Tentamen, Genetik (NBIA24, 91BI11, 91BI17, 92BI11, 92BI17 och TFBI11), 9/6 2016

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!

1. There are three alleles at the HB0 lokus: I^A, I^B and i^0. An individual with the genotype $I^B i^0$ will have the phenotype

   (a) 0
   (b) $I^B i^0$
   (c) $I^B I^B$
   (d) I^B-
   (e) I^B

2. Which of the following statements about the base pairing in DNA is correct?

   (a) A binds to T with two hydrogen bonds
   (b) A binds to C with three hydrogen bonds
   (c) A binds to T with three hydrogen bonds
   (d) G binds to C with two hydrogen bonds
   (e) T binds to G with two hydrogen bonds

3. A recessive allele

   (a) is always rarer in a population than a dominant allele.
   (b) doesn't express the associated trait when a dominant allele is present in an individual.
   (c) is always weaker than a dominant allele for the same trait.
   (d) will always inactivate the dominant allele for the same trait.
   (e) always has less, or a less active, gene product than a dominant allele for the same trait.

4. *Arabidopsis lyrata* is a self-incompatible species meaning it has a genetically coded inability to self-fertilize. An individual with the genotype $S_{14}S_{18}$ has the phenotype $S_{14}S_{18}$. This means that

   (a) S_{14} is dominant to S_{18}.

   (b) S_{18} is dominant to S_{14}.

   (c) S_{18} is codominant to S_{14}.

   (d) S_{18} and S_{14} are both codominant to each other.

   (e) the dominance hierarchies for the locus is not known.

5. How many different phenotypes can be expressed in a character controlled solely by a one-gene, two-allele system, in which the alleles are completely dominant and recessive respectively?

   (a) one

   (b) two

   (c) three

   (d) five

   (e) ten

6. The location on a chromosome of a piece of heritable information for a trait is called a(n)

   (a) allele

   (b) gene

   (c) genotype

   (d) locus

   (e) phenotype

7. Figure 1 shows

   (a) a triploid individual.

   (b) a trisomy.

   (c) a translocation.

   (d) an inversion.

   (e) a monosomy.

8. The individual in figure 1 is

   (a) a male mammal.

   (b) a male bird

   (c) a female mammal.

   (d) a female bird.
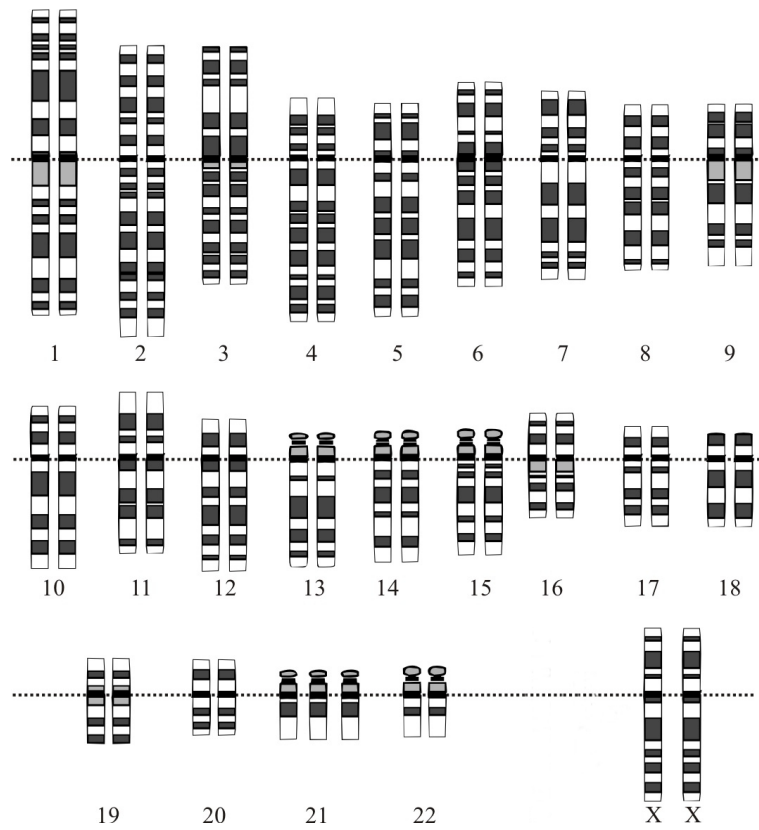
   (e) a female mammal or a female bird.

