PLNT2530 PLANT BIOTECHNOLOGY

MID-TERM EXAMINATION

11:30 am to 12:20 pm Monday, March 8, 2021

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. The questions total to 120 points. This exam is worth 20% of the course grade.

Hand in these question sheets along with your exam book. Question sheets will be shredded.

Ways to write a readable and concise answer:
i. Just answer the question. Save time by specifically addressing what is asked. Don't give irrelevant background if it doesn't contribute to the question that was asked.
ii. Avoid stream of consciousness. Plan your answer by organizing your key points, and then write a concise, coherent answer. Make your point once, clearly, rather than repeating the same thing several times with no new information.
iii. Point form, diagrams, tables, bar graphs, figures are welcome. Often they get the point across more clearly than a long paragraph.
iv. Your writing must be legible. If I can't read it, I can't give you any credit.

---

1. (10 points) Describe the purpose of a laminar flow hood. Explain how the function of the hood accomplishes that purpose.

2. (10 points) Why is it that plants cells in tissue culture can regenerate into complete organ systems such as shoots or roots? In particular, in what way do plants lend themselves to regeneration, where animals do not?

3. (5 points) Briefly explain the distinction between transposons and retrotransposons.

4. (10 points) For the following macroelements found used in tissue culture media, match each element with the phrase that best describes its role in the cell. To answer the question, simply write a list a - e, with the corresponding phrase. Only use each phrase once.

a) Nitrogen (N)
b) Potassium (K)
c) Calcium (Ca)
d) Magnesium (Mg)
e) Phosphorus (P)

i) nucleic acids, energy transfer, req'd in respiration and photosynthesis

ii) enzyme cofactor, component in chlorophyll

iii) proteins, nucleic acids

iv) regulates osmotic potential, main inorganic cation

v) cell wall structure, membrane function, signaling

5. (10 points) Consider the double-stranded duplexes shown below. Which duplex will be more stable, A or B? Which duplex will be more stable, C or D? In each case, explain your reasoning.

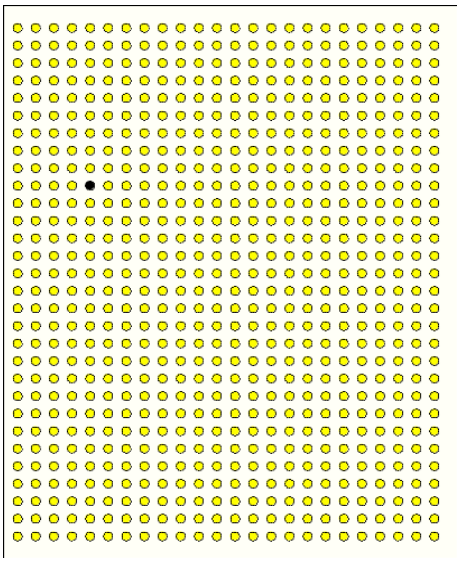
A 5' AACAATCGTAAG 3' 3' TTGTTAGCATTC 5'	**B** 5' AACTATCGTAAG 3' 3' TTGTTAGCATTG 5'
C 5' TCTGCTAACTGA 3' 3' AGACGATTGACT 5'	**D** 5' CCACTGACCTGG 3' 3' GGTGACTGGACC 5'

6. (5 points) Based on the data in the table below, which species, do you expect to have longer chromosomes, Glycine max or Zea mays? Explain your reasoning.

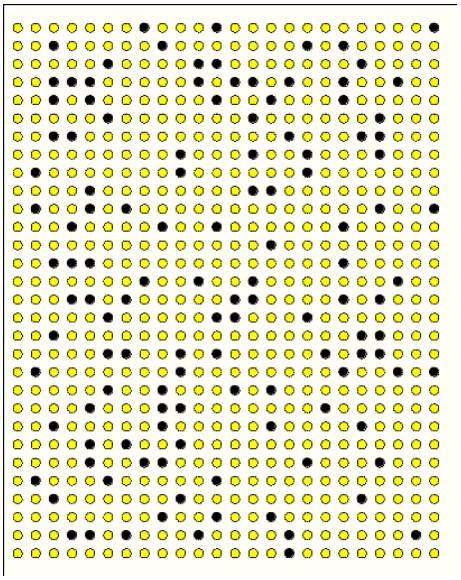
Organism	Chromosome number (n)	Genome size (bp)	Gene No.
Arabidopsis thaliana	5	1.19×10^8	25,400
Frageria vesca	7	2.80×10^8	25,050
Brassica rapa	10	2.84×10^8	41,174
Oryza sativa	12	4.66×10^8	58,000
Glycine max	20	1.10×10^9	46,430
Zea mays	10	2.80×10^9	63,000
Triticum aestivum	21	1.70×10^{10}	41,910

7. (10 points) A BAC library from pea (Pisum sativum) was screened with two probes. The first probe was a cDNA clone for pea defense gene DRR206. An identical filter was also probed using as a probe a 6 kb genomic fragment containing the DRR206 gene. Hybridization results for the two experiments are shown below. What is the most likely explantaion for the different results? You can ignore trivial explanations such as probe contamination.

