Tentamen, Genetik (NBIA24, 91BI11, 91BI17, 92BI11, 92BI17 och TFBI11), 10/6 2015

Sist i häftet hittar du svarsblanketten. Fyll i rätt svar på denna och lämna in.

Betygsgränser:
NBIA24, TFBI11: U: 0 - 31, 3: 32 - 37, 4: 38 - 43, 5: 44 - 50
91BI11, 91BI17, 92BI11, 92BI17: U: 0 - 31, G: 32 - 42, VG: 43 - 50

LYCKA TILL!

Tentatema: ärta

1. In pea the letter a can refer to
   (a) An allele at the locus for flower colour
   (b) The flower colour phenotype of an individual
   (c) The flower colour genotype of a gamete
   (d) More than one of a - c.
   (e) All of a - c.
2. The germ line refers to
   (a) Sperms and eggs
   (b) The zygote and all embryonic cells resulting from it
   (c) The zygote, the gametes and all the cells in between
   (d) The cells in the pollen tube
   (e) Bacteria infecting a wound and all the cells they give rise to

3. The *Elf* gene in pea shares an evolutionary origin with the *Elf* gene in *Arabidopsis thaliana*. The two genes are said to be

   (a) homologous
   (b) paralogous
   (c) orthologous
   (d) both homologous and paralogous
   (e) both homologous and orthologous

4. The sex chromosomes in the heterogametic sex is designated

   (a) XX
   (b) XY
   (c) ZZ
   (d) ZW
   (e) either XY or ZW depending on the sex determination system

5. A peahen with the genotype $Z^{+}Z^{ca}$ is crossed with a peacock with the genotype $Z^{ca}W$. What is the phenotype of the two birds?

   (a) the peahen is Z^{ca} and the peacock is Z^{+}
   (b) the peahen is Z^{+} and the peacock is Z^{ca}
   (c) the peahen is Z^{+} and the peacock is W
   (d) both are Z^{+}
   (e) both are Z^{ca}

6. A peahen with the genotype $Z^{ca}Z^{ca}$ is crossed with a peacock with the genotype $Z^{+}W$. In relation to the cross in 5 this cross is called a

   (a) testcross
   (b) backcross
   (c) reciprocal cross
   (d) monohybrid cross
   (e) dihybrid cross

7. Traits expressed only in one sex are called

   (a) sex limited.
   (b) sex linked.
   (c) sex oriented.
   (d) sex influenced.
   (e) hemizygous.

8. **XXX** are sets of genes that are similar in sequence but encode different products.

   (a) Codons
   (b) Genomes
   (c) Exons
   (d) Pseudogenes
   (e) Multigene families

9. What chromosomal mutation is shown in the figure?

   (a) paracentric insertion
   (b) pericentric insertion
   (c) paracentric inversion
   (d) pericentric inversion
   (e) translocation

10. How many different phenotypes can be expressed in a character controlled solely by a one-gene, two-allele system, in which the alleles are codominant?

   (a) one
   (b) two
   (c) three
   (d) five
   (e) ten

11. Which of the following statements about dominance is true?

   (a) A dominant allele is the most common in a population.
   (b) A dominant allele is the wildtype state of an allele.
   (c) A dominant allele is only expressed in homozygotes.
   (d) A dominant allele is expressed in homozygotes and heterozygotes.
   (e) More than one statement is correct.

12. A tall, yellow plant is crossed with a tall, green plant and yields 3/4 tall, yellow:1/4 short, yellow. What is the genotype of the tall, green plant?

   (a) $TTYY$
   (b) $TTYy$
   (c) $TtYy$
   (d) $Ttyy$
   (e) $TtYY$

13. After crossing two pure pea lines Mendel obtained individuals with the genotype *Yy Rr Aa Tt*. How many different gametes can the tetrahybrids produce?

    (a) 4
    (b) 8
    (c) 16
    (d) 64
    (e) 128

14. Which of the following would **not** necessarily be true for a DNA molecule?

    (a) A = T
    (b) C = G
    (c) A + T = G + C
    (d) A + G = C + T

15. In Mendel's peas, yellow seeds are dominant to green. A pure-breeding yellow plant is crossed with a pure-breeding green plant. All of the offspring are yellow. If one of these yellow offspring is crossed with a green plant, what will be the expected proportion of plants with green seeds in the next generation?

