Term Test 1

UNIVERSITY OF TORONTO MISSISSAUGA

Department of Biology

Introductory Genetics

Instructions: Duration 100 minutes

Please write your name and student # on both question sheet and Scantron.
Your Scantron cannot be read if the student number is filled in incorrectly.
For True/False questions, True is always a. and False is always b.
For multiple choice questions, choose the most applicable option.
Please hand back both the question sheet and Scantron.
Non-programmable calculators are permitted.

BIO207H5S WINTER 2017 Instructor Dr. JADE ATALLAH

1. Which of the following statements are true?
   a. Humans have been aware of hereditary traits > 10,000 years via selective breeding
   b. Exploring the mechanisms of heredity has been ongoing for > 10,000 years via selective breeding
   c. Mendel's work confirmed that DNA is the hereditary material
   d. a & b
   e. a & c
   f. b & c
   g. All of the above
2. Mendel chose the Pea as a model organism because
   a. It is easy to work with
   b. It comes in many varieties
   c. He was able to choose dichotomous traits
   d. He was able to perform controlled crosses
   e. a, b, and c
   f. a, b, and d
   g. All of the above
3. To ensure that parental strains are pure-breeding
   a. Mendel self-crossed plants over a period of 2 years before carrying out experimental crosses
   b. Mendel test-crossed plants over a period of 2 years before carrying out experimental crosses
   c. Mendel chose only dichotomous traits
   d. a & b
   e. a & c
   f. b & c
   g. All of the above
4. Performing controlled crossed in the pea plant involves
   a. Disposing of parent 1 flower ovules, fertilizing parent 2 flower with pollen from flower 1, and observing offspring of flower 2.
   b. Disposing of parent 1 flower ovules, fertilizing parent 2 flower with pollen from flower 1, and observing offspring of flower 1.
   c. Disposing of parent 1 flower ovules, fertilizing parent 1 flower with pollen from flower 2, and observing offspring of flower 1.
   d. Disposing of parent 1 flower pollen, fertilizing parent 1 flower with pollen from flower 2, and observing offspring of flower 2.
   e. Disposing of parent 1 flower pollen, fertilizing parent 2 flower with pollen from flower 1, and observing offspring of flower 2.
   f. Disposing of parent 1 flower pollen, fertilizing parent 1 flower with pollen from flower 2, and observing offspring of flower 1.
   g. None of the above
5. The blending theory of inheritance stipulates that when 2 pure breeding parental strains are crossed
   a. Traits in offspring are intermediates of parental traits
   b. Parental traits do not reappear when offspring are intercrossed in subsequent generations
   c. Dominant to recessive phenotypic ratios occur at a 3:1 in the F2 generation
   d. a & b
   e. a & c
   f. b & c
   g. All of the above
6. You are hired in a laboratory to confirm Mendel's finding. Which tests can be used to disprove the blending theory of inheritance?
   a. Cross pure breeding red eyes drosophila females to white eyes males followed by interbreeding F1.
   b. Cross pure breeding purple flowers to white flowers followed by interbreeding F1.
   c. Test cross pure breeding round-seeded flowers followed by interbreeding F1
   d. a & b