Figur 1: Use this figure to answer questions 7 to 10

9. Chromosome 3 in figure 1 is

    (a) acrocentric.
    (b) metacentric.
    (c) paracentric.
    (d) pericentric.
    (e) telocentric

10. The basic chromosome number for the species with the karyotype shown in figure 1 is

    (a) 3n = 21
    (b) 2n = 22
    (c) 2n = 23
    (d) 2n = 44
    (e) 2n = 46.

11. Suppose that a diploid cell contains 6 chromosomes (2n = 6). How many different combinations in the gametes are possible?

  (a) 2

  (b) 4

  (c) 8

  (d) 16

  (e) 64

12. In the allele giving rise to sickle cell anemia an A to T mutation exchanges a glutamate amino acid for a valine. This is an example of a

  (a) frameshift mutation

  (b) missense mutation

  (c) neutral mutation

  (d) nonsense mutation

  (e) reverse mutation

13. When Mendel self-fertilized the F_1 offspring of tall peas with axial flowers that had been crossed with short peas with terminal flowers, he found among the F_2 tall peas with axial flowers, tall peas with terminal flowers, short peas with axial flowers and short peas with terminal flowers. This was a result of

  (a) diploidy.

  (b) dominance.

  (c) mutation.

  (d) translocation.

  (e) recombination.

14. Synonymous mutations are expected to be

  (a) silent

  (b) forward

  (c) lethal

  (d) reverse

  (e) somatic

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

  (a) Codons

  (b) Exons

  (c) Genomes

  (d) Multigene families

  (e) Pseudogenes

16. Which of the evolutionary processes will **never**, on a long time-scale, increase the genetic diversity of a population?

    (a) Genetic drift

    (b) Selection

    (c) Mutation

    (d) Migration

    (e) All evolutionary processes will increase the genetic diversity of a population on a long enough time-scale.

17. Dark-coloured mice living on white sandy beaches are predated at a higher rate than light-coloured mice. Which of the following best describes how selection acts on the three genotypes A_1A_1, A_1A_2 and A_2A_2, if A_2 is a fully recessive allele causing light colouration?

    (a) 1 - s, 1 - s, 1

    (b) 1, 1, 0

    (c) 0, 0, 1

    (d) 1 - s, 1, 1

    (e) 1 - s, 1, 1 - s

18. Which mouse in table 1 is the fittest, in the evolutionary sense of the word?

Tabell 1: Mouse data

Mouse	Running speed	Fights won	Territory size	mates	Offspring
1	3.6 m/s	5	250 m^2	1	6
2	2.6 m/s	8	780 m^2	8	18
3	2.9 m/s	6	1200 m^2	3	35
4	3.4 m/s	0	1500 m^2	7	22
5	3.1 m/s	2	2000 m^2	4	15

    (a) Mouse 1

    (b) Mouse 2

    (c) Mouse 3

    (d) Mouse 4

    (e) Mouse 5

19. All of the following are associated with random genetic drift **except**

    (a) founder effects.

    (b) bottlenecks.

    (c) large population size.

   (d) non-representative sampling.

    (e) fixation rates.

20. In snow geese two plumage morphs exist, a white and a blue. As goslings, the birds learn the colour of their parents and later seek a partner with the same plumage colour. This leads to a preferential mating within morphs. Which term describes the mating pattern between the two morphs and what will be the genetic consequence?

    (a) Positive assortative mating will lead to increased homozygosity for the plumage colour gene.

    (b) Positive assortative mating will lead to decreased homozygosity for the plumage colour gene.

    (c) Positive assortative mating will lead to increased homozygosity for the whole genome.

    (d) Negative assortative mating will lead to increased homozygosity for the plumage colour gene.

    (e) Negative assortative mating will lead to decreased homozygosity for the plumage colour gene.

21. The probability that a gene is identical by descent is referred to as

    (a) the inbreeding coefficient.

    (b) assortative mating.

    (c) heritability.

    (d) outbreeding depression.

    (e) a molecular clock.

22. 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 telomeres in a rat cell in G2?