    (a) 0 %
    (b) 25 %
    (c) 50 %
    (d) 75 %
    (e) 100 %

16. Gregor crosses two pure lines of peas, one with round seeds and one with wrinkled seeds. He then allows the offspring, all of which are round to self-fertilize. What proportion of the seeds in the F_2 is expected to be round?

    (a) 1/4
    (b) 1/2
    (c) 2/3
    (d) 3/4
    (e) All seeds.

17. Assuming complete dominance and no linkage, what is the phenotypic ratio of the offspring of the cross $AaBb \times aabb$?

    (a) 1:1
    (b) 3:1
    (c) 1:1:1:1
    (d) 9:3:3:1
    (e) 1:2:1

18. A heterozygous pea is allowed to self fertilize. Among the offspring a particular phenotype segregates 1:2. What conclusion can you make?

    (a) The trait is controlled by more than one gene

    (b) The trait is a recessive lethal

    (c) The trait is a dominant lethal

    (d) The trait is caused by recessive epistasis

    (e) The trait is caused by dominant epistasis

19. What segregation ratio is expected among the phenotypes of a trait that is caused by two genes with dominant epistasis and no linkage?

    (a) 9:3:3:1

    (b) 9:3:4

    (c) 9:6:1

    (d) 12:3:1

    (e) 9.7

20. The following pea cross is set up: $++ \times yy$. Which of the following is **not** true?

    (a) The maternal plant has the dominant genotype

    (b) The maternal plant has a different phenotype from the pollen donor

    (c) The pollen donor has the recessive genotype

    (d) The pollen donor is wild type

    (e) The pollen donor carries a mutation

21. In 1892, the Swedish plant breeder Hans Tedin, made crossing experiments with peas. Tedin wanted to produce a new homogenous cultivar (all individuals identical), but had severe problems. Remember, this was eight years before the re-discovery of Mendel's laws. What should Tedin have done?

    (a) Repeatedly selected seeds from single individual plants.

    (b) Only chosen plants with phenotypes of dominant traits.

    (c) Alternated back crossing with the P_1 and P_2 plants.

    (d) Multiplied all offspring in several generations and then selected seed from single plants.

    (e) He could have used more than one strategy of the ones above.

22. A pea which is tall (T-locus) and has pigmented flowers (A-locus) is crossed with a pea that is tall and has unpigmented flowers. The offspring consists of 3/4 tall, pigmented and 1/4 short, pigmented. What is the genotype of the tall, unpigmented pea (assuming the genes are unlinked)?

    (a) $AATT$
    (b) $aatt$
    (c) $AATt$
    (d) $aaTt$
    (e) $AaTt$

23. The temporary reduction in density of a population leading to random genetic drift is called

    (a) a founder effect.
    (b) a Wahlund effect.
    (c) density-dependent selection.
    (d) a bottleneck.
    (e) selection.

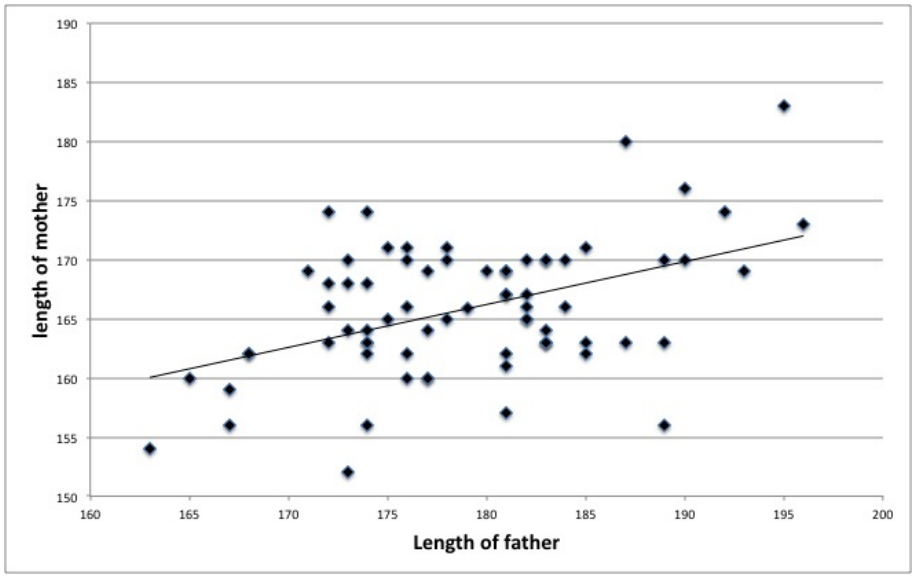
24. The evolution of a new species, regardless of mechanism, is called

    (a) cladogenesis.
    (b) anagenesis.
    (c) phyletic evolution.
    (d) true speciation.
    (e) speciation.

