Bio 1A Lecture Exam #1
Summer 2002

Biology 1A - Lecture Exam #1 – July 15, 2002

NAME _____ **SECTION #** 104 **GSI NAME** Patty Wedemeyer

1. Sit in every fourth seat as directed. Sit in your assigned area. All books and papers should be placed on the floor. NO CALCULATORS ARE PERMITTED!
2. PRINT CLEARLY on this cover sheet: Your name, section # and GSI name.
3. Leave your exam face UP. When told to begin, check your exam to see that you have all of the pages.
4. Read all questions very carefully. If you have a question, raise your hand. A GSI will help you. The GSI will not give you the answer or explain scientific terms. Trivial answers will not receive credit. Each multiple choice question is worth two points unless stated otherwise. Always pick the one best answer.
5. Do not talk during the exam. The exam is closed book. No calculator is necessary, nor permitted.
6. Use a #2 pencil for the scantron form. **ERASE ALL MISTAKES COMPLETELY AND CLEARLY.**
7. On the scantron sheet, write in your student ID #, and the last two digits of your section number below that. Bubble in the appropriate numbers to the left as shown in the example below.

Your SID goes into the first 8 boxes, from top to bottom. (e.g. 12345678).

The last 2 digits of your section number goes into the bottom 2 boxes. (eg. 07).

8. On the back of the scantron, print your name **CLEARLY** in the space provided. Print your GSI's name in place of "subject".
9. You should have 9 numbered pages. The exam is worth 150 pt's. You have 80 minutes. You are NOT PENALIZED for guessing! (GUESS EVEN IF YOU NOT SURE)
10. LOCATE YOUR SECTION. Turn in your SCANTRON form to the SCANTRON ENVELOPE and your EXAM to the EXAM ENVELOPE for your section. YOU MUST TURN IN BOTH or else you will get a ZERO.
11. WHEN TOLD TO STOP- STOP! Bubble in guesses **BEFORE** THIS TIME!

DO NOT READ OR WRITE BELOW THIS LINE TODAY. FOR REGRADE USE LATER!

Regrade Instructions

To the Student:

Please review your regrade requests with your GSI first to make sure that the requests are valid. If the request is valid, please write your request on the back of this sheet. Your GSI must then initial it. (GSI's need to initial requests--otherwise, request will not be read.)

You may request up to 3 questions only to be regraded. Additional instructions are on the back of this sheet.

All regrade requests are due Thursday August 1st by 5 PM in the mailbox outside of 2088 VLSB. (If late, no regrading!)

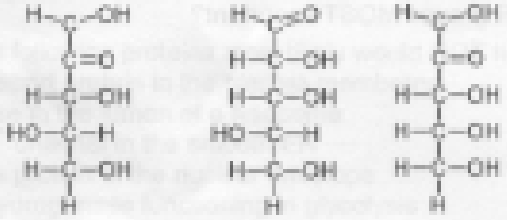
1. All of the following are true of both eukaryotic and prokaryotic cells EXCEPT:
   A. Possess organelles.
   B. Utilize energy.
   C. May have flagella with a 9 + 2 microtubular ultrastructure.
   D. Maintain homeostasis.
   E. Contain phospholipids.

2. The characteristics that distinguishes living matter from non-living matter
   A. result from the arrangement and interaction of component parts at lower structural levels.
   B. are emergent properties of life.
   C. are possible because living systems possess DNA.
   D. A, B, and C are all correct
   E. Only A and B are correct

3. Water's high specific heat is mainly a consequence of the
   A. absorption and release of heat when hydrogen bonds break and form.
   B. small size of the water molecules.
   C. high specific heat of oxygen and hydrogen atoms.
   D. fact that water is a poor heat conductor.
   E. inability of water to dissipate heat into dry air.

4. A compound contains hydroxyl groups as its predominant functional group. Which of the following statements is true concerning this compound?
   A. It is probably a lipid.
   B. It should dissolve in water.
   C. It should dissolve in a nonpolar solvent.
   D. It won't form hydrogen bonds with water.
   E. It is hydrophobic.

