

# Tentamen, Genetik (NBIA24, 91BI11, 91BI17, 92BI11, 92BI17 och TFBI11), 22/3 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

Tentatema: Små gröna gubbar...



LYCKA TILL!

1. In dogs the letter B can refer to all the suggestions below **except**
  - (a) a dominant allele.
  - (b) a recessive allele.
  - (c) a locus.
  - (d) a phenotype.
  - (e) a gene.
2. In the diploid species "little green men" the  $H$  locus codes for hair colour. Two little green men have the genotypes  $Hh^a$  and  $Hh$  respectively. Which of the following statements is correct.
  - (a) Both little green men will have the  $h$  phenotype.
  - (b) The  $h^a$  allele is recessive to all other alleles.
  - (c) One of the little green men will show a  $Hh^a$  phenotype.
  - (d) All the alleles are codominant.
  - (e) The two little green men will have the same coat colour.
3. In little green men nose colour is determined by the  $N$  locus. A homozygous  $N_1$  female is crossed with a homozygous  $N_2$  male resulting in  $N_1N_2$  progeny. What will be the phenotype of the offspring?
  - (a)  $N_1$
  - (b)  $N_2$
  - (c)  $N_1N_1$
  - (d)  $N_2N_2$
  - (e)  $N_1N_2$

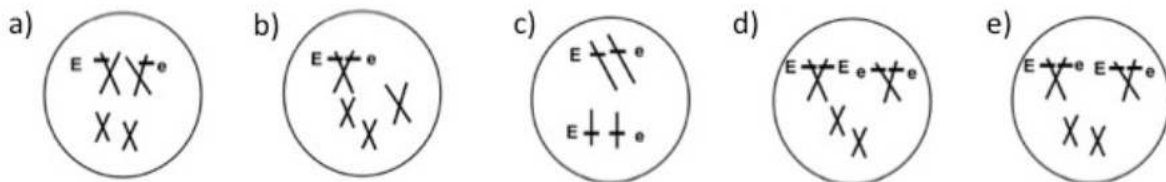
4. A fruit fly with a wild-type phenotype

- (a) is homozygous.
- (b) has a dominant allele at each locus.
- (c) has all recessive alleles.
- (d) will not grow in the lab.
- (e) none of the choices above.

5. A dominant allele

- (a) is always more common in a population than a recessive allele.
- (b) is always the stronger than a recessive allele for the same trait.
- (c) always expresses the associated trait when the allele is present in an individual.
- (d) will always inactivate the recessive allele for the same trait.
- (e) always has more, or a more active, gene product than a recessive allele for the same trait.

6. Below are drawings of chromosomes and alleles inside a cell. Which correctly illustrate two different alleles for an eye color gene in a diploid organism with four chromosomes ( $2n = 4$ )?



- (a) figure a
- (b) figure b
- (c) figure c
- (d) figure d
- (e) figure e

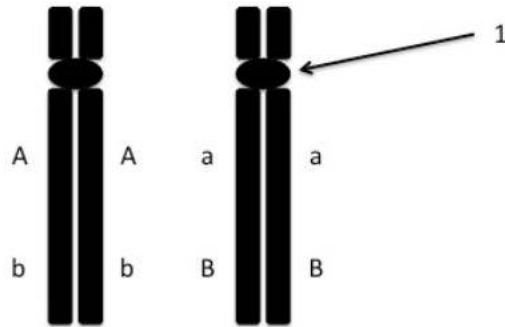
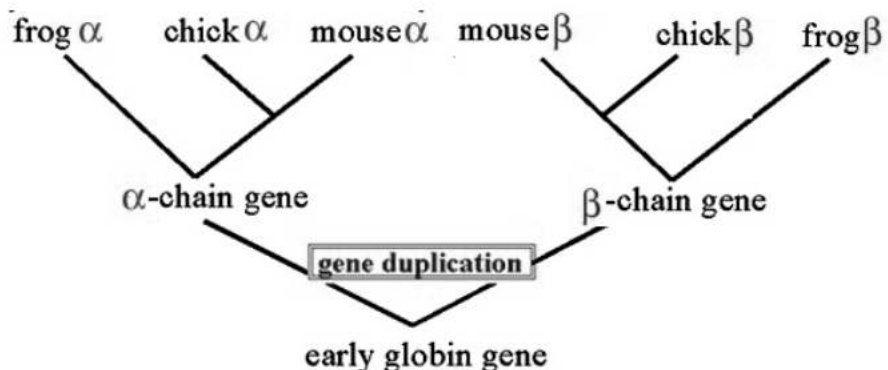


