PLNT3140 INTRODUCTORY CYTOGENETICS

MID-TERM EXAMINATION

1 p.m. to 2:15 p.m. Tuesday, October 21, 2010

Answer any combination of questions totalling to exactly 100 points. If you answer questions totalling more than 100 points, answers will be discarded at random until the total points equal 100. This exam is worth 15% of the course grade.

Hand in these question sheets along with your exam book.

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1. (20 points) In your exam booklet, constuct a table like the one below, and fill in each cell in the table with at least one example.

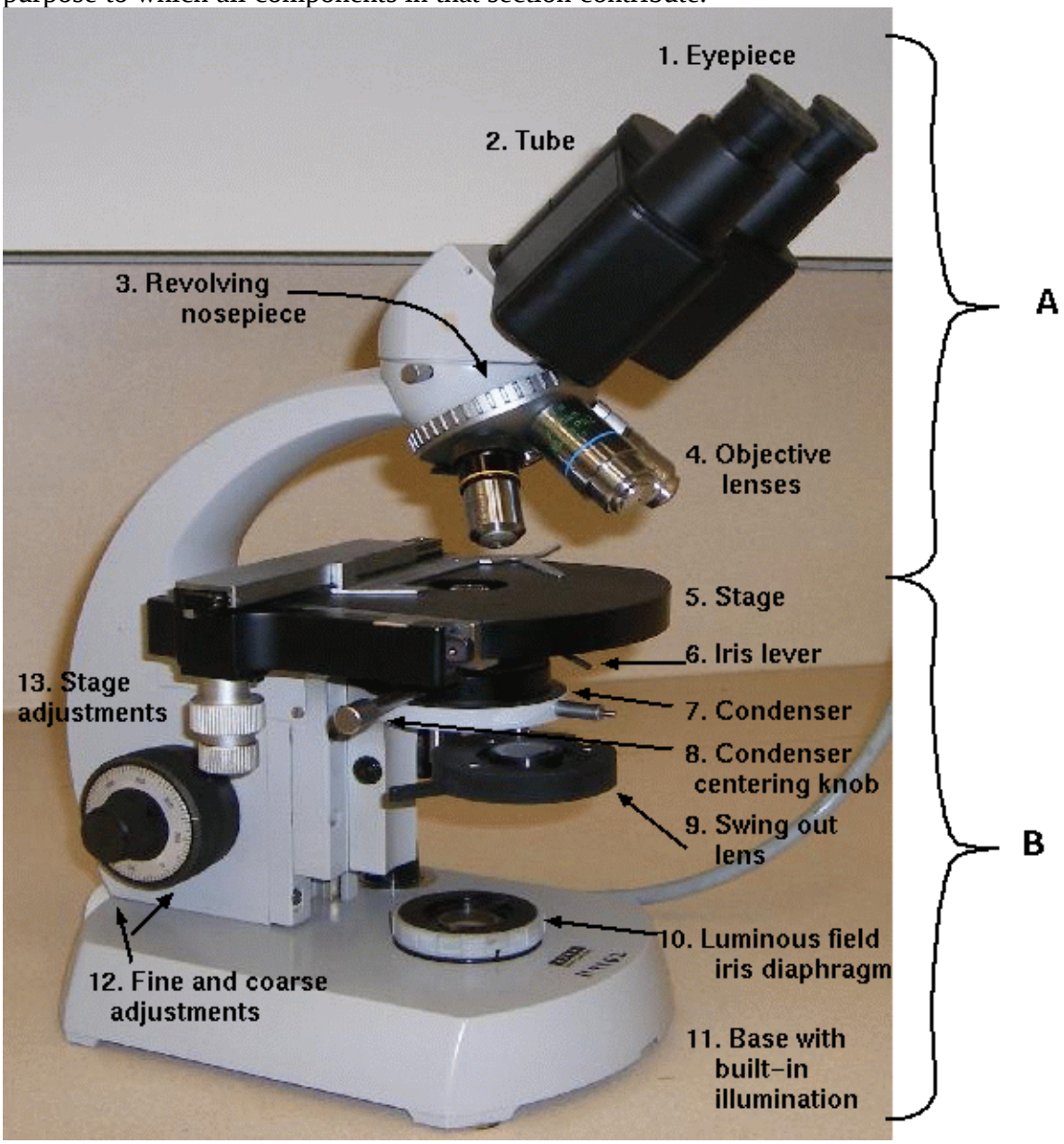
	PROKARYOTES	**EUKARYOTES**
TAXONOMIC GROUPS		
CELL-BIOLOGY		
GENOME STRUCTURE		
GENE EXPRESSION		
CELL CYCLE		