Use the following chemical structures to answer questions 5-6.

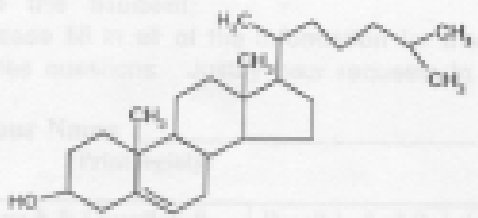


I II III

5. Which of the following is a correct statement describing the relationship between molecules I and III?
   A. Both are aldoses and structural isomers.
   B. Both are ketoses and structural isomers.
   C. Both are aldoses and enantiomers.
   D. Both are ketoses and enantiomers.
   E. None of the above is correct.

6. Which of the following is a correct statement concerning molecule II?
   A. II and III are structural isomers.
   B. II and I are enantiomers.
   C. II and III are enantiomers.
   D. Both B and C are correct statements.
   E. II is not an isomer of either I or III.

7. A molecule with the empirical formula $C_6H_{10}O_5N_2$ is most likely to be
   A. a nucleotide.
   B. an hexose.
   C. a fatty acid.
   D. a dipeptide.
   E. a disaccharide.



8. What is the structure shown above?
   A. a starch molecule
   B. a steroid
   C. a protein
   D. a cellulose molecule
   E. a nucleic acid polymer

9. The formation of polymers is best described as an example of
   A. catabolism.
   B. metabolism.
   C. hydrolysis.
   D. hydrophilic interactions.
   E. anabolism.

10. A triose ($C_3H_6O_3$) and two pentose sugars (each with the formula $C_5H_{10}O_5$) are joined to form an oligosaccharide. The resulting oligosaccharide would have the formula
   A. $C_{13}H_{22}O_{11}$
   B. $C_{13}H_{20}O_{13}$
   C. $C_{13}H_{22}O_{10}$
   D. $C_{13}H_{20}O_{13}$
   E. $C_{13}H_{20}O_{11}$

11. At which level of protein structure are interactions between R groups MOST important?
   A. primary
   B. secondary
   C. tertiary
   D. primary and secondary
   E. They are important at all levels

12. What levels of protein structure are found in ALL proteins?
   A. primary and quaternary
   B. secondary and tertiary
   C. primary and tertiary
   D. primary, secondary and tertiary
   E. primary and secondary

13. All of the following are found in DNA EXCEPT
   A. purines.
   B. ribose
   C. phosphate
   D. hydrogen bonds
   E. thymine

14. Which of the following would most likely NOT be found in a prokaryotic cell?
   A. ATP
   B. ribosomes
   C. histones
   D. phospholipids
   E. rRNA

15. All of the following are part of the cytoskeleton EXCEPT
    A. tubulin
    B. actin
    C. microfilaments
    D. centriole
    E. keratin

For questions 16-19, use the lettered answers below to match the structure to its proper cell type. Choose the most inclusive category. Each answer may be used once, more than once, or not at all.

    A. structure is found in all cells
    B. structure is found in eukaryotic cells only
    C. structure is found in prokaryotic cells only
    D. structure is found in plant cells only
    E. structure is found in animal cells only

16. Plasma membrane A

17. Golgi bodies B

18. mitotic spindle B

19. centrioles B

20. A tissue sample is ground up and centrifuged. From the pellet in the test tube organelles are isolated and purified. The organelles give off O_2 when hydrogen peroxide is added to them. These organelle are most likely
    A. vacuoles
    B. smooth ER
    C. peroxisomes
    D. lysosomes
    E. Golgi bodies

21. Which of the following proteins most likely would NOT have been synthesized on a bound ribosome?
    A. a transport protein in the plasma membrane
    B. a lipase in the lumen of a lysosome
    C. a Ca^{++} channel in the smooth ER
    D. a pore protein in the nuclear envelope
    E. a dehydrogenase functioning in glycolysis

22. A cell specialized for the uptake of sugar and its conversion into polysaccharide could be expected to have
    A. a large number of ribosomes.
    B. a large volume of rough ER.
    C. a large number of chloroplasts.
    D. a large volume of smooth ER.
    E. an extensive cytoskeleton.