Figure 1: Use this figure to answer questions 7 to 10

7. Figure 1 shows
  - (a) two X chromosomes
  - (b) two homologues.
  - (c) two pairs of homologues.
  - (d) two sister chromatids.
  - (e) four autosomes.
8. The chromosomes in figure 1 are
  - (a) telocentric.
  - (b) acrocentric.
  - (c) submetacentric.
  - (d) metacentric.
  - (e) allocentric.
9. In figure 1 the arrow labelled 1 points to the
  - (a) centromere.
  - (b) centrosome.
  - (c) telomere.
  - (d) chromatid.
  - (e) kinetochore.
10. A mutation happens in the individual in figure 1. Afterwards genetic mapping shows that *a* is now where *B* previously was and vice versa. What term is used to describe the mutation?
  - (a) Autopolyploidisation.
  - (b) Duplication.
  - (c) Paracentric inversion.
  - (d) Pericentric inversion.
  - (e) Reciprocal translocation.

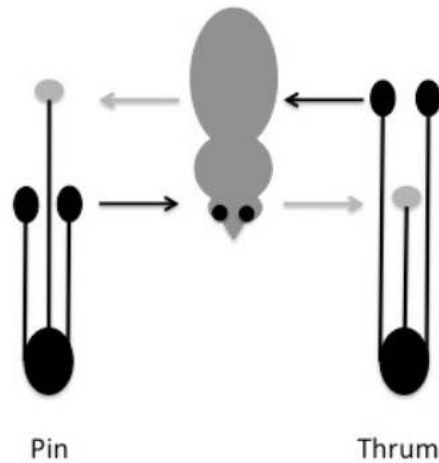
11. Which of the following statements about an animal bearing a somatic mutation is true?
- Some but not all of the animal's offspring will also carry the mutation.
  - All of the animal's offspring will carry the mutation.
  - Both the animal and its offspring will show the mutant trait.
  - The animal but not its offspring can be affected by the mutation.
  - Only the offspring and not the animal itself will show the mutant trait.
12. A xxx mutation changes a codon that specifies an amino acid into one that terminates translation.
- missense
  - nonsense
  - silent
  - neutral
  - reverse
13. The figure below shows the evolution of the globin gene family. Which of the following genes can be called paralogs?



- Frog  $\alpha$  and chick  $\alpha$ .
  - Mouse  $\alpha$  and mouse  $\beta$ .
  - Mouse  $\alpha$  and frog  $\beta$ .
  - All  $\alpha$  genes.
  - All  $\alpha$  and  $\beta$  genes.
14. Suppose that a diploid cell contains 8 chromosomes ( $2n = 8$ ). How many different combinations of the chromosomes are possible in the gametes?
- 2
  - 4
  - 8
  - 16
  - 64

15. In Danish, Swedish and Finnish Red Cattle a 660 kb stretch of DNA has been lost compared to all other cattle breeds. Embryos homozygous for deletion never develops but heterozygous cows have a higher milk yield and are favoured among dairy breeders. 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 the allele with the 660 kb deletion?
- (a) 1 - s, 1, 0
  - (b) 1, 1, 0
  - (c) 1, 1 - s, 1 - s
  - (d) 1 - s, 0, 1
  - (e) 1 - s, 1, 1 - s
16. Which is the term used to describe the type of selection acting in question 15?
- (a) Positive selection
  - (b) Negative selection
  - (c) Balancing selection
  - (d) Sexual selection
  - (e) More than one of the above
17. Rapid changes in allelic frequencies by xxx take place in populations that are small.
- (a) mutation
  - (b) natural selection
  - (c) inbreeding
  - (d) outbreeding
  - (e) genetic drift
18. A warmer climate and melting polar ice sheets have allowed bowhead whales from Alaska to reach the Atlantic population of bowhead whales. What will the genetic consequences to the Atlantic population be, now that it is no longer isolated from the Alaskan whales, assuming that the whales from the two populations will mate with each other?
- (a) The genetic diversity of the Atlantic whales will increase and they will become more similar to the Alaskan whales.
  - (b) The genetic diversity of the Atlantic whales will increase and they will become more dissimilar to the Alaskan whales.
  - (c) The genetic diversity of the Atlantic whales will decrease and they will become more similar to the Alaskan whales.
  - (d) The genetic diversity of the Atlantic whales will decrease and they will become more dissimilar to the Alaskan whales.
  - (e) The genetic diversity of the Atlantic whales will not change and they will remain as (dis)similar to the Alaskan whales as they were before.