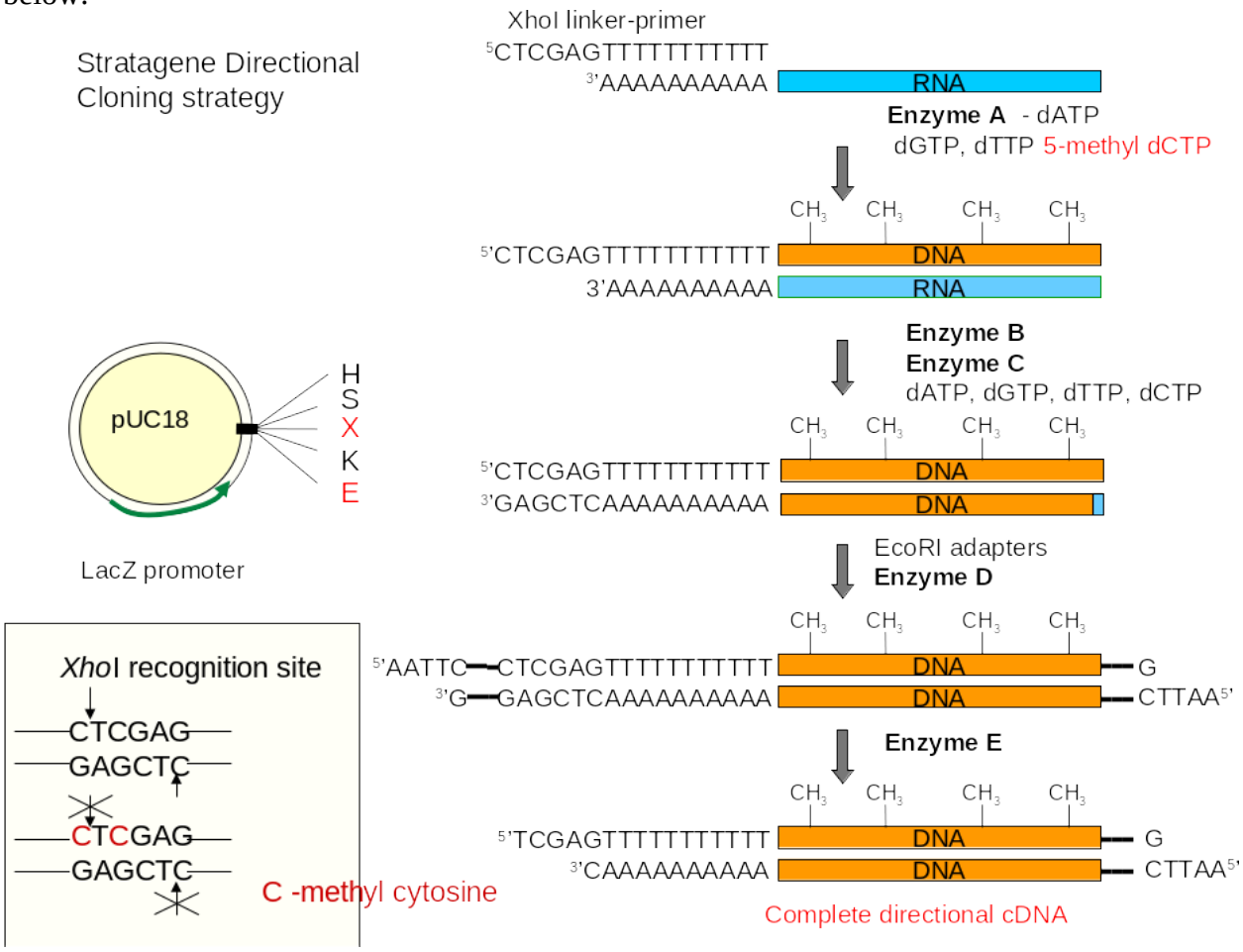
cDNA probe



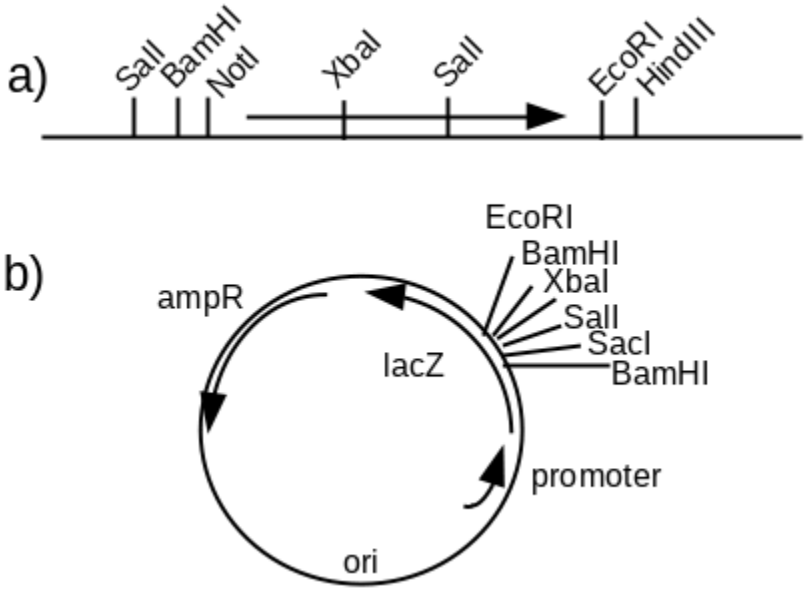
6 kb genomic probe



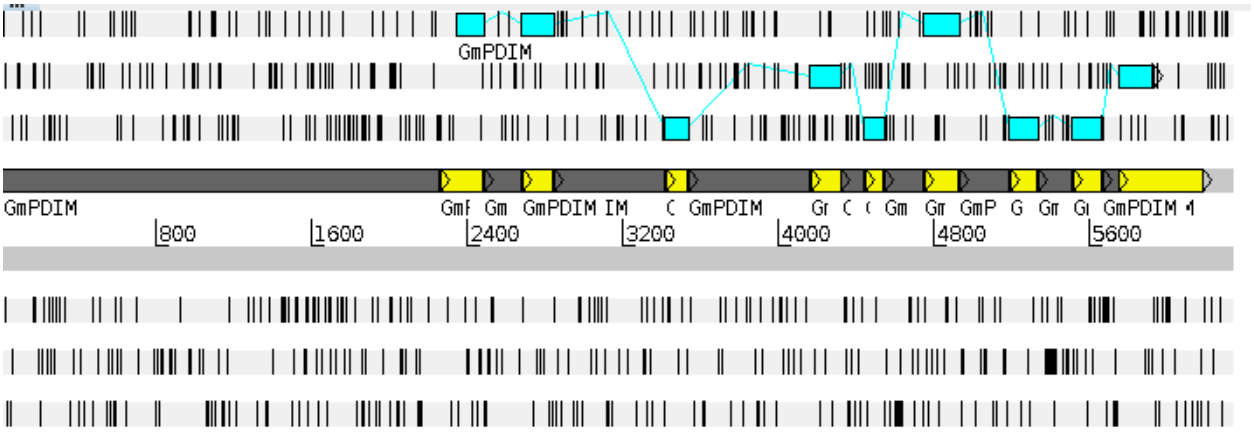
8. (10 points) List the names of Enzymes A - E, used in the cDNA cloning protocol shown below.



9. (10 points) Based on the restriction maps for a gene (a) and a vector (b), choose a pair of restriction enzymes that could be used to cut the entire gene from a, to be cloned between any two compatible sites in the vector.



10. (15 points) The image below depicts a clone for a gene for disulfide isomerase. In each of the 3 reading frames on the forward strand (top) and 3 reading frames on the reverse strand (bottom), stop codons are shown as vertical tick marks. A map of the gene is shown between the two strands.



a) Which boxes are exons, and which are introns? What lets you distinguish between exons and introns in this diagram?

b) Is this from a cDNA library, or a genomic library?