    (a) 21

    (b) 42

    (c) 84

    (d) 126

    (e) 168

23. How many tetrads occur in Drosophila melanogaster (eight chromosomes) at metaphase I of meiosis?

    (a) one

    (b) two

    (c) four

    (d) eight

    (e) sixteen

24. One or more of the cells represented below are haploid. Which one is it/which ones are they?
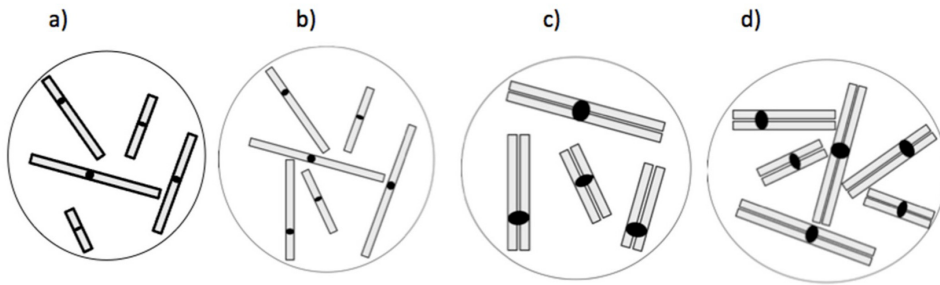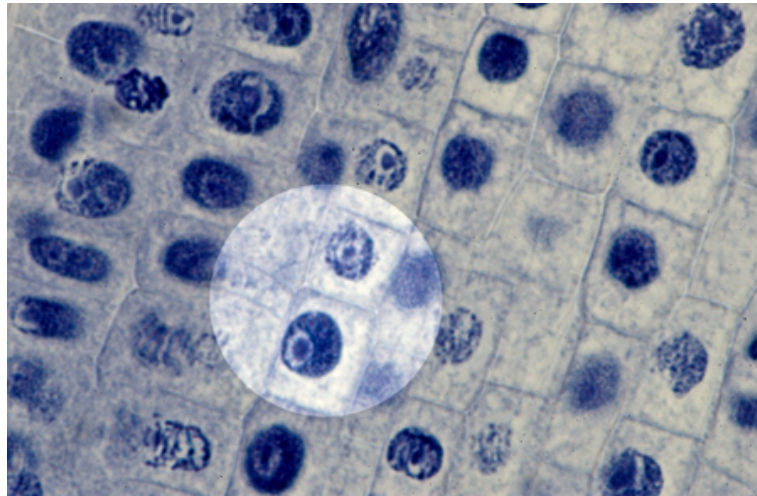

(a) Only cell a.

(b) Only cell b.

(c) Cell a and b.

(d) Cell a and c.

(e) Cell c and d.

25. The cell shown in figure below is in anaphase. Name the most likely process and chromosome number (2n) of the organism?
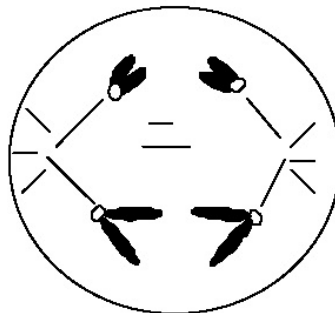
(a) mitosis, $2n = 2$

(b) mitosis, $2n = 4$

(c) meiosis I, $2n = 2$

(d) meiosis I, $2n = 4$

(e) meiosis II, $2n = 4$

26. In which phase are the cells highlighted in the figure?

(a) anaphase

(b) interphase

(c) metaphase

(d) prophase

(e) telophase

27. Two biallelic genes A and B are linked with a recombination frequency of 5 %. What proportion of the offspring from the cross AB/ab x AB/ab is expected to have the phenotype AB if A and B are completely dominant.

(a) 3/4

(b) 9/16

(c) 0.95

(d) 0.5

(e) 0.726

28. Use the following informations for question **28** - **30**.

Trihybrid F_1 tomatoes carrying mutations for flat fruit (o), hairy fruits (p), and small clustered flowers (s) are testcrossed and the following number of offspring are obtained for each phenotype class.

$+$	73	o	100
p	2	s	348
$o\ p$	306	$o\ s$	0
$p\ s$	96	$o\ p\ s$	63

Which were the haplotypes of the trihybrid parent?

(a) *OPS / ops*

(b) *ops / ops*

(c) *s / op*

(d) *OPs / opS*

(e) Both c and d are correct.