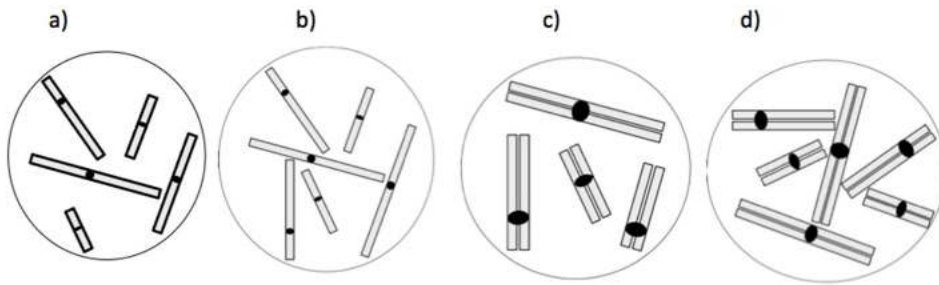
19. In *Primula* two flower morphs called pin and thrum occur and are encoded by a single Mendelian locus. Through different pollen deposition and transfer, with the aid of bumble bees, mating occurs preferentially between morphs (see figure 2). Which term describes the mating pattern between the two morphs and what will be the genetic consequence?



Figur 2: Pollen transfer in pin and thrum flower morphs in *Primula*

- (a) Positive assortative mating will lead to increased homozygosity for the gene.  
(b) Positive assortative mating will lead to decreased homozygosity for the 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 gene.  
(e) Negative assortative mating will lead to decreased homozygosity for the gene.
20. Self-fertilization of plants, or close breeding of relatives in animals, can cause
- (a) heritability.  
(b) twin production.  
(c) inbreeding depression.  
(d) outbreeding depression.  
(e) outbreeding vigor.
21. Crossing over occurs during:
- (a) interphase.  
(b) prophase.  
(c) metaphase.  
(d) anaphase.  
(e) telophase.

22. 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.

23. The figure shows a cell that is dividing mitotically. Which phase is the cell in?

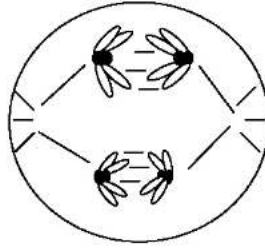


- (a) Anaphase
- (b) Telophase
- (c) Prophase
- (d) Metaphase
- (e) Interphase

24. How many tetrads are there in metaphase I of meiosis in little green men ( $2n = 10$ )?

- (a) 5
- (b) 10
- (c) 15
- (d) 20
- (e) 40

25. Which cell division shown in the cell in the figure and what is ploidy number of the organism?



- (a) mitosis,  $2n = 4$   
 (b) mitosis,  $2n = 8$   
 (c) meiosis I,  $2n = 2$   
 (d) meiosis I,  $2n = 4$   
 (e) meiosis II,  $2n = 4$
26. In the species little green men the recessive alleles  $b$  and  $v$  occur. A dihybrid female of little green men is testcrossed with a little green men male. Among the  $F_1$  the following number were found of each phenotype:

$B v$	944
$b v$	206
$b V$	965
$B V$	185

What haplotype(s) are present in the  $P_1$ ?

- (a)  $b v$  only  
 (b)  $B V$  only  
 (c)  $b v$  and  $B V$   
 (d)  $B v$  and  $b V$   
 (e)  $B, b, V$  and  $v$
27. Using the information in question 26, what is the genetic distance between  $b$  and  $v$  in cM?
- (a) 0,213  
 (b) 0,83  
 (c) 0,5  
 (d) 21,3  
 (e) The two genes are unlinked.



28. Trihybrid F<sub>1</sub> little green men carrying mutations for hairlessness (*hl*), yellow skin (*ys*), and early maturity (*e*) were testcrossed with the following results.

wild type	5	hairless	399
yellow	78	early	27
hairless, yellow	25	hairless, early	84
yellow, early	379	hairless, yellow, early	3

Which gene is in the middle on the chromosome?

- (a) hairless
  - (b) yellow
  - (c) early
  - (d) none, only two genes linked
  - (e) none, all genes are unlinked
29. From the results in question 28, what is your best estimate of the yellow - hairless distance, in map units?
- (a) 6
  - (b) 16.2
  - (c) 17
  - (d) 21.4
  - (e) 94
30. Singing in little green men is caused by a dominant allele. A female is a singer but one of her parents is not. The female has been crossed with a non-singing male little green man. What proportion of the offspring is expected to be non-singing?
- (a) 0
  - (b) 1/4
  - (c) 1/2
  - (d) 3/4
  - (e) 1
31. In a cross between *AaBbCc* and *AaBbcc*, what proportion of the offspring would be expected to be *A-bbcc* if the three genes are unlinked? (*A-* means *AA* or *Aa*.)
- (a) 3/64
  - (b) 3/32
  - (c) 3/16
  - (d) 3/8
  - (e) 3/4