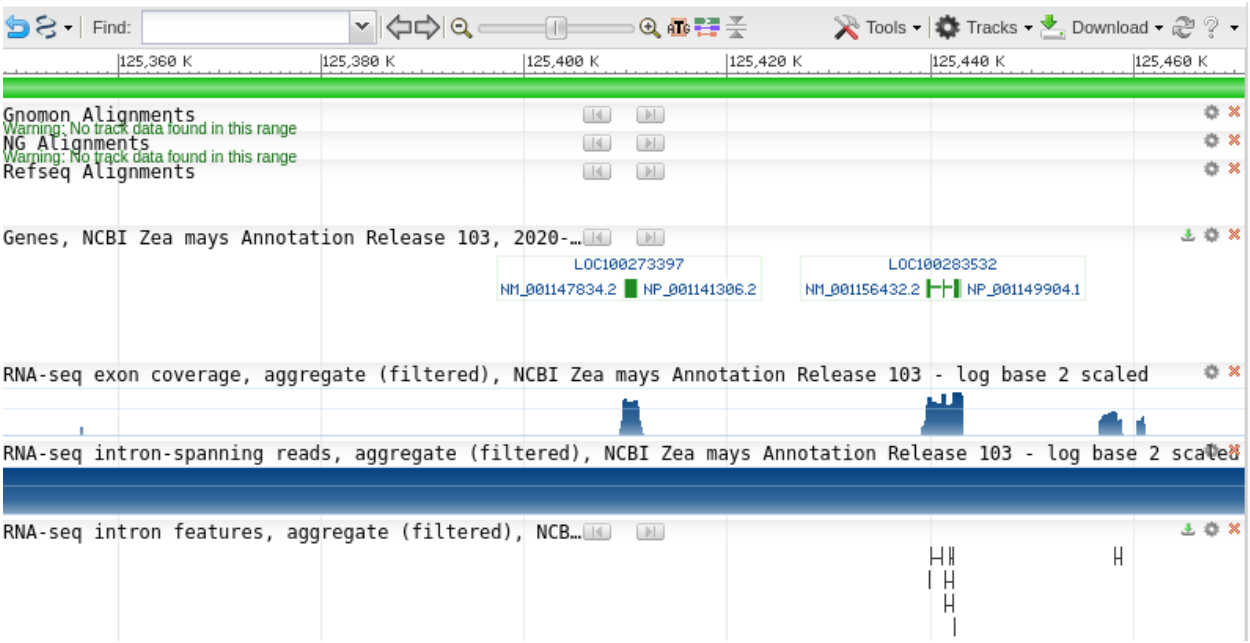
c) The gene shown was cloned into the multiple cloning region of the pUC18 cloning vector. Many white colonies were screened, but the disulfide isomerase protein could not be detected in any of the clones. What is the most likely reason that the protein was not produced in any of the clones?

11. (5 points) Media for co-cultivation of Agrobacterium with plant tissue needs Acetosyringone in order to induce Agrobacterium genes required for transformation. All other components are heat stabile, but Acetorsyringne would be destroyed by autoclaving. How could you sterilize the acetosyringone so that it could be added to the media after autoclaving?

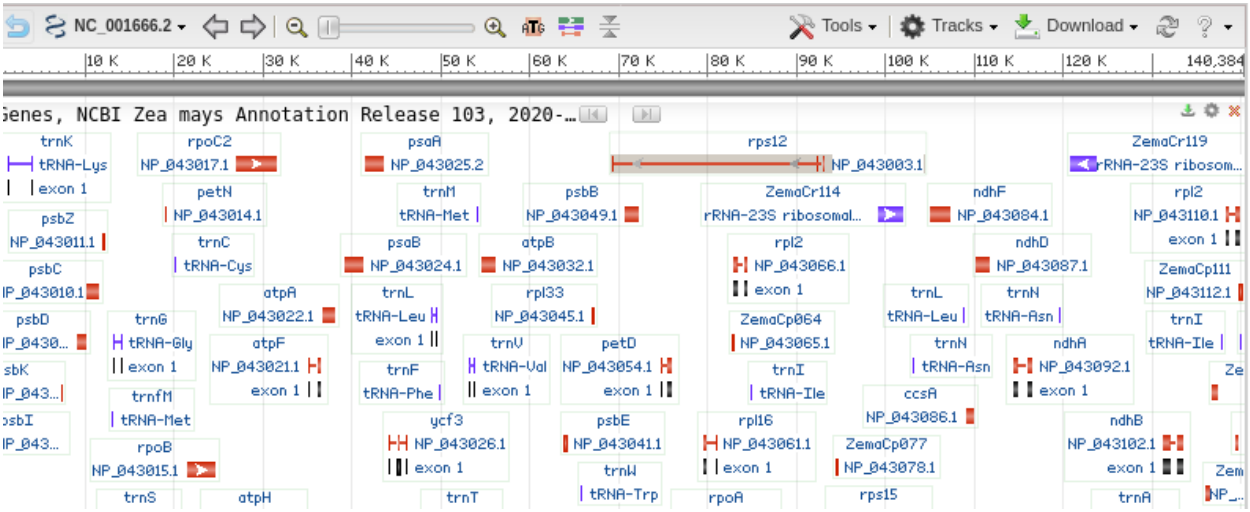
12. (10 points) The Td for a 100 bp DNA fragment is 72 °C at standard hybridization conditions. What would be the Td for a 500 bp fragment, given similar conditions? Show your work.