e. a & c
f. b & c
g. All of the above

7. Mendel's particulate theory of inheritance states that
   a. Plants carry 2 discrete hereditary units for each trait
   b. Plants carry 2 DNA molecules for each trait
   c. Plants carry 2 DNA sequences for each trait
   d. a & b
   e. a & c
   f. b & c
   g. All of the above
8. Rr x rr produces Rr:rr at a ratio of 1:1
   a. These results negate the blending theory of inheritance
   b. These results support Mendel's 1st law.
   c. These results support Mendel's 2nd law.
   d. a & b
   e. a & c
   f. b & c
   g. All of the above
9. Pure breeding purple flowers are test crossed. All F1 are purple and are interbred. 705 F2 are purple and 224 are white.
   a. These results negate the blending theory of inheritance
   b. These results support Mendel's 1st law.
   c. These results support Mendel's 2nd law.
   d. a & b
   e. a & c
   f. b & c
   g. All of the above
10. Pure breeding purple flowers are crossed to white flowers. All F1 are purple and are interbred. 651 F2 are purple and 207 are white.
   a. These results negate the blending theory of inheritance
   b. These results support Mendel's 1st law.
   c. These results support Mendel's 2nd law.
   d. a & b
   e. a & c
   f. b & c
   g. All of the above
11. You discover a new species of plants. You cross pure breeding transparent flowers to pure breeding rainbow flowers. All F1 are rainbow and are test crossed. 428 F2 are rainbow and 152 are transparent.
   a. These results negate the blending theory of inheritance
   b. These results support Mendel's 1st law.
   c. These results support Mendel's 2nd law.
   d. a & b
   e. a & c
   f. b & c
   g. All of the above
12. RR (round) x rr (wrinkled) produces round F1. F1 x rr produces 603 round and 599 wrinkled. Some intelligent 2017 Bio207 students rightfully argued that it is possible to generate these results while violating Mendel's laws, such that: 1) parental RR fail to segregate generating RR F1, 2) F1 RR fail to segregate generating RR F2, and 3) rr from individuals mated to F1 fail to segregate generating rr F2.
   a. This scenario is possible under the assumption that it is possible for different hereditary mechanisms to operate in the parental cross compared to the F1 cross
   b. This scenario is possible under the assumption that unsegregated rr is not passed on to F1 but is passed on to F2.
   c. Assuming same hereditary mechanisms operate in all crosses, these results support the law of segregation.
   d. a & b
   e. a & c

f. b & c
g. All of the above

Questions 13 to 33

Parent 1 (P1) ♂ RR (round seeds) x Parent 2 (P2) ♀ rr (wrinkled seeds). F1 are self-fertilized. Each F2 plant is self-fertilized individually.

13. The zygotes resulting from parental cross develop in the
    a. P1 plant b. P2 plant c. F1 plant d. F2 plant e. a & b f. more than one of the above
14. The genotype of resulting zygotes from parental cross before planting is
    a. R b. r c. RR d. Rr e. rr f. RR, Rr, or rr g. R or r
15. The phenotype of resulting zygotes from parental cross before planting
    a. Round b. Wrinkled c. Round:wrinkled @ 3:1 d. Round:Wrinkled @ 1:1 e. None of the above
16. The genotype of F1 somatic cells is
    a. R b. r c. RR d. Rr e. rr f. RR, Rr, or rr g. R or r
17. The genotype of F1 ovules is
    a. R b. r c. RR d. Rr e. rr f. RR, Rr, or rr g. R or r
18. The genotype of F1 pollen is
    a. R b. r c. RR d. Rr e. rr f. RR, Rr, or rr g. R or r
19. The phenotype of F1 ovules is
    a. Round b. Wrinkled c. Round:wrinkled @ 3:1 d. Round:Wrinkled @ 1:1 e. None of the above
20. The zygotes resulting from F1 self-fertilization develop in the
    a. P1 plant b. P2 plant c. F1 plant d. F2 plant e. a & b f. more than one of the above
21. Zygotes within 1 pod resulting from F1 self fertilization have the genotype
    a. R b. r c. RR d. Rr e. rr f. RR, Rr, or rr g. R or r
22. Zygotes within 1 pod resulting from F1 self-fertilization have the phenotype
    a. Round b. Wrinkled c. Round:wrinkled @ 3:1 d. Round:Wrinkled @ 1:1 e. None of the above
23. The genotype of F2 somatic cells is
    a. R b. r c. RR d. Rr e. rr f. RR, Rr, or rr g. R or r
24. The genotype of F2 ovules is
    a. R b. r c. RR d. Rr e. rr f. RR, Rr, or rr g. R or r
25. The genotype of F2 pollen is
    a. R b. r c. RR d. Rr e. rr f. RR, Rr, or rr g. R or r
26. The phenotype of F2 ovules is
    a. Round b. Wrinkled c. Round:wrinkled @ 3:1 d. Round:Wrinkled @ 1:1 e. None of the above
27. The phenotype of all resulting F3 plants is
    a. Round b. Wrinkled c. Round:wrinkled @ 3:1 d. Round:Wrinkled @ 1:1 e. None of the above
28. The genotype of all resulting F3 plants is
    a. R b. r c. RR d. Rr e. rr f. RR, Rr, or rr g. R or r
29. An F3 plant is picked randomly. What is the probability that its gametes are wrinkled?
    a. 0 b. 3/10 c. ½ d.7/10 e. 2/5 f. 3/5 g. None of the above
30. An F3 plant is picked randomly. What is the probability that all of its gametes have the same genotype?
    a. 0 b. 3/10 c. ½ d. 7/10 e. 2/5 f. 3/5 g. None of the above
31. An F3 plant is picked randomly. What is the probability that its gametes have variable genotypes?
    a. 0 b. 3/10 c. ½ d. 7/10 e. 2/5 f. 3/5 g. None of the above
32. An F3 plant is picked randomly. What is the probability that its gametes have variable phenotypes?
    a. 0 b. 3/10 c. ½ d. 7/10 e. 2/5 f. 3/5 g. None of the above
33. An F3 plant is picked randomly. What is the probability that its gametes are wrinkled or of variable genotypes?
    a. 0 b. 3/10 c. ½ d. 7/10 e. 2/5 f. 3/5 g. None of the above