32. If a male bird that is heterozygous for a recessive Z-linked mutation is crossed to a wild type female, what proportion of the progeny will be mutant males?
- (a) 100 %
  - (b) 75 %
  - (c) 50 %
  - (d) 25 %
  - (e) 0 %
33. In cats the allele *W* results in a completely white cat, masking the phenotypes at for example the *D* (dilution) locus. If a large number of dihybrid cats are bred to each other, which phenotypic ratio is expected among the offspring if the genes are located on different autosomes?
- (a) 9:3:3:1
  - (b) 3:1
  - (c) 1:2:1
  - (d) 12:3:1
  - (e) 9:3:4
34. Little green men, heterozygous for the trait hand colour, are bred to each other. Among the offspring hand colour segregates as 2 red : 1 yellow. What conclusion(s) can you make from the phenotypic segregation ratio?
- (a) The allele for red hand colour is lethal in homozygous form.
  - (b) More than one locus affects the trait.
  - (c) The trait must be sex-linked
  - (d) Pure-breeding red hand lines can be developed by sibling mating for many generations.
  - (e) More than one of the above.
35. A healthy man and a healthy woman both have one parent suffering from cystic fibrosis (autosomal recessive disease) and one healthy parent. The couple have had three healthy children so far. What is the probability that their fourth child will suffer from cystic fibrosis?
- (a) 0
  - (b) 1/4
  - (c) 2/4
  - (d) 3/4
  - (e) 1

36. A certain type of haemophilia is X-linked recessive. A non-haemophiliac woman has a haemophiliac father. The woman has a child with a non-haemophiliac man. Which phenotype is **not** expected?
- (a) a haemophiliac female
  - (b) a haemophiliac male
  - (c) a non-haemophiliac female
  - (d) a non-haemophiliac male
  - (e) more than one of the above
37. One-hundred little green men are tested for their MN blood types with the following results: 49 MM, 35 MN, 16 NN. What is the frequency of the M allele?
- (a) 0.6
  - (b) 0.7
  - (c) 0.49
  - (d) 0.84
  - (e) 0.665
38. In a large, randomly mating population of little green men 592 wildtype and 125 *ebony* individuals are found. The *ebony* phenotype is coded by an autosomal recessive allele. What is the frequency of the *ebony* allele assuming that the locus is in Hardy-Weinberg equilibrium?
- (a) 0.17
  - (b) 0.42
  - (c) 0.46
  - (d) 0.58
  - (e) 11.18
39. Suppose that in a population the frequency of a particular recessive condition is  $1/400$ . Assume the presence of only a dominant allele ( $A$ ) and a recessive allele ( $a$ ) in the population and that the population is at Hardy-Weinberg equilibrium. What is the frequency of heterozygotes in the population?
- (a)  $1/400$
  - (b)  $1/20$
  - (c)  $38/400$
  - (d)  $200/400$
  - (e)  $361/400$

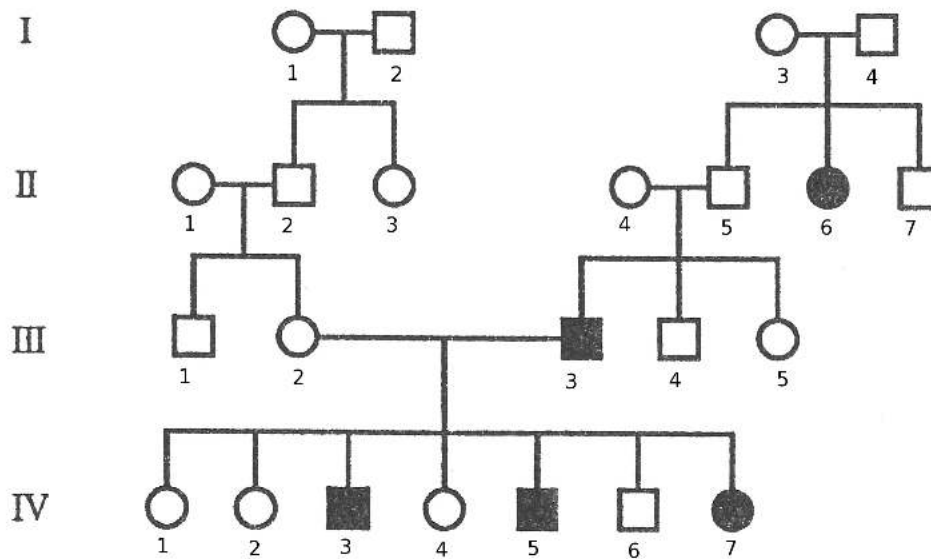
40. In little green men males are the homogametic sex. Blue ears in little green men occur in both sexes and is caused by a dominant sex-linked allele. Among the little green men the following phenotypes were found:

Blue-eared females	43
Green-eared females	159
Blue-eared males	75
Green-eared males	123

What is the frequency of homozygous blue-eared individuals among the males in the population?