23. Normal mitosis takes place in a diploid cell with genotype a+/a ; b+/b. Which of the following genotypes represent possible daughter cells?
    A. a+ ; b+
    B. a ; b
    C. a+ ; b
    D. a/a ; b+/b+
    E. a+/a ; b+/b

24. Which of the following is a characteristic feature of a carrier protein in a plasma membrane?
    A. It is a peripheral membrane protein.
    B. It exhibits a specificity for a particular type of molecule.
    C. It is symmetrical on both sides of the phospholipid bilayer.
    D. It works against diffusion.
    E. It has few, if any, hydrophobic amino acids.

25. All of the following cellular activities require ATP energy EXCEPT
    A. movement of O_2 into the cell
    B. protein synthesis
    C. Na^+ ions moving out of the cell
    D. cytoplasmic streaming
    E. exocytosis.

26. The kinds of molecules that pass through a cell membrane most easily are
    A. large and hydrophobic.
    B. small and hydrophobic.
    C. large polar molecules.
    D. ionic.
    E. monosaccharides such as glucose.

27. The fluid mosaic model of membrane structure was proposed by
    A. Schleiden and Schwann.
    B. Unger and Boveri.
    C. Sanger and Nicolson.
    D. Morgan and Sturtevant.
    E. Davson and Danielli.

28. Which of the following would decrease the entropy within a system?
    A. condensation reaction
    B. hydrolysis
    C. respiration
    D. digestion
    E. catabolism

29. Increasing the substrate concentration in an enzymatic reaction could overcome which of the following?
    A. denaturing of the enzyme
    B. allosteric inhibition
    C. competitive inhibition
    D. noncompetitive inhibition
    E. insufficient cofactors

30. Which of the following reactions is endergonic and could be coupled to the reaction ATP + H_2O → ADP + Pi? (Free energy of reaction given in parentheses).
    A. A + P → AP (+9 kcal)
    B. B + P → BP (+8 kcal)
    C. CP → C + P (-4 kcal)
    D. DP → D + Pi (-10 kcal)
    E. E + P → EP (+5 kcal)

31. Which of the following statements regarding enzymes is FALSE?
    A. Enzymes provide activation energy for the reactions they catalyze.
    B. Enzymes are usually proteins that function as catalysis.
    C. Enzymes display specificity for certain molecules to which they attach.
    D. The activity of enzymes can be regulated by factors in their immediate environment.
    E. An enzyme may be used many times over for a specific reaction.

32. The conformational change in the shape of the active site during binding of a substrate is referred to as
    A. cooperativity
    B. allosteric regulation
    C. induced fit
    D. cofactor binding
    E. activation

33. The K_M for enzyme A is 3.2×10^{-6} M and the K_M for enzyme B is 5.6×10^{-7} M. Which of the following statements is TRUE?
A. Enzyme A has a greater affinity for its substrate than enzyme B has for its substrate.
B. Enzyme B has a greater affinity for its substrate than enzyme A has for its substrate.
C. Enzyme A has a greater turnover than enzyme B.
D. Enzyme B does not bind its substrate as strongly as enzyme A.
E. A, C, and D are all true.

34. The energy source that directly drives ATP synthesis during respiratory oxidative phosphorylation is
A. oxidation of glucose to CO_2 and water.
B. the thermodynamically favorable flow of electrons from NADH to the mitochondrial electron transport carriers.
C. the final transfer of electrons to oxygen.
D. the difference in H^+ concentrations on opposite sides of the inner mitochondrial membrane.
E. thermodynamically favorable transfer of phosphate from glycolysis and Krebs cycle intermediate molecules of ADP.

