MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) The first generation of offspring from the parents is called

A) F_2. B) P. C) backcross. D) testcross. E) F_1.

Answer: E

2) Which of the following terms is *not* a type of mating cross?

A) reciprocal
B) dihybrid
C) monohybrid
D) dominant
E) testcross

Answer: D

3) Individuals having two different alleles for a single trait are called ________.

A) recessive
B) dominant
C) dizygotic
D) dihybrid
E) monohybrid

Answer: E

4) If an individual has 10 gene pairs, how many different gametes can be formed if three of the gene pairs are homozygous and the remaining seven gene pairs are heterozygous?

A) 100 B) 1024 C) 128 D) 49 E) 131,072

Answer: C

5) If the parents of a family already have two boys, what is the probability that the next two offspring will be girls?

A) 1/4 B) 1/3 C) 1/8 D) 1 E) 1/2

Answer: A

6) In some genetically engineered corn plants, a dominant gene (BT) produces a protein that is lethal to certain flying insect pests that eat the corn plants. It was also found that the pollen could cause death in some flying insects. If the corn plant is heterozygous for BT, what proportion of the pollen would carry the dominant gene?

A) 1/2 B) 1/4 C) 1/3 D) all pollen E) 1/8

Answer: A

7) A late onset genetic trait description can be used in which of the following?

A) Cystic fibrosis
B) Sickle-cell anemia
C) Huntington disease
D) Hurler's disease
E) Tay-Sachs disease

Answer: C

8) The gene responsible for the defective protein in cystic fibrosis is located on which of the following chromosomes?

A) 11 B) 15 C) X D) 7 E) 4

Answer: D

9) When a trait is determined by two or more genes and their interaction with the environment, this is referred to as?

A) Polygenic
B) Dominant
C) Environmental polygenic
D) Multifactorial
E) Recessive

Answer: D

10) Most single-gene diseases in humans that are *not* of late-onset are caused by which of the following?

A) Dominant alleles
B) Reciprocal allele
C) Vertical pattern of inheritance
D) Recessive alleles
E) Horizontal pattern of inheritance

Answer: D

11) Phenylketonuria (PKU) is caused by ________.

A) Multifactorial
B) Recessive allele
C) Dominant allele
D) Polygenic
E) Monohybrid allele

Answer: B

12) Suppose that in plants, smooth seeds (*S*) are dominant to wrinkled seeds (*s*) and tall plants (*T*) are dominant to short plants (*t*). A tall plant with smooth seeds was backcrossed to a parent that was short and wrinkled. Assuming independent assortment, what proportion of the progeny is expected to be homozygous for short and wrinkled?

A) 0 B) 1/4 C) 1/2 D) 1/8 E) 1/16

Answer: B

13) A rare recessive trait in a pedigree is indicated by which pattern of inheritance?

A) vertical
B) diagonal
C) both vertical and horizontal
D) father to daughter inheritance
E) horizontal

Answer: E

14) Sickle cell anaemia is a recessive trait in humans. The gene that causes this disease is not located on the sex chromosomes. In a cross between a father who has sickle cell anaemia and a mother who is heterozygous for the gene, what is the probability that their first three children will have the normal phenotype?

A) none
B) 1/4
C) 1/8
D) 1/2
E) 1/16 will be albino

Answer: C

15) A dominant trait, Huntington disease, causes severe neural/brain damage at approximately age 40. The gene that causes this disease is not located on the sex chromosomes. A female whose mother has Huntington disease marries a male whose parents are normal. It is not known if the female has the disease. Assuming the female's mother was a heterozygote, and her father was normal, what is the probability that their firstborn will inherit the gene that causes Huntington disease?

A) 25% B) 100% C) 75% D) 50% E) 0%

Answer: A

16) In a monohybrid cross $AA \times aa$, what proportion of homozygotes is expected among the F_2 offspring?

A) 1/2
B) 1/4
C) 3/4
D) All are homozygotes.
E) None are homozygotes.

Answer: A

17) An allele that expresses its phenotype even when heterozygous with a recessive allele is called ________.

A) recessive.
B) recombinant.
C) independent.
D) dominant.
E) parental.

Answer: D

18) Assume that in guinea pigs, dark brown fur (*B*) is dominant to black fur (*b*). If you mate a black guinea pig with a homozygous brown guinea pig, what proportion of the progeny will be homozygous?

A) none B) all C) 3/4 D) 1/4 E) 1/2

Answer: A

19) In the dihybrid cross *AaBb* × *aabb*, what proportion of individuals are expected to be homozygotic for both genes in the F_1 generation?

A) 1/2
B) 3/4
C) 1/4
D) All are homozygotes.
E) None are homozygotes.