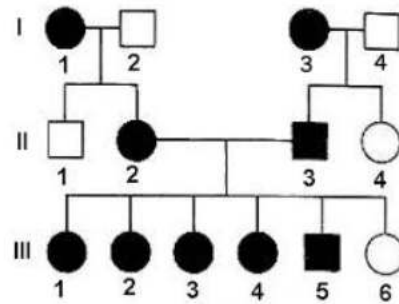
- (a) 0.045
  - (b) 0.213
  - (c) 0.379
  - (d) 0.335
  - (e) There will not be any homozygous males as they only have a single X chromosome.
41. Among the royal houses of Europe a certain amount of inbreeding occurred during historical times. If a recessive trait occurred in 10 % of the members of the royal houses of Europe at that time, what would be the frequency of the recessive allele in the population?
- (a) 0.32
  - (b) 0.68
  - (c) 0.95
  - (d) 3.16
  - (e) Cannot be determined.

42. Could the trait followed in the pedigree below be caused by an autosomal dominant disease? Why or why not?



- (a) Yes, all individuals fit the autosomal dominant inheritance pattern.
- (b) No, the offspring of I-1 and I-2 contradict an autosomal dominant inheritance.
- (c) No, the offspring of II-1 and II-2 contradict an autosomal dominant inheritance.
- (d) No, the offspring of II-4 and II-5 contradict an autosomal dominant inheritance.
- (e) No, the offspring of III-2 and III-3 contradict an autosomal dominant inheritance.
43. If the characteristic followed in the pedigree in question 42 is autosomal recessive, what is II-2's genotype?
- (a) definitely homozygous for a dominant allele
- (b) definitely homozygous for a recessive allele
- (c) definitely heterozygous
- (d) either heterozygous or homozygous dominant
- (e) either heterozygous or homozygous recessive

44. If the trait followed in the pedigree below is caused by an autosomal dominant allele, which individuals are definitely heterozygous?



- (a) All the dark-coloured individuals.  
 (b) II-2 and II-3.  
 (c) II-1, II-4 and II-6.  
 (d) I-1, I-3, II-2 and II-3.  
 (e) I-1, I-3, II-2, II-3, III-2, III-3 and III-5
45. The variance in beard length at age 100 days in a population of little green men is found to be 21.6. When little green men from the same population are reared under identical conditions the variance in beard length is found to be 17.2. What is the genotypic variance in beard length at 100 days in the population?
- (a) 0.20  
 (b) 0.80  
 (c) 4.4  
 (d) 17.2  
 (e) 21.6
46. In the same population of little green men as in 45, what is the broad-sense heritability for beard length at 100 days?
- (a) 0.11  
 (b) 0.20  
 (c) 0.26  
 (d) 0.79  
 (e) 0.80
47. In little green men, birth weight has a narrow-sense heritability of 0.37. If the additive genetic variance is 100, approximately what is the total phenotypic variance?
- (a) 0  
 (b) 37  
 (c) 270  
 (d) 370  
 (e) 960

48. What is the predicted response to selection ( $R$ ) if the narrow-sense heritability is 0.2 and the selection difference is 0.5?
- (a) 0.1
  - (b) 0.4
  - (c) 0.5
  - (d) 2.5
49. **XXX** speciation arises in the absence of any geographic barrier to gene flow.
- (a) Allopatric
  - (b) Autocratic
  - (c) Parapatric
  - (d) Peripatric
  - (e) Sympatric
50. An **XXY** chromosome constitution produces **xxx** development in humans and **xxx** development in fruit flies.
- (a) female; female
  - (b) male; male
  - (c) female; male
  - (d) male; female

# Facit

Fråga 27 utgår, då samtliga svar är fel. De betygsgränser som tidigare angetts kommer att korrigeras neråt med 1 poäng.

1b 2e 3e 4e

5c 6d 7b 8c

9a 10c 11d 12b

13b 14d 15a 16c

17e 18a 19e 20c

21b 22d 23d 24a

25d 26d 27- 28a

29a 30c 31b 32e

33d 34a 35b 36a

37e 38b 39c 40a

41e 42d 43d 44d

45d 46e 47c 48a

49e 50d