35. The ATP made during fermentation is generated by which of the following?
A. substrate-level phosphorylation
B. electron transport
C. photophosphorylation
D. chemiosmosis
E. oxidation of NADH

36. Isocitrate dehydrogenase is an enzyme of the Krebs cycle. Where in the cell is this enzyme located?
A. in the thylakoid
B. in the intermembrane space in mitochondria
C. in the chloroplast
D. in the mitochondrial matrix
E. in the stroma

37. Suppose a yeast cell uses 10 moles of glucose for energy production. No oxygen is available. What will be the maximum net yield of ATP in moles?
A. 12
B. 15
C. 20
D. 30
E. 36

38. During aerobic respiration, which of the following directly donates electrons to the electron transport chain at the lowest energy level?
A. NAD+
B. NADH
C. ATP
D. ADP + Pi
E. $FADH_2$

39. The complete aerobic respiration of sucrose, a disaccharide of glucose and fructose, or of maltose, a disaccharide of two glucose molecules, would release _____ molecules of CO_2?
A. 2
B. 3
C. 6
D. 11
E. 12

. Use following choices for questions 40-46 with reference to photosynthesis. Each answer can be used once, more than once, or not at all.

A. Involves photosystem I only
B. Involves photosystem II only
C. Involves both photosystem I and II
D. Occurs in the Calvin cycle
E. Does not occur in photosynthesis.

40. The reduction of water. B

41. Production of NADH. C

42. Linear electron flow C

43. Cyclic electron flow. PSI only A

44. Participation of cytochrome oxidase. B

45. Oxidation of NADPH. D

46. The decision for a cell to enter mitosis is determined at the G2 checkpoint by the interactions of
A. actin and myosin.
B. Cdk and cyclin MPF
C. ligand and receptor
D. tubulin
E. cAMP

47. Which of the following is NOT true of sister chromatids?
A. They arise by replication during S phase. T
B. They segregate from each other during each mitotic anaphase. T
C. They usually contain identical versions of the same genetic information. T
D. They segregate from each other during meiosis I F - reward
E. They are joined during prophase and metaphase at their common centromeres. T

48. In an organism where 2N=10, how many genetically unique gametes could be generated by meiosis (assume no crossing over).
A. 2^2
B. 2 X 5
C. 2^5
D. 2 X 10
E. 2^{10}

49. In which of the following phases do centromeres divide and sister chromatids separate?
A. mitotic anaphase
B. anaphase I of meiosis
C. anaphase II of meiosis
D. A and C are correct
E. A and B are correct

50. Synapsis of homologous chromosomes occurs in
A. prophase of mitosis
B. prometaphase of mitosis
C. prophase II of meiosis
D. prophase I of meiosis
E. metaphase I of meiosis

Part II

Fill in the blanks with the most appropriate word or phrase for the definition or concept. (1 pt each)

1. hydrogen bonding — Accounts for water's cohesion, surface tension, and high specific heat.
2. phosphodiester — Name given to the type of covalent bond that links two nucleotides.
3. cytoplasm — The area of a eukaryotic cell between nucleus and plasma membrane
4. ~~microtubules~~ — Protein used in building the internal ultrastructure of flagella.
5. nucleolar organizer — Section of a eukaryotic chromosome around which the nucleolus forms.
6. signaling — Mechanism by which chemical signals are transferred across the plasma membrane via the interaction of membrane proteins, resulting in the activation of a second messenger inside the cell.
7. ~~pachytene~~ — Name of structure in meiosis where non-sister chromatids are in contact and crossing over occurs.
8. ~~F6P~~ 1,6 fructosebisphosphate — Substrate (derived from glucose) present at the end of the energy investment phase of glycolysis.
9. PEP carboxylase — Enzyme that initially fixes CO_2 in CAM plants.
10. feedback inhibition — Phenomenon where endproduct of a metabolic pathway is an allosteric inhibitor of an enzyme near the beginning of the pathway.
11. kinetochores — Protein structure at the centromeres of mitotic chromosomes to which microtubules connect.
12. reaction center — Component of photosystem which passes electrons on to the primary electron acceptor.
13. nondisjunction — Failure of chromosomes or chromatids to separate properly during meiosis.
14. hemizygosity — Condition of having only one copy for a particular chromosome in a normally diploid organism.
15. lactic acid fermentation — Name of mechanism by which NAD+ is regenerated under anaerobic conditions in vigorously exercising muscle cells.