Answer: C

20) ________ is a/are cross(es) between parents that differ in only one trait.

A) Self-fertilization
B) Reciprocal crosses
C) Monohybrid crosses
D) Artificial selection
E) Cross fertilization

Answer: C

21) Assuming independent assortment, which of the crosses below will produce a 1:1 phenotypic ratio among the F_1 progeny?

A) *AABB* × *aabb*
B) *AaBB* × *aaBB*
C) *AaBb* × *AaBb*
D) *AaBb* × *aabb*
E) *AAbb* × *aaBB*

Answer: B

22) The actual alleles present in an individual make up the individual's

A) zygote.
B) allele.
C) dominant allele.
D) genotype.
E) recombinant types.

Answer: D

23) In a dihybrid cross *AAbb* × *aaBB*, what proportion of the F_2 offspring is expected to be homozygotic for at least one gene?

A) 3/4
B) 1/2
C) 1/4
D) All are homozygotes.
E) None are homozygotes.

Answer: A

24) A phenotype reflecting a new combination of genes occurring during gamete formation is called

A) a recombinant type.
B) heterozygous.
C) a multihybrid cross.
D) an independent assortment.
E) homozygous.

Answer: A

25) Assume that in guinea pigs, dark brown fur (*B*) is dominant to black fur (*b*). If you mate a homozygous black guinea pig with a heterozygous brown guinea pig, what proportion of the progeny will be black?

A) all B) 1/4 C) 1/2 D) 3/4 E) none

Answer: C

26) The diploid cell formed by the fertilization of the egg by the sperm during sexual reproduction is a

A) monohybrid.
B) gamete.
C) reciprocal.
D) dihybrid.
E) zygote.

Answer: E

27) A gamete is ________.

A) A zygote
B) Either an egg or a sperm
C) Only a sex chromosome
D) Only a sperm
E) Only an egg

Answer: B

28) In a dihybrid cross for which the parental cross is *AABB* × *aabb*, what proportion of F_2 offspring will be heterozygous for both genes? Assume independent assortment.

A) 3/4
B) 1/2
C) 1/4
D) All are heterozygotes.
E) None are heterozygotes.

Answer: C

29) An alternative form of a single gene is known as

A) reciprocal. B) dihybrid. C) parental. D) allele. E) recessive.

Answer: D

30) Assume that in guinea pigs, dark brown fur (*B*) is dominant to black fur (*b*). If you mate a homozygous black guinea pig with a homozygous brown guinea pig, what proportion of the progeny will be heterozygous?

A) 1/2 B) 3/4 C) all D) none E) 1/4

Answer: C

31) Which of the crosses listed below will give a 1:1:1:1 genotypic ratio in the F_1 generation? Assume independent assortment.

A) *AAbb* × *aaBB*
B) *AABB* × *aabb*
C) *AaBB* × *aaBB*
D) *AaBb* × *AaBb*
E) *AaBb* × *aabb*

Answer: E

32) For the cross *AaBb* × *aabb*, what proportion of F_1 offspring will be heterozygous for both gene pairs? Assume independent assortment.

A) 3/4
B) 1/2
C) 1/4
D) All are heterozygotes.
E) None are heterozygotes.

Answer: C

33) If a dog breeder chooses the parents for a desired next generation, the dog breeder is using a process called ________.

A) evolution
B) mutation
C) random selection
D) natural selection
E) artificial selection

Answer: E

34) When both egg and pollen from the same plant produce a zygote, the process is called

A) outcrossing.
B) self-fertilization.
C) cross-pollination.
D) recombination.
E) trans-pollination.

Answer: B

35) Which of the following was not involved in the rediscovery of Mendel's work?

A) Correns B) Morgan C) Watson D) de Vries E) Tschermak

Answer: B

36) What does a vertical pattern of inheritance in a pedigree likely indicate?

A) mulitgenic inheritance
B) common recessive trait
C) environmental impact
D) rare dominant trait
E) rare recessive trait

Answer: D

37) Calculate the probability of either all-dominant or all-recessive genotypes for the alleles A, B, E, and F in the following cross: *AaBbccddEeFf* × *AaBbCcddEeFf*

A) 1/32 B) 1/16 C) 1/256 D) 1/128 E) 1/64

Answer: D

38) In some plants, a purple pigment is synthesized from a colourless precursor. In a cross between two plants, one purple and the other colourless, an F_1 generation was produced that was all-purple. The F_2 produced from the F_1 had 775 purple, 200 red, and 65 colourless. What is the genotype of the parents?