25. In humans living in parts of Africa the allele for sicle cell anemia can be considered lethal in homozygous form while it in heterozygous form gives the carrier a certain resistance to malaria. Which of the following best describes how selection is acting on the three genotypes?

    (a) 1 - s, 1, 1 - s
    (b) 1 - s, 1, 0
    (c) 1, 1, 1 - s
    (d) 1, 1 - s, 1
    (e) 0, 1, 0

26. The figure shows length data for human couples. It is an example of



(a) positive assortative mating.

(b) negative assortative mating.

(c) inbreeding.

(d) heterozygote advantage

(e) selection

27. **XXX** speciation arises in the absence of any geographic barrier to gene flow.

(a) Allopatric

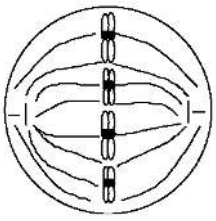
(b) Autocratic

(c) Parapatric

(d) Peripatric

(e) Sympatric

28. Identify the stage of cell division and the diploid number of the cell in the figure below.



(a) metaphase I of meiosis, 2n = 4

(b) metaphase I of meiosis, 2n = 8

(c) metaphase II of meiosis, 2n = 4

(d) metaphase of mitosis, 2n = 4

(e) none of these choices

29. What process is unique to plants?

    (a) meiosis
    (b) double fertilization
    (c) crossing over
    (d) haploid gametes
    (e) spermatogenesis

30. Which of the following is the correct sequence of stages of the eukaryotic cell cycle?

    (a) G1, S, M, G2
    (b) G1, G2, S, M
    (c) M, G1, S, G2
    (d) M, S, G1, G2
    (e) S, G1, G2, M

31. The female snake Marsha Jones parthenogenetically produced a son, Napoleon. The species has a chromosomal ZZ/ZW sex determination system. Which of the following statements is true.

    (a) Napoleon will be completely homozygous since he's the result of a failed meiosis
    (b) Napoleon will be completely haploid since he's the result of an unfertilised egg
    (c) Napoleon will be genetically identical to his mother since he must be the result of mitosis
    (d) Napoleon will be genetically identical to his mother since he's a result of a failed meiosis
    (e) The fact that Napoleon is male proves he cannot be the result of mitosis

32. A diploid somatic cell from a rat has a total of 42 chromosomes (2n = 42). As in humans, sex chromosomes determine sex: XX in females and XY in males. What is the total number of chromosomes present in the cell during metaphase I of meiosis?

    (a) 21
    (b) 42
    (c) 84
    (d) 126
    (e) 168

33. Linked genes...

    (a) assort randomly
    (b) are allelic
    (c) segregate independently
    (d) co-segregate
    (e) none of the above

34. Herbert Lamprecht crossed pure lines of peas with round seed and tendrils (shown in the figure below) with peas with wrinkled seeds and no tendrils. The F_1 had round seeds and tendrils. Test crossing the F_1 produced an F_2 with the following phenotypes: 537 round seeds, with tendrils; 542 wrinkled seeds, without tendrils; 99 round seeds, without tendrils; 107 wrinkled seeds, with tendrils. What map distance did Herbert find between the two loci?