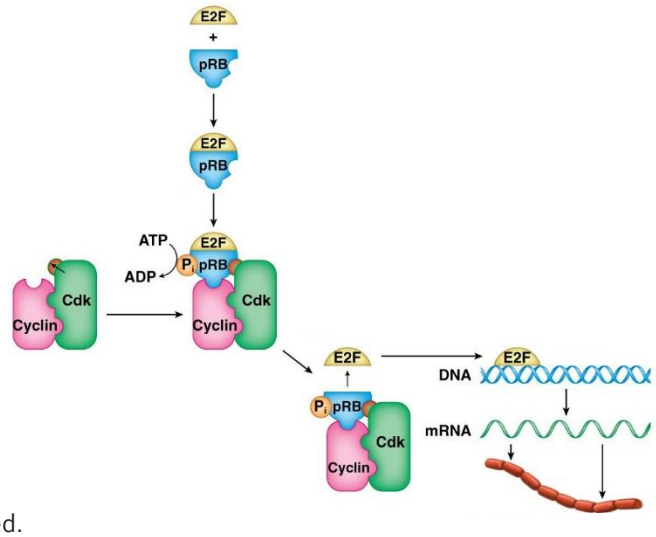
Questions 34 to 62

Consider a diploid plant species with 3 different chromosomes. Parent 1 (P1) ♂ RR (round seeds) x Parent 2 (P2) ♀ rr (wrinkled seeds). F1 are self-fertilized. All experimental subjects contain 100% healthy cells.