A) *aabb* × *aabb*
B) *AABB* × *AABB*
C) *aaBB* × *aabb*
D) *AABB* × *aabb*
E) *AAbb* × *aabb*

Answer: D

39) Lines that produce offspring carrying specific parental traits that remain constant from generation to generation are called

A) indeterminate
B) True-breeding
C) heterozygous
D) wild-type
E) maternal

Answer: B

40) After a cross between two corn plants, the F_1 plants all had a dwarfed phenotype. The F_2 consisted of 1,207 dwarf plants and 401 tall plants. Identify the phenotypes and genotypes of the two parents.

A) *DD* (dwarf), *dd* (tall)
B) *dd* (dwarf), *dd* (tall)
C) *DD* (dwarf), *DD* (tall)
D) *dd* (dwarf), *Dd* (tall)
E) *DD* (tall), *dd* (dwarf)

Answer: A

41) Rosy coloured eyes and forked bristles are unlinked, recessive traits in Drosophila. A rosy-eyed Drosophila with wild-type bristles was crossed with a forked Drosophila with wild-type eyes. All of the F_1 were phenotypically wild-type for both traits, whereas the F_2 consisted of 306 wild-type, 94 rosy-eyed, 102 fork-bristled, and 33 forked-bristled and rosy-eyed flies. Infer the genotypes of the parents.

A) *RRff*, *rrFF*
B) *RRFF*, *RRFF*
C) *Rrff*, *rrFf*
D) *rrff*, *RRFF*
E) *rrff*, *rrff*

Answer: A

42) Which of the following is not a phenotypic description of allele interactions affecting the expression of traits?

A) polymorphic
B) codominance
C) incomplete dominance
D) multifactorial
E) pleiotropic

Answer: D

43) An interaction between non-allelic genes that results in the masking of expression of a phenotype is

A) incomplete dominance.
B) epistasis.
C) dominance.
D) epigenetic.
E) codominance.

Answer: B

44) Which of the following diseases show pleiotropism?

A) albinism
B) muscular dystrophy
C) male pattern baldness
D) sickle cell anaemia
E) colour blindness

Answer: D

45) A deviation from normal Mendelian ratios, which may be resolved by counting and/or controlled crosses, is seen in which of the following terms?

A) complete dominance
B) penetrance and expressivity
C) incomplete dominance
D) codominance
E) pleiotropy

Answer: B

46) Which of the following phenotypic ratios show incomplete dominance?

A) 1:2:1 B) 4:1 C) 3:1 D) 1:1 E) 2:1

Answer: A

47) Which of the following ratios show codominance?

A) 4:1 B) 3:1 C) 1:2:1 D) 2:1 E) 1:1

Answer: C

48) Which of the following ratios indicates a lethal gene?

A) 1:2:1 B) 1:1 C) 2:1 D) 3:1 E) 4:1

Answer: C

49) A person who has type O blood has

A) anti-A antibodies.
B) both anti-A and -B antibodies.
C) anti-AB antibodies.
D) anti-B antibodies.
E) no surface antigens.

Answer: B

50) If two or more forms of the same gene exist, the different forms are called________

A) alleles.
B) pleiotropic.
C) penetrance and expressivity.
D) incomplete dominance.
E) dihybrid.

Answer: A

51) The blood groups A, B, and O are different types of

A) heterozygotes.
B) alleles.
C) incomplete dominance.
D) penetrance and expressivity.
E) pleiotropy.

Answer: B

52) The blood groups A, B, and O show

A) complete dominance.
B) codominance.
C) recessiveness.
D) complete dominance, recessiveness, and codominance.
E) corecessiveness.

Answer: D

53) Which of the following monohybrid ratios can describe incomplete dominance and codominance?

A) 1:3 B) 4:1 C) 1:2:1 D) 3:1 E) 2:1

Answer: C

54) Which of the following ratios demonstrate gene interaction?

A) 1:2:1 B) 2:1 C) 3:1 D) 1:3 E) 9:3:4

Answer: E

55) A ________ results whenever the nucleotide sequence is changed.

A) mutation B) phenotype C) character D) genotype E) trait

Answer: A

56) When the same gene is related to respiratory problems and sterility, it can be described as

A) complete dominance.
B) codominance.
C) pleiotropy.
D) incomplete dominance.
E) penetrance and expressivity.

Answer: C

57) Another name for a normal gene is

A) pleiotropy.
B) recessive.
C) wild-type.
D) codominant.
E) dominant.

Answer: C

58) The phenotypic ratio 1:2:1 may indicate

A) complete dominance.
B) epistasis.
C) codominance.
D) codominance and epistasis.
E) recessive lethal.

Answer: C

59) The phenotypic ratio 3:1 may indicate

A) incomplete dominance.
B) codominance and epistasis.
C) codominance.
D) complete dominance.
E) epistasis.

