for a pharmaceutical company and they ask you to suggest a good target for an anti-cancer drug. You should suggest a drug whose action results in

A. decreased apoptosis.
B. decreased binding of cyclin to CDK.
C. increased CDK activity.
D. increased telomerase.
E. decreased caspase.

---

26. DNA is most highly condensed around nucleosomes during

A. G_1
B. S
C. G_2
D. prophase
E. metaphase

---

27. Since honeybee males are haploid, they make gametes by mitosis.
Which of the following sources of genetic variability would be associated with producing gametes by mitosis?

A. Crossing-over between homologues.
B. Independent assortment.
C. Random alignment of chromatids at metaphase.
D. X-linkage.
E. Such males make identical gametes with no variability.

---

28. The two different alleles of a given gene would normally be found

A. on two different sister chromatids in G_2.
B. at two different loci on a given chromosome.
C. in either *cis* or *trans* arrangement on a chromosome.
D. paired together during prophase of meiosis.
E. in the same gamete from a dihybrid.

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29. A dominant allele of a given gene will always

A. be more common than the recessive allele.
B. "turn off" the recessive allele during prophase pairing.
C. determine the phenotype of a heterozygote.
D. be larger than the recessive allele.
E. be wild-type.

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30. If a mother has histocompatability alleles (HLA) 1 & 3, while a father has alleles 1 & 2, what is the likelihood of them having a child who will be a tissue match with one parent or the other?

A. 0
B. 1/2
C. 1/4
D. 1/8
E. All children are tissue matches for at least one parent.

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31. Phenylketonuria (PKU) is an autosomal recessive disorder in humans arising from accumulation of the amino acid phenyalanine. If a phenotypically normal couple already has one affected son, what is the likelihood that their next child will be an affected boy or an affected girl?

A. 100%
B. 75%
C. 50%
D. 25%
E. 0%.

---

32. If one were to study hundreds of children from families in which the parents both had MN blood type, the distribution would be close to 1 MM: 2 MN: 1 NN. Such a distribution is evidence for

A. codominance.
B. linkage.
C. epistasis.
D. sex-linkage.
E. polygenic inheritance.

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33. In the early 1900's, Bateson and Punnet discovered epistasis in their studies of flower colour in sweet pea (*Lathyrus*). They observed that flowers were purple only if the plants had at least one dominant allele for both of two unlinked genes, C and P. Plants homozygous recessive for either gene had white flowers.

The diagram below shows the biochemical pathway that produces the purple pigment as well as the genes involved.

Gene C Gene P

White pigment → White pigment → Purple pigment

What is the expected distribution of purple to white flower colour among the progeny of a dihybrid cross (CcPp x CcPp)?

A. 15:1
B. 13:3
C. 12:4
D. 9:7
E. 8:8

---

34. Consider an organism with the following genotype: HhJjMmpp. If all of these genes are on separate chromosomes, how many different gametes would be produced?

A. 3
B. 6
C. 8
D. 9
E. 16

---

35. Consider a trihybrid organism with all three genes linked in cis. How many different recombinant gametes would be produced?

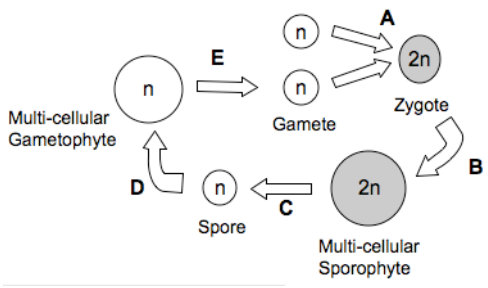
A. 9
B. 8
C. 6
D. 3
E. 2

---

36. The diagram at right represents the life cycle of a typical higher plant such as Mendel's peas.

Which letter indicates the location of meiosis?

A. A
B. B
C. C
D. D
E. E



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37. Consider a *Drosophila* cross in which the male is homozygous recessive for two genes: black body colour (bb) and curved wings (cc). The female is heterozygous for both genes (bb^+cc^+) and shows the wild-type gray body, straight wings phenotype.

One thousand progeny were randomly selected and found to be as follows:

Progeny	Number	Progeny	Number
Black body Curved wing	133	Black Straight	371
Gray Curved	359	Gray Straight	137

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

A. 0.27
B. 27
C. 73
D. 0.73
E. Can not tell without knowing the cis or trans arrangement in the dihybrid parent.

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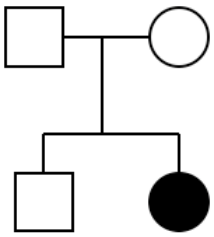
38. Which mode of inheritance could explain the pattern shown in the pedigree at right?



A. autosomal dominant
B. autosomal recessive
C. sex-linked dominant
D. sex-linked recessive
E. Both B and D are correct.

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39. Mapping experiments have revealed the following recombination frequencies for the pairs of genes shown at right.

What is the predicted map distance (cM) separating genes T and S?

Gene Pair	Recombination Frequency (%)
M and Q	34
M and S	24
Q and T	14
S and Q	10
M and T	20

A. 4
B. 8
C. 10
D. 12
E. 14

---

40. In *Drosophila*, the genes for white eye (w) and miniature wing (m) are linked at 40 map units on the X chromosome. If a dihybrid female (ww^+mm^+, linked in trans) was crossed to a white miniature male, what would be the percentage of wild-type males among the total progeny? (There are no alleles for either of these particular genes on the Y chromosome.)