13. (10 points) One of the figures below is from a region of a maize nuclear chromosome. The other is from the maize chloroplast genome. Both diagrams span around 140 Kb of DNA. State which is genomic, and which is from chroloplast. What observations support your choices?

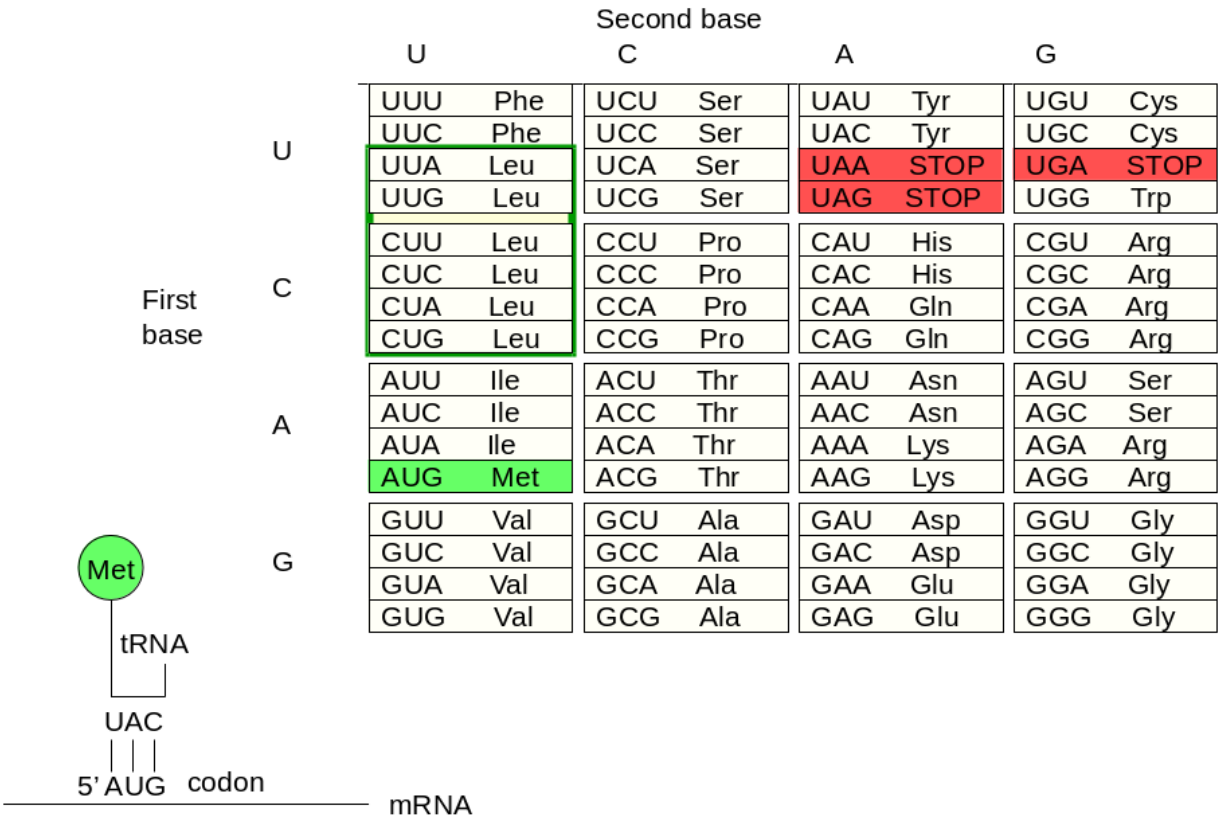
A



B



Genetic code



Frequencies of Restriction Sites (or other oligonucleotides)

length n	frequency: occurs every 4^n	example	sequence
1	4	Single nucleotide	G
2	16	Di-nucleotide	GT
3	64	Codon	ATG
4	256	Taq I	TCGA
5	1024	MboII	GAAGA
6	4096	Hind III	AAGCTT
7	16384	Abe I	CCTCAGC
8	65536	Not I	GCGGCCGC