Answer: D

60) The phenotypic ratio 2:1 may indicate

A) recessive lethal.
B) codominance and epistasis.
C) codominance.
D) complete dominance.
E) epistasis.

Answer: A

61) The phenotypic ratio 9:7 may indicate

A) complementary gene action.
B) codominance.
C) complete dominance.
D) recessive lethal.
E) epistasis.

Answer: A

62) The phenotypic ratio 9:3:4 may indicate

A) codominance and epistasis.
B) complete dominance.
C) codominance.
D) epistasis.
E) recessive lethal.

Answer: D

63) Which of the following phenotypic ratios show independent assortment?

A) 7 B) 5 C) 4 D) 9 E) 13:3

Answer: E

64) Temperature sensitive (*ts*) alleles of the Drosophila *shibire* gene were isolated by David Suzuki. Under permissive conditions, what is the phenotype of flies homozygous for the *ts* alleles?

A) conditional on other factors
B) co-dominant
C) indistinguishable from wild-type
D) continuously variable
E) lethal

Answer: C

65) People may inherit a specific genotype that predisposes them to cancer. However, not everyone with this genotype develops cancer; the occurrence of cancer in these individuals is dependent on environment. This is an example of:

A) incomplete dominance
B) variable expressivity
C) incomplete penetrance
D) epistasis
E) complementation

Answer: C

66) If a mother is phenotype A and her child is phenotype B then the father's genotype is ________?

A) ii
B) I^AI^B
C) I^AI^A
D) I^Ai
E) Cannot be determined

Answer: B

67) Which of the following options is considered the universal donor of blood?

A) I^Ai B) ii C) I^AI^B D) I^Bi E) I^AI^A

Answer: B

68) Which of these is *not* an example of a continuous trait?

A) occurrence of phenylketonuria (PKU)
B) human skin colour
C) birth weight of mice
D) age at death
E) plant height

Answer: A

69) Which of the following statements about continuous traits is *not* true?

A) They are relevant to medicine.
B) They are called complex traits.
C) They are also called quantitative traits.
D) They are relevant to agriculture.
E) They do not obey Mendel's laws.

Answer: E

70) Several alleles at several different loci all contribute additively to the same trait. Therefore, for this trait:

A) continuous variation may be observed
B) homozygotes cannot exist
C) only one phenotypic class is possible
D) heterozygotes cannot exist
E) only two phenotypic classes are possible

Answer: A

71) How does penetrance differ from expressivity?

A) Penetrance is dependent on environment; expressivity is not.
B) Expressivity is dependent on environment; penetrance is not.
C) Penetrance is qualitative (presence or absence); expressivity is quantitative.
D) Penetrance involves multiple genes; expressivity involves a single gene.
E) Expressivity is qualitative (presence or absence); penetrance is quantitative.

Answer: C

72) When a gene has a more subtle and secondary effect on the phenotype, the gene is usually called ________.

A) Lethal
B) Recessive
C) Permissive
D) Modifier
E) Conditional

Answer: D

73) When a certain condition stimulates a particular allele to be lethal, this allele is referred to as ________.

A) Permissive
B) Lethal
C) Restrictive
D) Modifier
E) Conditional

Answer: B

74) Wild-type pea flowers are purple. You find spontaneous, white-flowered mutants growing nearby in five different locations (numbered a-e). You establish pure breeding lines of each and perform crosses between them, and record the F_1 phenotype in the table below. Based on the data in the table, many different genes in the pathway for purple flowers have been identified by mutation?

	a	b	c	d	e
a	white	purple	purple	white	purple
b	purple	white	purple	purple	purple
c	purple	purple	white	purple	white
d	white	purple	purple	white	purple
e	purple	purple	white	purple	white

A) 1 B) 2 C) 3 D) 4 E) 5

Answer: C

75) Which of the following is *not* useful in a complementation test?

A) recessive alleles
B) alleles dominant to wild-type
C) sexual reproduction
D) F_1 progeny
E) pure breeding lines

Answer: B

76) If two homozygous recessive mutants show the same phenotype, but are caused by mutations at different loci, what will be the phenotype ratio among their F_1 progeny?

A) 0 wild-type : 1 mutant
B) 1 wild-type : 0 mutant
C) 2 wild-type : 1 mutant
D) 1 wild-type : 1 mutant
E) 1 wild-type : 2 mutant

Answer: B

77) *AA* and *Aa* make red flowers, and *aa* makes white flowers. *BB* and *Bb* make tall plants, and *bb* makes short plants. What would be the expected ratios of phenotypes among the offspring of the cross of *AaBb* × *aaBb*? Note the genotypes in the cross carefully. Assume independent assortment of each gene.