Part III

1. (X pts) A complementation test was performed on 7 histidine negative strains of a particular species of fungus to determine the number of genes involved in the synthesis of histidine. From the data below, what is the minimum number of genes involved in the pathway? For each gene detected, list all strains with mutations in that gene. Show your work below.

	1	2	3	4	5	6	7
1	--	--	+	--	+	+	+
2		--	+	--	+	+	+
3			--	+	+	+	--
4				--	+	+	+
5					--	+	+
6						--	+
7							--

1, 2, 4 → 1 gene

3, 7 → 1 gene

5 → 1 gene

6 → 1 gene

minimum = 4 genes

5 and 6 complement, so must be different

1, 2, 4 fail to complement, so have same mutation

3, 7 fail to complement, so have same mutation

pts 53

(3)

2. (4pts) Human somatic cells have 46 chromosomes. For each of the following stages, give the number of chromosomes and the total number of chromatids present. Also for each stage, state the quantity of DNA present relative to that of a gamete (1x, 2x, 3x, etc). Assume that cells in telophase have undergone cytokinesis.

STAGE	# Chromosomes	# Chromatids	DNA
a. mitotic metaphase:	46	2n	2n
b. metaphase I meiosis:	46	2n	2n
c. mitotic telophase	46	46	2n
d. telophase II meiosis:	23	23	n

1 + 2

(4)

3. (4 pts) Pairwise crosses were carried out to determine the genetic distances between the five genes listed below. Use the recombination data to construct a chromosome map showing the proper linear arrangement and distance between these genes (on the chromosome). Show your work to the right.

gene pair	% recombination
d y	42
d c	4
d b	28
d t	behaves as if unlinked
y c	38
y b	14
y t	10
t b	24
c b	24

4. (8 pts) A 18-carbon dipeptide is deaminated, processed, and enters cellular respiration as pyruvate and Acetyl-CoA. Only two molecules of pyruvate are constructed from the amino acid. The rest of the carbons enter as acetyl-CoA. Answer the following questions with respect to the complete oxidation of the indicated molecule.

	per 1 pyruvate	per 1 Acetyl-CoA
# NADH + H+	4	3
# FADH2	1	1
# ATP (by substrate level phosphorylation)	1	1
# ATP (by oxidative phosphorylation)		

(2 pts) The total number of ATP generated for the complete oxidation of the dipeptide would be _____ (Show work)

X^A = apricot (dom) ww = white (rec)
X^{A^+} = brown (w^+ rec) ww^+ = w^+ (dom)

5. (6 pts) In *Culex pipiens* (a mosquito), apricot eye is dominant to wild-type eye color (brown) and is an X-linked trait. White wing is an autosomal recessive mutant. An apricot-eyed female with wild-type wings from a true-breeding stock is mated with a normal eyed male (wild type) with white wings, also from a true-breeding stock. Given this cross, answer the following questions.

A. Using proper genetic notation (developed for *Drosophila*), write the genotypes of the P male and female.

(2)

♂ (male) $\frac{X^{A^+}}{Y}$; $\frac{ww}{ww}$ ♀ (female) $\frac{X^A}{X^A}$; $\frac{ww^+}{ww^+}$

B. Give the F1 genotypes (and their corresponding phenotype) and ratios expected from this cross.

(1.5)

$\frac{X^{A^+}}{X^A}$; $\frac{ww}{ww}$ ♀: apricot eyes ♂ wild type wings

$\frac{X^A}{Y}$; $\frac{ww^+}{ww^+}$ ← male: apricot eyes + wild type wings

C. In the F2 generation (progeny of F1 male x F1 female), what proportion of the female offspring can be expected to be wild-type for both traits? Show your work.