A. 10
B. 20
C. 40
D. 50
E. 80

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41. Examples of prezygotic isolation include

A. Gamete incompatibility.
B. Autopolyploidy.
C. Hybrid inviability.
D. Temporal isolation.
E. A and D only are correct.

---

42. Which is the correct representation of the scientific name for the house sparrow?

A. *Passer domesticus* (House Sparrow)
B. *Passer domesticus* L.
C. Passer domesticus L.
D. *Passer domesticus*
E. *P. domesticus*

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43. In hermaphroditic organisms, each individual

A. functions as a male or a female.
B. is gynogenetic.
C. functions as a male and a female.
D. is androdioeceous.
E. is sterile.

---

44. Meiosis is used to produce gametes in

A. fungi.
B. birds.
C. ferns.
D. gynogenetic species.
E. flowering plants.

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45. Analysis of molecular genetic data has revealed that

A. modern humans interbred with Neanderthals.
B. there are three distinct genetic lines of living elephants.
C. there is hybridization among species of Darwin's finches.
D. there are many species and subspecies of snapdragons (*Antirrhinum*).
E. B and D only are correct.

---

46. Gene flow occurs almost continuously among individuals in populations of

A. a ring species.
B. house mice (*Mus musculus*).
C. Frosted glass-whiskers (a lichen).
D. Snails such as *Balea perversa.*
E. B and D only are correct.

---

47. Habitat connectivity strongly influences gene flow in

A. Hoary bats (*Lasiurus cinereus*).
B. Eurasian red squirrels (*Sciurus vulgaris*).
C. Snapdragons (*Antirrhinum*).
D. Dwarf birch (*Betula nana*).
E. Norway rats (*Rattus norveigicus*).

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48. In trees like *Prunus mahaleb,* gene flow occurs over hundreds of meters through

A. pollination by insects.
B. wind dispersal of fruit.
C. wind dispersal of pollen.
D. mammals eating fruit.
E. B and D only are correct

---

49. Polyploids are individuals with one or more extra copies of the entire haploid chromosome complement. Allopolyploidy and autopolyploidy are <u>different</u> because only

A. Allopolyploidy can arise from an error in mitosis or meiosis.
B. Autopolyploidy can occur when chromosomes do not pair during meiosis.
C. Allopolyloidy can occur when chromosomes do not pair during meiosis.
D. Autopolyploidy can arise from an error in meiosis or mitosis.
E. None of the above is true.

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50. One generally accepted concept of a biological species is an “interbreeding natural population that is reproductively isolated (does not produce fertile offspring with) other such groups”. However, this definition does not apply with the same ease to all species.

Which of the following does not fit the above description of a species because they do produce fertile hybrids?

A. Self-fertilizing plants (Chinese orchid)
B. Gynogenetic fish (Amazon Molly)
C. Androdiecious fish (*Rivulus*)
D. Darwin’s finches
E. horses and donkeys

Please continue with lab questions Q51 to Q56.

People in La/999 do not need to answer these lab questions. Leave them blank

Laboratory Questions based on Lab 1 and 2

People in La/999 do not need to answer Q51 to Q56 (i.e. leave them blank).

51. Which of the following statements involving electrophoresis is false.

A. DNA is negatively charged and will always migrate towards the positive electrode.
B. RNA is negatively charged and will always migrate towards the positive electrode.
C. Proteins can either be positively or negatively charged.
D. Larger molecules will travel through the matrix faster than smaller molecules.
E. Agarose, Acrylamide and Cellulose are different types of matrix that can be used for electrophoresis.

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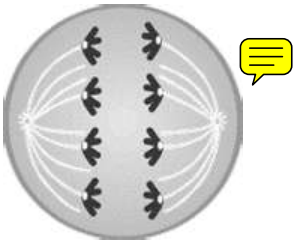
52. ~~Identify the mitotic stage of the following cell.~~



~~A. Interphase~~
~~B. Prophase~~
~~C. Metaphase~~
~~D. Anaphase~~
~~E. Telophase /Cytokinesis~~

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53. Based on the information in this diagram, what is the identity of the unknown plasmid (**U**)?

A. S1
B. S2
C. S3
D. S4
E. S5

U	S1	S2	S3	S4	S5
	———				
		———			———
———				———	———
———			———	———	
		———			———
———				———	

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54. If you were viewing a plant cell under a compound microscope using a 10x ocular and 4 x objectives, what is the magnification of the image as you see it?

A. 40
B. 14
C. 400
D. 100
E. 16

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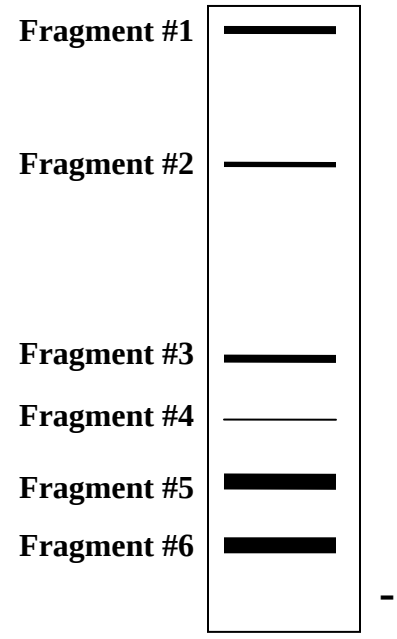
55. Based on the gel data presented which of the following statements about the restriction digest is **false**.



A. Fragment #5 and 6 have the highest concentration of DNA.
B. Fragment #6 is the smallest DNA fragment.
C. Fragment #2 contains the lowest concentration of DNA fragments.
D. Fragments #1 and #3 contain the same concentration of DNA fragments.
E. The sequence of Fragment #5 contains fewer base pairs than Fragment #6.

56. The thickness of the coverslip is <u>most</u> critical when using the _____ objective lens.

A. low power (4x)
B. medium power (10x)
C. high power (40x)
D. None of A, B or C is correct.
E. All of A, B and C are correct.