A) all (red & tall)
B) 3 (red & tall): 1 (red & short): 3 (white & tall): 1 (white & short)
C) 9 (red & tall): 3 (red & short): 3 (white & tall): 1 (white & short)
D) 3 (red & tall): 1 (white & tall)
E) 1 (red & tall): 1 (red & short): 1 (white & tall): 1 (white & short)

Answer: B

78) Seeds of some lentils are speckled. A true breeding strain with small speckles is crossed with a true breeding strain with large speckles. All of the F1 progeny have both large and small speckles. Which of the following is true?

A) The trait is controlled by one gene and the alleles are co-dominant.
B) The trait is controlled by one gene and both alleles are dominant.
C) The trait is controlled by two genes and the alleles are co-dominant.
D) The trait is controlled by one gene and the alleles are incompletely dominant.
E) The trait is controlled by two genes and the alleles are incompletely dominant.

Answer: D

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

79) Phenotype for a given trait can be influenced by an environmental factors such as temperature.

Answer: ● True False

80) The mating of parents with antagonistic traits produces hybrids.

Answer: ● True False

81) Mendel's law of segregation states that two alleles for each trait unite in a specific, predictable manner during gamete formation.

Answer: True ● False

82) Dihybrid crosses helped reveal the law of independent assortment.

Answer: ● True False

83) The Punnett square was introduced in 1906 by Reginald Punnett and provides a simple and convenient method of tracking possible combinations of gametes that might be produced in a given cross.

Answer: ● True False

84) Using the product rule, one would calculate the probability of parents having six children who are all boys as $(1/2)^6$.

Answer: ● True False

85) The sum rule states that the probability of both of two mutually exclusive events occurring is the sum of their individual probabilities.

Answer: True ● False

86) If you know the phenotype and the dominance relation of the alleles you can predict the genotype.

Answer: True ● False

87) An individual can be a heterozygote for one trait and a homozygote for another.

Answer: ● True False

88) A testcross is a cross between two heterozygotes.

Answer: True ● False

89) At fertilization, in the mating of dihybrids, four different kinds of eggs can combine with four different kinds of pollen, producing a total of sixteen different genotypes.

Answer: True ● False

90) When examining a pedigree, a father to son transmission for a disease that manifests itself in every generation is an indication that the pattern of inheritance is likely to be autosomal dominant.

Answer: ● True False

91) If a 4 generation family pedigree shows that the disease manifests for the first time in the 4th generation then it's likely that the pedigree would show consanguinity.

Answer: ● True False

92) A 3 generation pedigree of Huntington's disease would show a skip generation.

Answer: True ● False

93) During gamete formation, different pairs of alleles on different chromosomes segregate independently of each other.

Answer: ● True False

94) If yellow and round phenotypes in peas are dominant, and pea shape and colour are each controlled by a single gene, you know the genotype of all peas that are green and wrinkled.

Answer: ● True False

95) Several single-gene disorders are more common in some populations of people than in others.

Answer: ● True False

96) When examining a dominant trait, affected children always have at least one affected parent.

Answer: ● True False

97) Two affected parents can produce unaffected children in a recessive trait.

Answer: True ● False

98) Consanguineous mating increase the likelihood of a dominant trait.

Answer: True ● False

99) Incomplete dominance means that the hybrid does not resemble either pure-breeding parent.

Answer: ● True False

100) A lethal disorder does not include the inheritance of traits that cause death in adulthood.

Answer: True ● False

101) Cross-fertilization is the same as reciprocal cross.

Answer: True ● False

102) Traits such as human height are considered as a type of discrete traits.

Answer: True ● False

103) When a sperm cell fertilizes an egg cell the result is called zygote.

Answer: ● True False

104) The following genotype: Gg is called heterozygote.

Answer: ● True False

105) Parental generation is designated as (P) and the progeny of the parental generation is designated as F1.

Answer: ● True False

106) The law of segregation is a Mendelian law that states that both alleles must separate during gamete formation.

Answer: ● True False

107) Multifactorial inheritance is when a phenotype arises as a result of multiple genes interacting with each other and/or the environment.

Answer: ● True False

108) The flower colours white, pink, and red indicate codominant inheritance.

Answer: True ● False

109) A phenotype that is expressed in 87% of individuals with the same genotype shows complete penetrance.

Answer: True ● False

110) When a late blooming pea and an early blooming pea are crossed and an intermediate phenotype occurs, this result would suggest incomplete dominant inheritance.

Answer: ● True False

111) In codominance, F_1 hybrids show the traits of both parents.

Answer: ● True False

112) Different alleles indicate unique genes.