(1.5)

all ♀ are brown

$\frac{X^{A^+}}{X^A}$; $\frac{ww^+}{ww}$ (X) $\frac{X^A}{Y}$; $\frac{ww^+}{ww}$ $\frac{3}{4} \times \frac{1}{2} = \boxed{\frac{3}{8}}$

	X^A	Y
X^{A^+}	$X^AX^{A^+}$	$X^{A^+}Y$
X^A	X^AX^A	X^AY

wild type must be $X^{A^+}X^{A^+}$ or $X^{A^+}Y$ ⇒ ¼

	ww^+	ww
ww^+	ww^+ww^+	ww^+ww
ww	ww^+ww	ww

wild type must be ww^+ or ww^+ ⇒ ¾

6. (7 pts) In mice B is a dominant allele that determines brown coat color; bb individuals are white. But for pigment to be produced at all, P and M, both dominant alleles, have to be present at two other loci. A white mouse heterozygous Bb at the B locus but of unknown genotype at the other two loci was mated with a BbPPmm mouse. The offspring included brown and white offspring in a ratio of 3 brown to 5 white.

A) What is the phenotype of the BbPPmm mouse? white, because there is no dominant M allele ✓

B) Given the outcome of the cross, what is the genotype of the other mouse (Show work and take into account the phenotypic ratios in the offspring. **You MUST SHOW your work** by including Punnett square(s) and indicate yor reasoning. Assume that the genes are autosomal and unlinked.

(7)

Bb PP mm x Bb Pp MM

or Bb PP MM

or Bb Pp Mm

or Bb pp Mm

- there must be a M somewhere to produce brown
- ⅛ of both ps must be rec
- the offspring will always have at least 1 dominant P
- to create of white > brown, so less are all dominant

Bb pp Mm

	B	b
B	BB	Bb
b	Bb	bb

¾ brown

¼ white

	P	P
P	PP	Pp
P	Pp	PP

all dom present

× 1

	M	m
M	MM	Mm
m	Mm	mm

½ dom

½ rec

12

Mean Chi-sq
X̄ = 71 Σ 13.6

Answers Exam 1 Bio 1A, Summer 2002

1 C	6 A	11 C	16 A	21 E	26 B	31 A	36 D	41 E	46 B
2 E	7 D	12 C	17 B	22 D	27 C	32 C	37 C	42 C	47 D
3 A	8 B	13 B	18 B	23 E	28 A	33 B	38 E	43 A	48 C
4 B	9 E	14 C	19 E	24 B	28 C	34 D	39 E	44 E	49 D
5 D	10 A	15 D	20 C	25 A	30 E	35 A	40 E	45 D	50 D

Multiple Choice: 1) Pro & euk have different flagellar structure. 2) C may be true but it isn't required to answer this question. 5) enantiomers differ at a chiral C 12) All proteins must have primary and tertiary but not secondary (alpha helix/beta sheets). 13) DNA has deoxyribose 14) prokaryotes lack histone proteins (DNA packing). 18) eukar have spindle, but prokaryotes don't 19) plants lack centrioles. 21) cytosolic ribosomes synthesize cytosolic proteins 22) sugar metabolism = SER. 25) movement of gases strictly by diffusion. 35) ATP in glycolysis is via SLP. 38) FADH2 is lower than NADH (2 ATP vs 3). 39) 12 Carbons = 12 CO2 40 & 41) O2 gets reduced to H2O in photosynthesis, NADH gets produced during glycolsysis/krebs cycle. 43) cyclic = only PS I. 44) cytochrome oxidase in mt ETC

Part II–1) Hydrogen bonds, 2) phosphodiester, 3) cytoplasm (not cytosol), 4) tubulin, 5) nucleolar organizer, 6) signal transduction 7) chiasma, 8) F 1,6 biP or phosphoglyceraldehyde, 9) PEP carboxylase, 10) Feedback inhibition, 11) kineotchore, 12) reaction center, 13) non-disjunction, 14) monosomy, 15) lactic acid fermentation