2. (10 points) Describe briefly two ways in which sexual reproduction through meiosis contributes to the genetic diversity in a population.

3. (5 points) Many eukaryotic organisms go through a haploid phase eg. plant gametophyte generation. How does going through a haploid phase benefit the species, from an evolutionary point of view?

4. (5 points) A small amount of DNA synthesis occurs at zygotene and pachytene. Why?

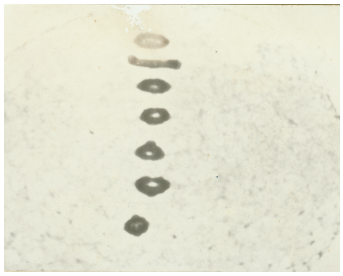
5. (10 points) The components of the microscope could be said to be organized into two sections, labeled A and B on the figure. For section, describe in one sentence the common purpose to which all components in that section contribute.



6. (5 points) What is the distinction between the term 'centromere' and the term 'kinetochore'?

7. (10 points) Describe two functions of the eukaryotic telomeres.

8. (10 points) Explain why chromosomes at meiotic metaphase I often have a "doughnut" shaped appearance, as shown in the figure.



9. (15 points) The protocol for C-banding, discussed in class, is given below.

a. Roots are harvested, pretreated and fixed in 3:1 95% ethanol:glacial acetic acid for at least 24 h. The roots are softened in 45% acetic acid or in 0.5% aceto-carmine. Slides are prepared by the squash method and the cover glass is removed using dry-ice method. Chromosomes adhere to the slide surface.

b. Dehydration. Typically slides are placed in 95 to 100% ethanol for 1 hour.

c. Denaturation. Treatment with barium hydroxide for 5 to 15 min at elevated temperature 50-55° C .

d. Renaturation. The slides are then washed with distilled water and transferred to incubation at 60° C in saline sodium-citrate solution SSC (NaCl). Incubation periods and temperature are variable.

e. Staining. Slides are then stained with Geimsa stain and checked periodically to see how the stain is progressing. When the optimal staining has been achieved, the slides are rinsed in distilled water to remove the excess stain, air-dried, stored in xylene overnight, air dried again and the cover slip is mounted using Canada Balsam, etc.

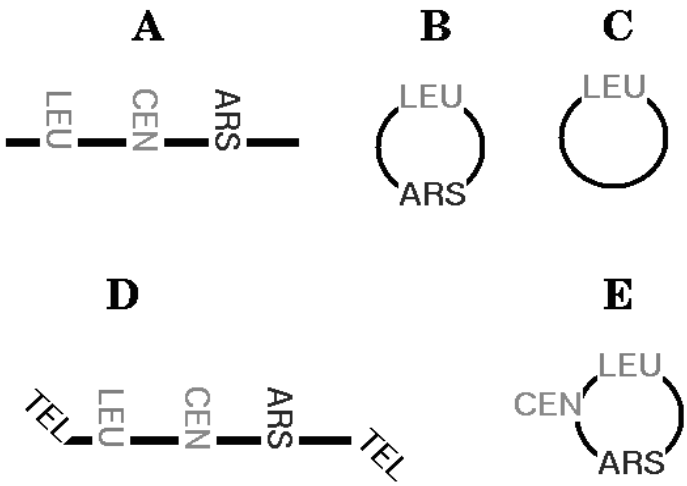
<u>Briefly</u> describe the purpose of :

i) The acid treatment a

ii) The alkali treatment in c

iii) The renaturation step in d ie. why does this step affect centromeric DNA differently and the rest of the genome?