Answer: True ● False

113) Mutations are the source of new alleles.

Answer: ● True False

114) A wild-type allele is any allele whose frequency is closest to 100%.

Answer: True ● False

115) A measurable traits such as the length of a tobacco flower in millimeters is often considered a form of a discontinuous trait and is polygenic.

Answer: True ● False

116) A mutant allele has a rare occurrence in a population.

Answer: **True** False

117) Genes with more than one wild-type allele are termed polymorphic.

Answer: **True** False

118) The mouse *agouti* gene has one wild-type allele and several mutant alleles.

Answer: **True** False

119) The phenomenon of a single gene determining a number of distinct and seemingly unrelated characteristics is known as pleiotropy.

Answer: **True** False

120) Hbß^{S} Hbß^{S} homozygous are resistant to *Plasmodium falciparum.*

Answer: **True** False

121) In epistasis, one gene's alleles mask the effects of another gene's alleles.

Answer: **True** False

122) A gene interaction in which the effects of an allele at one gene hide the effects of alleles at another gene is known as dominance.

Answer: True **False**

123) Epistasis in which a dominant allele of one gene hides the effects of another gene is called recessive epistasis.

Answer: True **False**

124) When an organism has two genes that perform the same function, these genes are called redundant genes.

Answer: **True** False

125) In complementary gene action, dominant alleles of two or more genes are required to generate a particular trait.

Answer: **True** False

126) Mutant alleles at one of two or more different genes can result in the same phenotype.

Answer: **True** False

127) Dominant epistasis II is also known as dominant suppression.

Answer: **True** False

128) To produce a particular normal phenotype, the dominant allele of two interacting genes can both be necessary.

Answer: **True** False

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

129) You are a judge in a civil trial where a young man is attempting to prove that he is the illegitimate child of a very wealthy man who has recently died. He wishes to be included in the distribution of the wealth. After considering all the testimony about how this person was conceived, the key evidence seems to come down to two main facts. The wealthy man and the mother of the young man are both deaf but the young man is not. Therefore the lawyer of the family suggests that the wealthy man is not the father. The mother, wealthy man, and young man all have O, MM, and Rh Blood Type at the phenotypic level but a genotyping screen indicates that the wealthy man is actually I^AI^A *hh* blood type. How do you interpret the evidence presented and how does it influence your decision in this case?

Answer: The fact that the young man can hear is not evidence against his being the son of the wealthy man. Two deaf individuals can, via complementation, give rise to hearing offspring if the mutation they carry is on different genes (hearing is a polygenic trait.) The blood type evidence is definitive in favour of the wealthy man not being the father of the young man. Although both putative parents and the son in question have O blood type, the wealthy man is genetically type A and phenotypically type O because of recessive homozygosity of the *h* allele which leads to Bombay phenotype; the protein to which the A sugar attaches is missing thereby making the wealthy man phenotypically type O. Any son of his would be highly likely to have A-antigen, as the *h* allele is very rare in humans, making homozygous recessive offspring extremely unlikely except in consanguineous matings.

130) Can a phenotype O be the father of a child who is phenotype B if the mom is phenotype A?

Answer: No

131) Calculate the probability of the production of a homozygous recessive genotype for the following cross: *AaBbccddEeFf* × *AaBbCcddEeFf*

Answer: $1/4 \times 1/4 \times 1/2 \times 1 \times 1/4 \times 1/4 = 1/512$

132) A phenotypically normal man who has two siblings died from an autosomal recessive disease before the age of 5. What is the risk that this man is heterozygous carrier for the autosomal recessive mutation?

Answer: 2/3

133) Karen, a 35-year-old woman affected by an autosomal dominant disease that has 80% penetrance marries Jon, a 40 year old man who is similar to his wife (a heterozygous) for the same autosomal dominant disease. If they decide to have a child, what is the probability that the child is going to be phenotypically normal?

Answer: 40%

134) In *Drosophila,* forked (*fk*) bristles are recessive to normal (fk^+) and glassy eyes (*gls*) are recessive to normal (gls^+). If an F_1 heterozygous female is backcrossed to the homozygous wild-type male parent, predict the genotypes and phenotypes of the offspring.

Answer:

Genotype	Phenotype
$fk^+fk^+gls^+gls^+$	Wild Type
$fk^+fk^+gls^+gls$	Wild Type
$fk^+fk\ gls^+gls^+$	Wild Type
$fk^+fk\ gls^+gls$	Wild Type

135) A science teacher is attempting to convince her class that alcoholism, which has long been known to be a disease of polygenic inheritance, really is partially genetically determined. You are asked to assist in the design of an experiment that will help show eighth graders genetic transmission of differences in alcohol drinking. You have been given outbred rats as your experimental model. Set up a quantitative experiment that would test the hypothesis that alcoholism, as determined by amount of alcohol drunk, is a quantitative trait.