34. All cells of P1 individual contain the same number of chromosomes. T/F

35. All cells of F1 individuals contain the same number of chromosomes. T/F
36. All G2 somatic cells of P1 contain the same number of chromosomes. T/F
37. All G2 somatic cells of F1 contain the same number of chromosomes. T/F
38. All G2 and S somatic cells of F1 contain the same number of chromosomes. T/F
39. All G1 and S somatic cells of P2 contain the same number of chromosomes. T/F
40. All mitosis daughter cells of F1 contain an ' r ' allele. T/F
41. All F1 gametic cells contain the same number of chromosomes. T/F
42. You extract a somatic cell from F1. You expect that it contains ------- ' r ' allele(s).
    a. 1 b. 2 c. 3 d. 12 e. 24 f. 48 g. Depends on random segregation.
43. You extract a G1 somatic cell from F1. You expect that it contains ------- ' r ' allele(s).
    a. 1 b. 2 c. 3 d. 12 e. 24 f. 48 g. Depends on random segregation.
44. You extract a G2 somatic cell from F1. You expect that it contains ------- copies of the ' r ' allele.
    a. 1 b. 2 c. 3 d. 12 e. 24 f. 48 g. Depends on random segregation.
45. You extract an S phase somatic cell from F1. You expect that it contains ------- copies of the ' r ' allele.
    a. 1 b. 2 c. 3 d. 12 e. 24 f. 48 g. Depends on random segregation.
46. You extract a somatic cell from F1. You expect that it contains ------- chromosomes.
    a. zero b. 3 c. 6 d. 12 e. 24 f. 48 g. Depends on the organ the cell is extracted from and/or the developmental stage.
47. You extract a somatic cell from F1. You expect that it contains ------- homologous chromosome pairs.
    a. zero b. 3 c. 6 d. 12 e. 24 f. 48 g. Depends on the organ the cell is extracted from and/or the developmental stage.
48. You extract a gametic cell from F1. You expect it contains ------- chromosomes.
    a. zero b. 3 c. 6 d. 12 e. 24 f. 48 g. Depends on the gender of the individual.
49. You extract a gametic cell from F1. You expect that it contains ------- ' r ' allele(s).
    a. 1 b. 2 c. 3 d. 12 e. 24 f. 48 g. Depends on random segregation.
50. You extract a gametic cell from F1. You expect that it contains ------- homologous chromosome pairs.
    a. zero b. 3 c. 6 d. 12 e. 24 f. 48 g. Depends on the gender of the individual.
51. During G2, a cell extracted from an F1 leaf is expected to contain ------ strands of ssDNA.
    a. 2 b. 3 c. 6 d. 12 e. 24 f. 48 g. Depends on whether strands are 5' to 3'.
52. During prophase of meiosis I, a cell is expected to contain ------ chromosomes.
    a. 2 b. 3 c. 6 d. 12 e. 24 f. 48 g. Depends on the substages of prophase.
53. During prophase of meiosis I, a cell is expected to contain ------ pairs of homologous chromosomes.
    a. zero b. 3 c. 6 d. 12 e. 24 f. 48 g. Depends on the substages of prophase.
54. During metaphase of meiosis I, a cell is expected to contain ------ pairs of sister chromatids.
    a. zero b. 3 c. 6 d. 12 e. 24 f. 48 g. Depends on the progression of metaphase.
55. During prometaphase of meiosis I, a cell is expected to contain ------ double helices.
    a. zero b. 3 c. 6 d. 12 e. 24 f. 48 g. Depends on whether nondisjunction is occurring.
56. During meiosis I, a cell is expected to contain ------ strands of ssDNA.
    a. zero b. 3 c. 6 d. 12 e. 24 f. 48 g. Depends on whether strands are 5' to 3'.
57. During mid- meiosis I, a cell is expected to contain ------ bound kinetichores.
    a. zero b. 3 c. 6 d. 12 e. 24 f. 48 g. Depends on the stage of meiosis.
58. During meiosis II, a cell is expected to contain ------ chromosomes.
    a. zero b. 3 c. 6 d. 12 e. 24 f. 48 g. Depends on the stage of meiosis II.
59. During meiosis II, a cell is expected to contain ------ pairs of sister chromatids.
    a. zero b. 3 c. 6 d. 12 e. 24 f. 48 g. Depends on the stage of meiosis II.
60. During metaphase of meiosis II, a cell is expected to contain ------ double helices.
    a. zero b. 3 c. 6 d. 12 e. 24 f. 48 g. Depends on whether nondisjunction is occurring.
61. During mid-meiosis II, a cell is expected to contain ------ bound kinetichores.
    a. zero b. 3 c. 6 d. 12 e. 24 f. 48 g. Depends on the stage of meiosis.
62. During early meiosis II, a cell is expected to contain ------ pairs of homologous chromosomes.
    a. zero b. 3 c. 6 d. 12 e. 24 f. 48 g. Depends on the stage of meiosis.

Questions 63 to 64

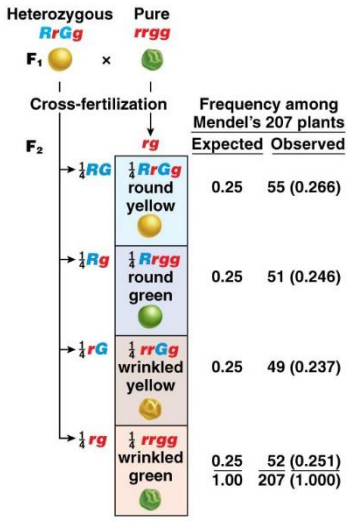


63. Mutations that overexpess Rb gene expression will have what effect on cell proliferation?
    a. Cells will proliferate less because growth factors are absent.
    b. Cells will proliferate more, regardless of growth factor concentration.
    c. Cells will proliferate less
    d. Cells will proliferate more because growth factors are produced in excess.
    e. There will be no effect on cell proliferation; only apoptosis occurs.