10. (15 points) The figure at right shows several recombinant DNA constructs containing sequences including the yeast Leucine synthase gene (LEU), the yeast centromere (CEN), the yeast origin of replication (ARS) and the yeast telomere (TEL). The bottom figure illustrates several experiments in which yeast mutants deficient in leucine biosynthesis (ie. *leu* $^{-}$) were transformed with one of these constructs and plated first on complete media, and later plated on minimal media to test for growth without leucine. For each of the five constructs (A - E), indicate which of the experimental results (1-4) would be seen and explain why.



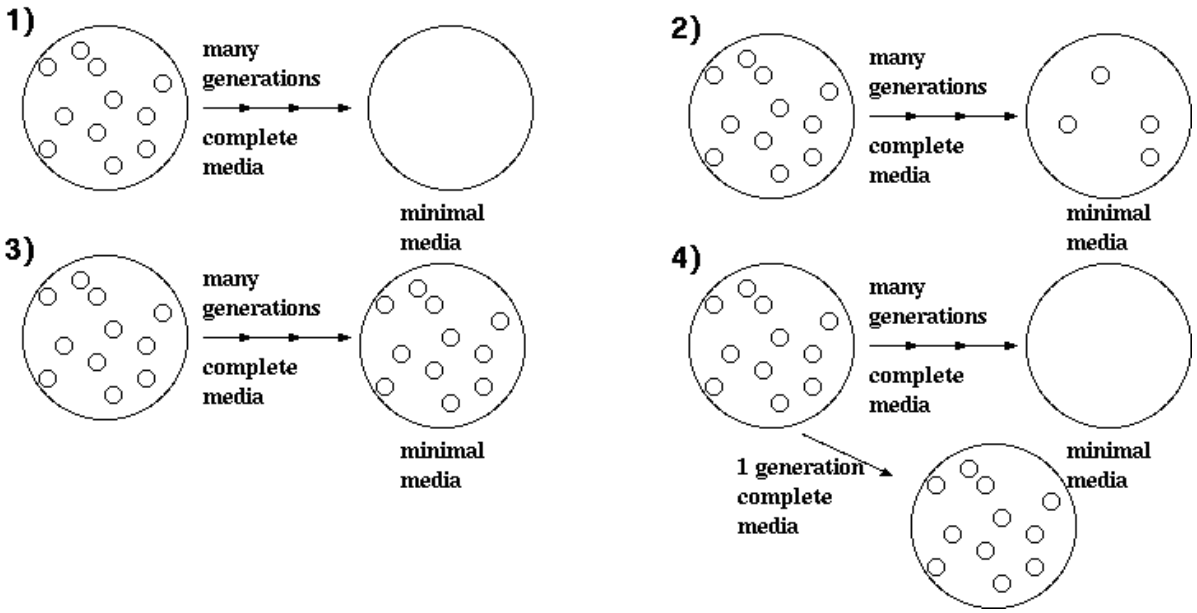
A)

B)

C)

D)

E)



11. (15 points) A spool of thread represents one solution to the problem of neatly packaging a very long object in a small space. We demonstrated in class that a chromosome packages DNA roughly 10 times more efficiently than a spool packages thread. While in principle it is concievable that a chromosome could be packaged on a "spool", there are a number of ways in which spool-like packaging would be disadvantageous, compared to the multi-level hierarchical packaging found in eukaryotic chromosomes. Considering all the things that eukaryotic chromosomes need to do, cite three reasons why hierarchical packaging is better than spool packaging.