Answer: Set up a selective breeding experiment. Provide rats with water and with a solution of water and alcohol in a low concentration. Measure the consumption of the alcohol-containing solution per day for all rats. Breed the high-drinking male rats with the high-drinking females, and the low-drinking males with low-drinking females. Test the offspring for alcohol solution consumption, and do the same in subsequent generations. If the rats bred for high drinking continue to increase their drinking levels from generation to generation, and the low drinkers decrease their drinking levels in the same way, this is evidence that alcohol consumption is genetically determined. Your data will also show that the individual rats differ in amount of consumption, and when plotted together the data will show a continuous distribution, indicating a quantitative trait (interactions of more than one gene and interactions with the environment contribute to the alcohol drinking trait).

136) In corn, liguleless (*l*) is recessive to ligules (*L*) and a green leaf (*G*) is dominant to the normal non-green (*g*). If a testcross is performed with a plant that is a dihybrid for both of these genes, what would be the phenotypes and genotypes of the progeny? Assume independent assortment.

Answer:

Genotype	Phenotype
LlGg	Ligules/Green
Llgg	Ligules/Non-green
llGg	Liguleless/Green
llgg	Liguleless/Non-green

137) Short hair in rabbits is produced by a dominant allele (l^+) and long hair by its recessive allele (*l*). Black hair results from the action of a dominant allele (b^+) and brown hair from its recessive allele (*b*). Determine the genotypic and the corresponding phenotypic ratios of the F_2 offspring, beginning with a parental cross of a rabbit with brown, short hair to a rabbit with long, black hair. Assume that the parent with short hair is homozygous for that allele, and that the parent with black hair is homozygous for that allele. Assume independent assortment.

Answer:

#	Genotype	Phenotype
1	$l^+l^+\ b^+b^+$	Short Black
2	$l^+l\ \ b^+b^+$	Short Black
2	$l^+l^+\ b^+b$	Short Black
4	$l^+l\ \ b^+b$	Short Black
1	$l^+l^+\ bb$	Short Brown
2	$l^+l\ \ bb$	Short Brown
1	$ll\ b^+b^+$	Long Black
2	$ll\ b^+b$	Long Black
1	$ll\ bb$	Long Brown

138) What does a diamond symbol ◊ in a pedigree indicate?

Answer: Sex unspecified

139) You wish to know the genotype of some carrot plants that you have grown in your garden so that you might grow more of them. They have reddish orange flesh, are sweet in taste, long in root, and short in leaf. Using classical genetic techniques how would you determine the genotype?

Answer: You need to determine the dominant/recessive nature of each trait. Set up crosses between reddish orange, sweet tasting, long in root, and short in leaf carrot plants and true orange, plain tasting, short in root, and long in leaf carrot plants to determine each dominant trait. Then create a "tester plant" that is recessive for all four traits. Cross your favourite carrot plants with the tester and observe the offspring. The traits shown in the offspring are indicative of the genotype of your original carrot plant.

140) List 3 criteria to recognize dominant traits?

Answer: Affected children always have at least one affected parent, there is vertical pattern of inheritance, the trait shows up in every generation, two affected parents can produce unaffected children (if the parents are heterozygous).

141) In *Drosophila,* forked (*fk*) bristles are recessive to normal (fk^+) and glassy eyes (*gls*) are recessive to normal (gls^+). If a homozygous wild-type male is mated to a forked-bristled, glassy-eyed female, predict the genotypes and phenotypes of the F_2. Assume independent assortment.

Answer:

#	Genotype	Phenotype
1	$fk^+fk^+\ gls^+gls^+$	Wild type
2	$fk^+fk^+\ gls^+gls$	Wild type
2	$fk^+fk\ gls^+gls^+$	Wild type
4	$fk^+fk\ gls^+gls$	Wild type
1	$fk^+fk^+\ gls\ gls$	Glassy eyes
2	$fk^+fk\ gls\ gls$	Glassy eyes
1	$fk\ fk\ gls^+gls^+$	Forked bristles
2	$fk\ fkgls^+gls$	Forked bristles
1	$fk\ fk\ gls\ gls$	Forked bristles and glassy eyes

142) In *Drosophila,* forked (*fk*) bristles are recessive to normal (fk^+) and glassy eyes (*gls*) are recessive to normal (gls^+). If a homozygous wild-type male is mated to a forked-bristle, glassy-eye female, predict the genotypes and phenotypes of the F_1.