29. Which gene is in the middle on the chromosome?

(a) *o*

(b) *p*

(c) *s*

(d) none, only two genes linked

(e) none, all genes are unlinked

30. From the results, what is your best estimate of the *p* - *o*, in map units?

(a) 6.3

(b) 14.0

(c) 16.1

(d) 20.0

(e) 33.6

31. Two heterozygous individuals are bred to each other. Among the offspring the phenotypes segregate as 1:2:1. Which of the following is a valid conclusion?

    (a) The heterozygous individuals are heterozygous for the same codominant alleles.

    (b) The heterozygous individuals are heterozygous for dominant and recessive alleles at a single locus.

    (c) The heterozygous individuals are heterozygous for dominant and recessive alleles at two different loci.

    (d) The heterozygous individuals are heterozygous are carrying a lethal allele.

    (e) The heterozygous individuals are heterozygous for two completely linked dominant alleles.

32. Full pod shape (F) is dominant to constricted pod shape (f), and yellow pod color (Y) is dominant to green pod color (y) in pea plants. A pure-breeding green plant with full pods is crossed with a pure-breeding yellow plant with constricted pods. The offspring are then testcrossed. How many different phenotypes do you expect in the offspring if the genes are located at different ends of a large chromosome?

    (a) one

    (b) two

    (c) three

    (d) four

    (e) cannot be determined

33. Two loci are unlinked. One has two codominant alleles; the other has two alleles with a dominant-recessive relationship. What is the phenotypic ratio among offspring of a testcrossed dihybrid?

    (a) 9:3:3:1

    (b) 3:6:3:1:2:1

    (c) 1:2:1:2:4:2:1:2:1

    (d) 1:1:1:1

    (e) 3:1

34. In cats long hair, l and pigment dilution, d, are recessive to short hair, L and undiluted pigment, D respectively. If dihybrid cats are bred to each other, which phenotypic ratio is expected among the offspring if the genes are located on different autosomes?

    (a) 3:1

    (b) 9:3:3:1

    (c) 1:2:1

    (d) 12:3:1

    (e) 9:3:4

35. A wildtype peahen is bred to a cameo peacock (sex-linked recessive trait). How many of the female chicks will be wildtype?

   (a) 0

   (b) 1/4

   (c) 2/4

   (d) 3/4

   (e) 1

36. How many of the female chicks will be wildtype from the reciprocal cross of that in 35 if the wildtype individual is homozygous?

   (a) 0

   (b) 1/4

   (c) 2/4

   (d) 3/4

   (e) 1

37. At the A locus the two alleles A and a occur and at the B locus the alleles B and b occur. The cross is set upp between individuals from pure lines with the phenotypes Ab x aB. The resulting F_1 is backcrossed to the paternal genotype. What proportion of the F_2 will have the AB phenotype if there is free recombination between A and B?

   (a) 0

   (b) 0.25

   (c) 0.5

   (d) 0.75

   (e) 1

38. In moths, males are homogametic. Spotted wings (s) are recessive to the wild-type ($+$) and sex linked. A wild-type male is mated to a spotted female, and all the F_1 are wild-type. If these F_1 males are mated to F_1 females, what will be the ratio of wild-type to spotted females in the F_2?

   (a) 1:1

   (b) 3:1

   (c) 0:1

   (d) 1:0

   (e) 1:2

39. In a large, randomly mating population 318 individuals with the phenotype A and 24 individuals with the phenotype a were found. What is the frequency of the A allele assuming that the locus is in Hardy-Weinberg equilibrium?

   (a) 0.265
   (b) 0.735
   (c) 0.930
   (d) 0.964
   (e) 4.899

40. Three genotypes occur in the following proportions: f(AA) = X, f(Aa) = Y, f(aa) = Z. Therefore, f(A) is

   (a) X + (Y/2).
   (b) $\sqrt{X}$.
   (c) (X + Y)/2.
   (d) Z^2.
   (e) (X/2) + Y.

41. Approximately one child in 10,000 is born with the recessive trait Ollienorth syndrome. Approximately what percentage of the population is made up of carriers assuming that the locus is in Hardy-Weinberg equilibrium?

   (a) less than 1 %
   (b) 1.4 %
   (c) 2.0 %
   (d) 2.7 %
   (e) 5.0 %

42. In a population the allele frequency of B is 0.1. How many heterozygotes are expected among 500 individuals in a population in Hardy-Weinberg equilibrium if the locus is biallelic?