64. If you mutate the gene encoding Cdk such that Cdk protein product cannot bind to pRB, what effect would you expect to see?
    a. Cdk will be constitutively active, so the cell cycle will be unchecked.
    b. Cdk will phosphorylate its target proteins regardless of the cell cycle.
    c. Cdk will be unaffected.
    d. Cdk will be inactive, so the target proteins will not be phosphorylated.
    e. The cell cycle will be up-regulated, and the cells will proliferate.

Questions 65 to 69

The following figure shows the results of Mendel's test-cross analysis of independent assortment. In this experiment, he first crossed pure-breeding round, yellow plants to pure-breeding wrinkled, green plants. The round yellow F1 are crossed to pure-breeding wrinkled, green plants.



65. To what interval of P values does the chi-square value correspond?
    a. 0.70-0.90
    b. 0.70-0.90
    c. 0.01-0.05
    d. 0.05-0.10
    e. 0.05-0.10
    f. 0.90-0.95
    g. 0.90-0.95
66. Can the null hypothesis be rejected?
    a. Yes b. No
67. To support Mendel's model, P value should be <0.05. T/F
68. These results indicate that deviations from Mendel's model are a fluke. T/F
69. The null hypothesis supports Mendel's model. T/F

Optional – No marks would be lost by not answering.

70. I found the online lecture extremely helpful in learning. T/F

71. I would like more courses to use online lectures. T/F

72. I prefer online over in-class lectures. T/F

Chi-Square Distribution

Degrees of Freedom	0.99	0.95	0.90	0.75	0.50	0.25	0.10	0.05	0.01
1	0.000	0.004	0.016	0.102	0.455	1.32	2.71	3.84	6.63
2	0.020	0.103	0.211	0.575	1.386	2.77	4.61	5.99	9.21
3	0.115	0.352	0.584	1.212	2.366	4.11	6.25	7.81	11.34
4	0.297	0.711	1.064	1.923	3.357	5.39	7.78	9.49	13.28
5	0.554	1.145	1.610	2.675	4.351	6.63	9.24	11.07	15.09
6	0.872	1.635	2.204	3.455	5.348	7.84	10.64	12.59	16.81
7	1.239	2.167	2.833	4.255	6.346	9.04	12.02	14.07	18.48
8	1.647	2.733	3.490	5.071	7.344	10.22	13.36	15.51	20.09
9	2.088	3.325	4.168	5.899	8.343	11.39	14.68	16.92	21.67
10	2.558	3.940	4.865	6.737	9.342	12.55	15.99	18.31	23.21
11	3.053	4.575	5.578	7.584	10.341	13.70	17.28	19.68	24.72
12	3.571	5.226	6.304	8.438	11.340	14.85	18.55	21.03	26.22
13	4.107	5.892	7.042	9.299	12.340	15.98	19.81	22.36	27.69
14	4.660	6.571	7.790	10.165	13.339	17.12	21.06	23.68	29.14
15	5.229	7.261	8.547	11.037	14.339	18.25	22.31	25.00	30.58
16	5.812	7.962	9.312	11.912	15.338	19.37	23.54	26.30	32.00
17	6.408	8.672	10.085	12.792	16.338	20.49	24.77	27.59	33.41
18	7.015	9.390	10.865	13.675	17.338	21.60	25.99	28.87	34.80
19	7.633	10.117	11.651	14.562	18.338	22.72	27.20	30.14	36.19
20	8.260	10.851	12.443	15.452	19.337	23.83	28.41	31.41	37.57
22	9.542	12.338	14.041	17.240	21.337	26.04	30.81	33.92	40.29
24	10.856	13.848	15.659	19.037	23.337	28.24	33.20	36.42	42.98
26	12.198	15.379	17.292	20.843	25.336	30.43	35.56	38.89	45.64
28	13.565	16.928	18.939	22.657	27.336	32.62	37.92	41.34	48.28
30	14.953	18.493	20.599	24.478	29.336	34.80	40.26	43.77	50.89
40	22.164	26.509	29.051	33.660	39.335	45.62	51.80	55.76	63.69
50	27.707	34.764	37.689	42.942	49.335	56.33	63.17	67.50	76.15
60	37.485	43.188	46.459	52.294	59.335	66.98	74.40	79.08	88.38