(a) 0.16 cM

(b) 0.77 cM

(c) 8.3 cM

(d) 16.0 cM

(e) 18.4 cM

35. In pea round seeds are dominant over wrinkled seeds, blunt pod apex is dominant over pointed pod apex and normal wax layer is dominant over limited wax layer. The Swedish pea geneticist Stig Blixt testcrossed trihybrid pea plants. Determine the gene order from the following information about the progeny phenotypes:

round, blunt, normal wax	135	wrinkled, blunt, normal wax	461
round, blunt, limited wax	395	wrinkled, blunt, limited wax	307
round, pointed, normal wax	309	wrinkled, pointed, normal wax	398
round, pointed, limited wax	459	wrinkled, pointed, limited wax	132

(a) round - blunt - normal wax

(b) round - normal wax - blunt

(c) blunt - round - normal wax

(d) normal wax - blunt - round

(e) blunt - normal wax - round

36. Use the information in 35 and calculate the genetic distance between the loci for seed shape and wax distribution.

    (a) 29.0 cM
    (b) 34.0 cM
    (c) 40.8 cM
    (d) 50 cM
    (e) 64.6 cM

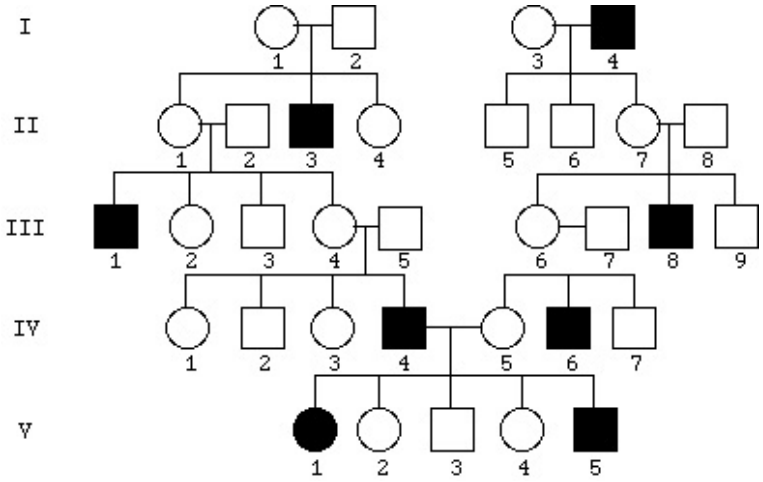
37. A tortoiseshell female cat is mated with a red male cat. Which of the following phenotypes is **not** expected?

    (a) a red female
    (b) a tortoiseshell female
    (c) a black male
    (d) a red male
    (e) a tortoiseshell male

38. Red-green colour blindness is X-linked recessive. A woman with normal colour vision has a father who is colour blind. The woman has a child with a man with normal colour vision. Their first child is colour blind son. What is the probability that the second child is a colour blind son?

    (a) 0
    (b) 1/4
    (c) 1/2
    (d) 3/4
    (e) 1

39. The pedigree shows the inheritance of a rare disease. What conclusions regarding the inheritance of the disease can you make from the pedigree?



(a) The trait must be autosomal dominant

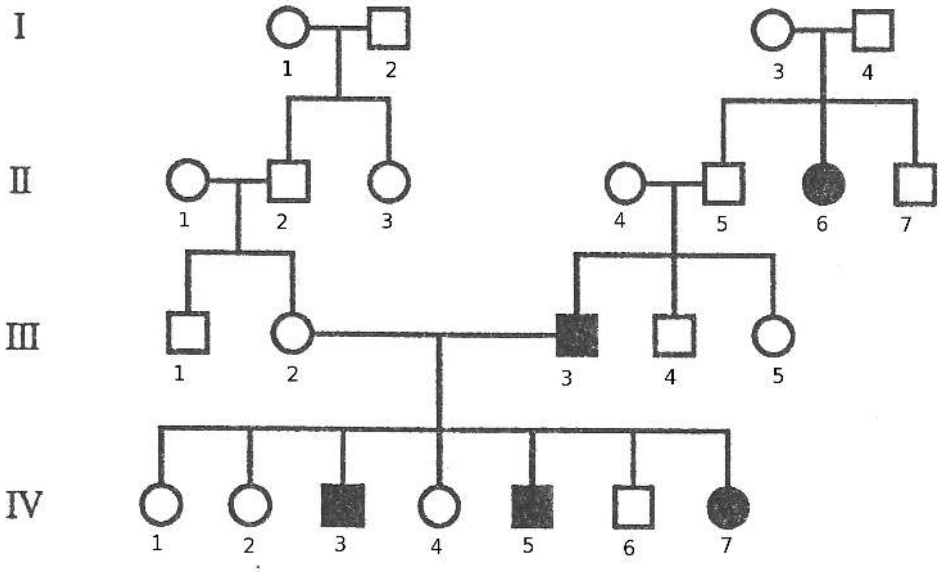
(b) The trait must be autosomal recessive

(c) The trait must be X-linked dominant

(d) The trait must be X-linked recessive

(e) More than one mode of inheritance is possible.