   (a) 0.1
   (b) 50
   (c) 50 %
   (d) 90
   (e) 495

43. Among the royal houses of Europe a certain amount of inbreeding occurred during historical times. If a recessive trait occurred in 10 % of the members of the royal houses of Europe at that time, what would be the frequency of the recessive allele among the royal houses of Europe?

    (a) 0.32
    (b) 0.68
    (c) 0.95
    (d) 3.16
    (e) Cannot be determined.
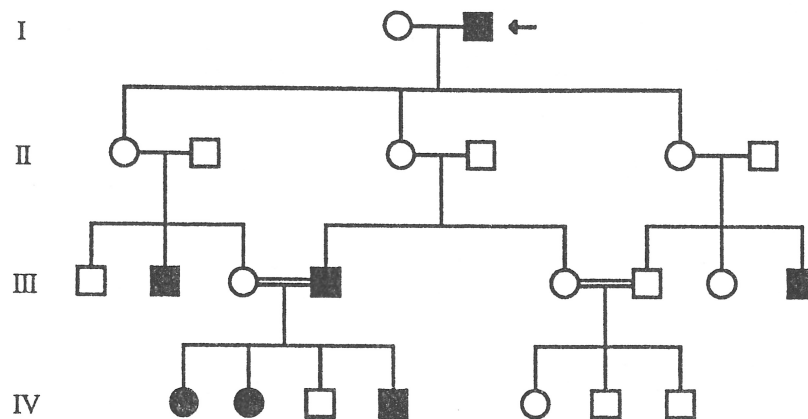
Figur 2: Use this pedigree to answer questions 44 - 45

44. Robin Croeseson was the sole survivor of a shipwreck in Pacific Ocean. He managed to make his way to an island inhabited by a small number of people. Robin had a disease that was previously unknown on the island. After four generations Robin's pedigree looked as in figure 2. Determine the most likely mode of inheritance of Robin's disease.

    (a) Autosomal recessive.
    (b) Autosomal dominant.
    (c) X-linked recessive.
    (d) X-linked dominant.
    (e) Y-linked.

45. Labelling the individuals in each generation numerically from left to right, which of the healthy individuals in generation III in figure 2 **must** be carriers of the disease?

    (a) III-3 only
    (b) III-5 and III-7
    (c) III-3, III-5. III-6 and III-7
    (d) All female individuals
    (e) All healthy individuals.

46. Which model best explains inheritance of complex traits such as height, weight, and IQ?

   (a) control of the traits by a single gene with dominant and recessive alleles

   (b) control of the traits by two genes with independent assortment

   (c) control of the traits by more than one gene with no effect of the environment

   (d) control of the traits by more than one gene plus environmental effects

   (e) control of the traits by environmental factors and not genetic factors

47. If broad-sense heritability for a trait is very high and narrow-sense heritability is very low, which of the following must be true?

   (a) Additive variance must be high relative to total phenotypic variance.

   (b) Dominance variance must be high relative to total phenotypic variance.

   (c) Environmental variance must be high relative to total phenotypic variance.

   (d) Genotypic-environmental covariance must be high relative to total phenotypic variance.

48. Average adult weight in a population of rabbits was 1.5 kg. Breeders were chosen whose average adult weight was 1.8 kg. Their offspring had a mean adult weight of 1.6 kg. Assuming that there is no covariance (interaction) of environment and genotype, what is the narrow-sense heritability?

   (a) 0.33

   (b) 0.40

   (c) 0.45

   (d) 0.50

   (e) 1.5

49. **XXX** is the splitting of one lineage into two.

   (a) Anagenesis

   (b) Cladogenesis

   (c) Genesis

   (d) Neogenesis

   (e) Phylogenesis

50. **XXX** The first step in allopatric speciation is

   (a) splitting of a population into two or more groups by a geographic barrier.

   (b) origin and spread of a new mutation in part of the population.

   (c) strong disruptive selection.

   (d) formation of allopolyploid individuals.

   (e) both a and b are correct.

Facit

1e 2a 3b 4d

5b 6d 7b 8c

9b 10e 11c 12b

13e 14a 15d 16a

17a 18c 19c 20a

21a 22e 23c 24d

25e 26b 27e 28e

29a 30d 31a 32d

33d 34b 35a 36e

37c 38a 39b 40a

41c 42d 43e 44c

45a 46d 47b 48a

49b 50a