BIOL 2104, Winter 2011 **Practise Midterm 2**

Check that you have 18 multiple choice questions and one long answer question (4 parts, worth 5 marks) on 5 pages in this document. Answer all multiple choice questions on scantron and the long answer question in the examination booklet. Be sure to enter the exam version number on your scantron and examination booklet. You may take this question booklet with you after completing the exam. The duration of this exam is 80 minutes.

1) A woman of blood type AB has two children with a man of blood type A whose father was of type O (disregard the possibility of a Bombay phenotype as it is very rare). What is the probability that the first child will be a son of type AB and the second child will be a son of type B?
a. zero b. 1/64 c. 1/16 d. 1/32 e. none of the previous

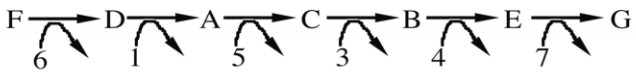
2) A and B are independently assorting genes. Given that A^1A^1 = lethal, A^1A^2 = gray, A^2A^2 = black, B^1B^1 = long hair, B^1B^2 = short hair, B^2B^2 = very short hair (fuzzy) and that the parents are both A^1A^2 ; B^1B^2, what is the fraction of adult offspring that is expected to be gray, fuzzy?
a. 1/4 b. 1/2 c. 2/3 d. 1/6 e. 3/4

3) If an individual has 10 gene pairs, how many different types of gametes can be formed if five of the gene pairs are homozygous and the remaining 5 gene pairs are heterozygous?
a. 42 b. 109 c. 32 d. 1024 e. none of the previous

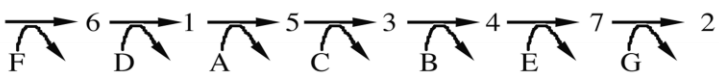
4) Two white-flowered strains of sweet pea were crossed, producing F1 with only purple flowers. Random crossing among the F1 produced 96 progeny plants, 53 exhibiting purple flowers and 43 with white flowers. What type of gene interaction is likely to be involved here?
a. redundant gene action b. complementary gene action
c. recessive epistasis d. no gene interaction

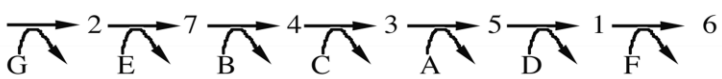
5) The intermediates A, B, C, D, E and F all occur in the same biochemical pathway. G is the product of the pathway and mutants 1 through 7 are all G⁻, meaning that they cannot produce the substance G. The table (right) shows which intermediate will (+) or will not (0) promote growth in each of the mutants. The best representation of the pathway is

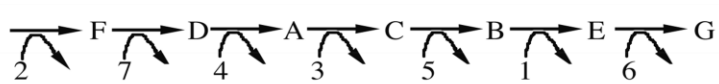
mutant	supplement						
	A	B	C	D	E	F	G
1	+	+	+	+	+	0	+
2	0	0	0	0	0	0	+
3	0	+	+	0	+	0	+
4	0	+	0	0	+	0	+
5	+	+	+	0	+	0	+
6	+	+	+	+	+	+	+
7	0	0	0	0	+	O	+

a. 

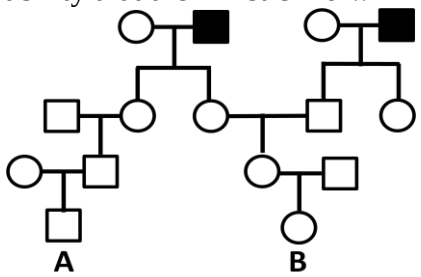
b. 

c. 

d. 

e. 

6) Phenylketonuria (PKU) is a rare human hereditary disease resulting from the inability of the body to process the chemical phenylalanine, which is contained in the protein we eat. PKU is is a autosomal recessive disease. Based on the pedigree below, if persons A and B mate, what is the probability that their first child will have PKU?



a. 1/48 b. 1/96

c. 1/64 d. 1/12

e. none of above

7) DNA that has been liberally labelled with radioactive ^{14}C is used as the template for replication. Replication is then carried out in a medium containing only unlabelled nucleotides. After two rounds of replication, what percent of DNA duplex molecules are still labelled?

a. 100 b. 50 c. 75 d. 25 e. 10

8) Four homozygous recessive mutant lines of *Drosophila melanogaster* (labeled 1 through 4) showed abnormal leg coordination, which made their walking highly erratic. These lines were intercrossed; the phenotypes of the F1 flies are shown in the following grid, in which "+" represents wild-type walking and "-" represents abnormal walking:

	1	2	3	4
1	-	+	+	+
2	+	-	-	+
3	+	-	-	+
4	+	+	+	-

How many different genes were mutated in creating these four lines?

a. 4 b. 3 c. 2 d. 1

9) In contrast to bacteria, eukaryotic chromosomes need multiple DNA replication origins because:

a. eukaryotic chromosomes cannot usually replicate bidirectionally.
b. eukaryotic genomes are not usually circular, like the bacterial chromosome is.
c. the processivity of the eukaryotic DNA polymerase is much less than the bacterial enzyme.
d. their replication rate is much slower, and it would take too long with only a single origin per chromosome.
e. they have a variety of DNA polymerases for different purposes, and need a corresponding variety of replication origins.