40. If the pedigree is for an autosomal recessive trait, which individuals are definitely heterozygous?



(a) IV-1, IV-2, IV-4, IV-6

(b) I-3, I-4, II-4, II-5, III-2

(c) I-2, I-3, I-4, II-2, II-4, II-5, III-2

(d) I-3, I-4, II-4, II-5, III-2, IV-1, IV-2, IV-4, IV-6

(e) I-2, I-3, I-4, II-2, II-4, II-5, III-2, IV-1, IV-2, IV-4, IV-6

41. Three genotypes occur in the following proportions: f(AA) = U, f(Aa) = V, f(aa) = W. Therefore, f(A) is

    (a) $\sqrt{U}$.

    (b) (U + V)/2.

    (c) U + (V/2).

    (d) W^2.

    (e) (U/2) + V.

42. The cream gene in horses is codominant. In a population of mustangs the following genotypes were observed: 73 CC, 17 CC^{cr} and 12 $C^{cr}C^{cr}$. What is the allele frequency of C?

    (a) 0.72

    (b) 0.79

    (c) 0.80

    (d) 0.88

    (e) Cannot be calculated with the available information

43. Compare the observed genotype frequencies in 42 with those expected under Hardy-Weinberg equilibrium. What conclusion can you make?

    (a) The mustangs have an excess of homozygotes which could be the result of inbreeding.

    (b) The mustangs have an excess of homozygotes which could be the result of positive assortative mating.

    (c) The mustangs have an excess of heterozygotes which could be the result of negative assortative mating

    (d) The mustangs have a deficit of one homozygote which could be the result of selection

    (e) More than one of the above can be correct.

44. Another mustang population was polymorphic for the grey gene, where the colour grey is dominant over non-grey. In the population there were 12 grey and 115 non-grey mustangs. Estimate the frequency of the grey allele assuming the population is in Hardy-Weinberg equilibrium.

    (a) 0.05

    (b) 0.09

    (c) 0.19

    (d) 0.91

    (e) 0.95

45. Hardy-Weinberg is poorly suited to used as a population model for pea populations because...

    (a) Pea is predominantly randomly mating
    (b) Pea is predominantly selfing
    (c) The population size in pea is much smaller than other organisms
    (d) There's a lot of selection in pea
    (e) Pea is a domesticated species

46. In a population fulfilling all the assumptions of the Hardy-Weinberg equilibrium, allelic frequencies

    (a) change randomly from generation to generation.
    (b) change infinitesimally from generation to generation.
    (c) change from generation to generation only in females.
    (d) change from generation to generation only in males.
    (e) will not change from generation to generation.

47. Peas were cultivated and plant height was measured. The phenotypic variance was measured to be 868 while the environmental variance was 363. What is the broad-sense heritability?

    (a) 505
    (b) 0.28
    (c) 0.42
    (d) 0.58
    (e) 0.72

48. The narrow sense heritability is

    (a) the fraction of the phenotype that results from selection.
    (b) the fraction of the phenotype due to additive genes.
    (c) an artificial standard
    (d) depends on epistatic effects
    (e) represents the total phenotypic variance

49. Knowing the **xxx** of a trait has great practical importance because it allows statistical predictions regarding the phenotypes of offspring to be made on the basis of the parents' phenotypes.

    (a) variance
    (b) inbreeding coefficient
    (c) heritability
    (d) genotype

50. In a population of peas the average number of seeds produced per plant was 45.64. From this population plants producing more than 80 seeds (average 119,52) were chosen as parents for the next generation. With a narrow-sense heritability of 0.38, on average how many seeds will the plants in the next generation produce?

    (a) 17.6

    (b) 28.1

    (c) 45.6

    (d) 73.1

    (e) 91.4

Facit

1e
2c
3e
4e

5b
6c
7a
8e

9d
10c
11d
12d

13c
14c
15c
16d

17c
18b
19d
20d

21e
22d
23d
24e

25b
26a
27e
28d

29b
30c
31e
32b

33d
34d
35c
36b

37e
38b
39e
40d

41c
42c
43e
44a

45b
46e
47d
48b

49c
50d