Part III– **1)** 4 pts, 4 genes as follows: 1,2 & 4 = 1 gene, 3 & 7 = another, 5 = another, 6 = another. **2a)** 46; 92; 4X. **2b)** 46, 92, 4X, **2c)** 46, 46 (or 0), 2X, **2d)** 23, 23 (or 0), 1X. **3)** order and distance is d (4) c (24) b (14) y (10) t. **4)** 1/2 pt/box. per 1 pyruvate = 4 (NADH + H+), 1 FADH2, 1 ATP (SLP), 14 (OP). per 1 acetylcoA = 3 (NADH + H+), 1 FADH2, 1 ATP (SLP), 11 (OP). Note that all of the NADH + H+ made is in the matrix and not in the cytosol ("no transportation costs"). 3 ATP/NADH + H+ and 2 ATP/FADH2. 18C dipeptide yields 2 pyruvates which still leaves 12 C (each 2 X 3 C = 6). The number of ATP so far is 30 (2 X 15). 12 C yields 6 acetylCoA molecules (6 X 2 C) and each acetylCoA yields 12 ATP. Therefore 6 X 11 = 72 ATP. Total = 72 + 30 = 102 ATP. 5A) X^{Ap}/X^{Ap}; w^+/w^+ = the female 1/2 pt for each homologous chromosome (X's and the autosome). X^{Ap^+}/Y; w/w = the male 1/2 pt for each homologous chromosome (X and Y, and the autosome).

5B) ratio = 1:1	X^{Ap^+}; w (sperm)	Y; w (sperm)
X^{Ap}; w^+ (egg)	X^{Ap^+}/X^{Ap}; w/w^+ phenotype = Ap^+, w+ (female)	X^{Ap}/Y ; w^+/w phenotype = Ap, w^+ (male)

5C) The answer is all females will have Ap eyes because the Male will donate X^{AP} to females (see the males in the above box for the Punnett square) and the Ap is dominant. Therefore no females will be heterozygous for both traits. You can ignore the autosome because 0 X any number is 0. **6A)** white

6B) i) mouse is B/b. Therefore 3/4 of the offspring will have B phenotype (potentially brown depending upon the other loci) and 1/4 will be white independent of the other loci. So far we have 3/4 B, 1/4 b. (1pt)

ii) mouse must be heterozygous or homozygous M in order to produce any pigment (if it was m/m then you would never get pigment). Half of the reasoning. We need to determine if M/m or M/M.

iii) It is either P/P, P/p or p/p at the third locus. The mouse is white in phenotype so it must be p/p or else it couldn't be white. Therefore so far we know the mouse is B/b; p/p or M/M or M/m.

iv) So we have B/b; p/p, M/? X BbPPmm. Since the individuals are heterozygous for B 3/4 of the offspring have the B phenotype and 1/4 have the b phenotype. All would have the P phenotype; since all offspring are P/p (p/p X P/P). Back to the M/? situation. If the individual is M/M then all of the offspring would be M/m and they would all be able to make pigment. Thus 3/4 X 1 X 1 should be brown. (B phenotype, P phenotype, M phenotype).

v) This doesn't fit the data but M/m does. M/m crossed with m/m yields individuals with M phenotype 1/2 and m phenotype 1/2. The outcome is summarized below.

Thus 3/4 (B phenotype) X 1/2 (M phenotype) X 1 (P phenotype) = 3/8 would be brown.
Thus 3/4 (B phenotype) X 1/2 (m phenotype) X 1 (P phenotype) = 3/8 would be white due to m/m.
Thus 1/4 (b phenotype) X 1/2 (M phenotype) X 1 (P phenotype) = 1/8 would be white due to b/b.
Thus 1/4 (b phenotype) X 1/2 (m phenotype) X 1 (P phenotype) = 1/8 would be white due to b/b (& m/m).