10) The genes for *mahogany eyes* and *ebony body* are approximately 30 map units apart on chromosome III (an autosome) in *Drosophila*. A mahogany-eyed female was mated to an ebony-bodied male. The resulting F1 females, which were phenotypically wild-type, were mated to mahogany, ebony males. Of 1000 offspring, what would be the expected number of phenotypically wild-type individuals?

a. 750 b. 300 c. 350 d. 250 e. none of the previous

11) Which of the following sequences can fully base-pair with itself?

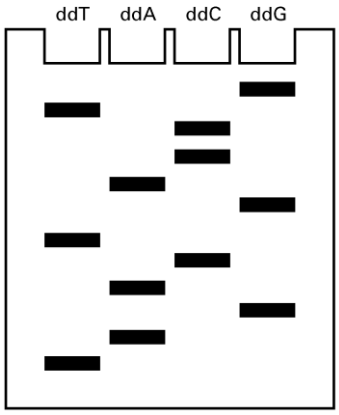
a. 5′-AAGCCGAA-3′
b. 5′-AAGCCGTT-3′
c. 5′-AAGCGCAA-3′
d. 5′-AAGCGCTT-3′

12) In a cross in *Neurospora* involving two alleles, b^+ (+) and *b*, the following tetrad patterns were observed. What is the map unit distance between the gene and the centromere?

top of ascus → bottom of ascus								Number of Tetrads
+	+	+	+	*b*	*b*	*b*	*b*	36
b	*b*	*b*	*b*	+	+	+	+	44
+	+	*b*	*b*	+	+	*b*	*b*	4
b	*b*	+	+	*b*	*b*	+	+	6
+	+	*b*	*b*	*b*	*b*	+	+	3
b	*b*	+	+	+	+	*b*	*b*	7

a. 5 b. 10 c. 12.5 d. 20 e. 25

13) You have sequenced a short piece of DNA and produced the gel shown below. What is the sequence of the template strand?



a. 5’-CAGGTCAGTCTA-3’
b. 5’-GTCCAGTCAGAT-3’
c. 5’-ATCTGACTGGAC-3’
d. 5’-TAGACTGACCTG-3’

14) The bacterial repair system that corrects mismatched bases after polymerization is able to discriminate between the old and newly made DNA strands because:

a. the new strand will contain the incorrect base if a mismatch occurs.
b. older DNA is more likely to contain errors.
c. older DNA contains methyl groups at specific sequences
d. newer DNA contains methyl groups at specific sequences
e. the DNA polymerase is attached to the new strand

15) The 5′ → 3′ exonuclease activity of *E. coli* DNA polymerase I is involved in:

a. formation of a nick at the DNA replication origin.
b. formation of Okazaki fragments.
c. proofreading of the replication process.
d. removal of RNA primers.
e. sealing of nicks by ligase action.

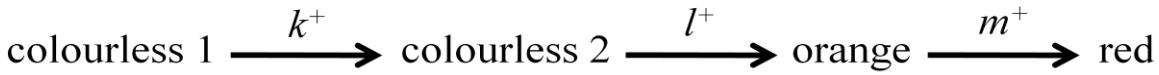
16) If radioactive sulfur (^{35}S) is used to label phages before infection of bacteria, after lysis the radioactivity will appear predominantly in the

a. bacterial DNA b. progeny phage c. bacterial proteins
d. progeny phage proteins e. sheared parental phage ghosts

17) Assume that a wild-type sequence is 5'AGCCTAC3'. Indicate the sequence that might be produced by a transversion.

a. 5'AGTCTAC3'
b. 5'AGCCGCCGCCGCCTAC3'
c. 5'AGCCCAC3'
d. 5'ATCCTAC3'
e. 5'AGCCTGC3'

18) k^+, l^+, and m^+ are independently assorting genes that control the production of a red pigment. These genes act in a biochemical pathway as follows:



The mutant alleles that produce abnormal functioning of the three genes are *k*, *l*, and *m*; each is recessive to its wild-type counterpart. A red individual homozygous for all three wild-type alleles is crossed with a colourless individual that is homozygous for all three recessive mutant alleles. The F1 is red. The F1 is then selfed to produce the F2 generation. What proportion of the F2 is colourless?

a. 7/16 b. 27/64 c. 36/64 d. 1/2 e. 9/64

Long Answer Question : Answer this question in the EXAMINATION BOOKLET provided. Show work and **WRITE NEATLY**. Worth 5 marks.

19) ROC is a hypothetical polymorphic short tandem repeat (STR) locus in humans with a repeating unit of **[CAGA]**. The locus is shown below as a box with 25 bp of flanking DNA sequences.

(a) You plan to use PCR to type individuals for the ROC locus. If PCR primers must be 18 nucleotides long, what are the sequences of the pair of primers required to amplify the ROC locus? Design the primers such that they immediately flank the ROC locus.

(b) Consider ROC alleles with 10 and 7 copies of the repeating unit. Using the primers you have designed, what will be the sizes of the amplified PCR products for each allele?

(c) There are four known alleles of ROC with 15, 12, 10 and 7 copies of the repeating unit. How many possible human genotypes are there for these alleles, and what are they?

(d) If one parent is heterozygous for the 15 and 10 alleles of the ROC locus and the other parent is heterozygous for the 10 and 7 alleles, what are the possible genotypes of their offspring for this locus, and in what proportion will they be found?