Answer:

Genotype	Phenotype
$fk^+fk\ gls^+gls$	Wild type

143) Short hair in rabbits is produced by a dominant allele (l^+) and long hair by its recessive allele (*l*). Black hair results from the action of a dominant allele (b^+) and brown hair from its recessive allele (*b*). Determine the genotypic and the corresponding phenotypic ratios of the F_1 offspring, beginning with a parental cross of a rabbit with brown, short hair to a rabbit with long, black hair. Assume that the parent with short hair is homozygous for that allele, and that the parent with black hair is homozygous for that allele. Assume independent assortment.

Answer:

Genotype	Phenotype
$l^+l\ b^+b$	short, black

144) Stem colour of tomato plants is known to be under the genetic control of at least one pair of alleles such that *A*_ results in the production of anthocyanin pigment (purple stem). The recessive genotype *aa* lacks this pigment and hence is green. The production of two locules (seed chambers) in the tomato fruit is controlled by the dominant allele *M*, and multiple locules is determined by *mm*. Determine the genotypic and phenotypic ratios of the F_1 from a cross between an inbred tomato plant with a purple stem and fruit with two locules crossed to a tomato plant with a green stem and fruit with multiple locules.

Answer:

Genotype	Phenotype
AaMm	purple, 2 locules

145) In corn liguleless, (*l*) is recessive to ligules (*L*) and a green leaf (*G*) is dominant to the normal non-green (*g*). If a plant homozygous for liguleless and green leaves is crossed to one homozygous for non-green with ligules, predict the phenotypes and genotypes of the F_1. Assume independent assortment.

Answer:

Genotype	Phenotype
LlGg	Ligules/Green

146) If a scientist performs a cross in which the male parent traits and the female parent traits are reversed , the cross is referred to as ________.

Answer: reciprocal cross

147) You are out on a nature walk up in the mountains and you find a pretty wildflower in the lower altitu short and bushy with small, fragrant, bright purple flowers. In the higher altitude you find what seem same plant, yet it is tall and sparse with larger flowers of the same colour and fragrance.

A) Set up an experiment to test the hypothesis that the plants are different due to genetic but not envi influences.

B) Is it possible to tell if both genetic and environmental effects occur?

Answer: A) Assuming these are not endangered plants and you are not in a protected area, obtain several specimens from each location. Plant seeds of both types of plants in both low- and high-altitude locations. Observe the offspring. If the offspring look the same as their parental stock, then the differences are simply genetic in nature. If the offspring look short and bushy wi small fragrant, bright purple flowers in the lower altitude, but tall and sparse with larger flower same colour and fragrance in the higher altitude, then the differences are due to environmental influences.

B) Yes, a combination of the traits would indicate that both environmental and genetic influenc role in the differences you have identified.

148) List two diseases that are caused by a dominant allele?

Answer: Hypercholesterolaemia, Huntington

149) List two diseases that are caused by a recessive allele?

Answer: Sickle-cell anemia, cystic fibrosis, Tay-Sachs Phenylketonuria, Thalassemia.

150) In corn liguleless, (*l*) is recessive to ligules (*L*) and a green leaf (*G*) is dominant to the normal non-green (*g*). If a plant homozygous for liguleless and green leaves is crossed to one homozygous for non-green with ligules, predict the phenotypes and genotypes of the F_2.

Answer:

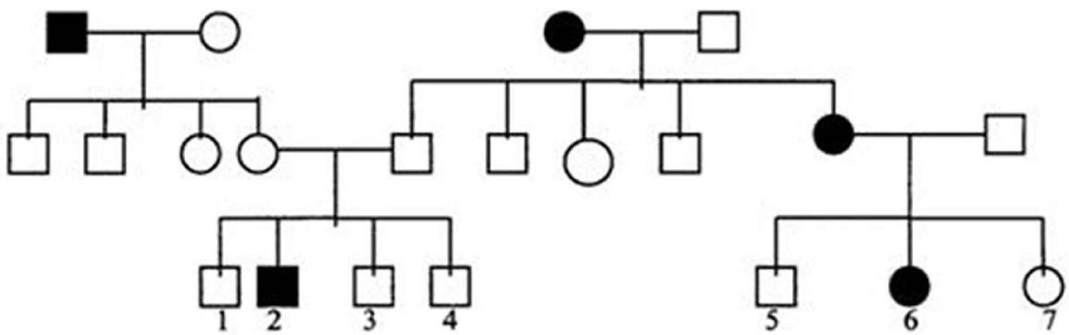
# Genotype	Phenotype
1 *LLGG*	Ligules/Green
2 *LLGg*	Ligules/Green
2 *LlGG*	Ligules/Green
4 *LlGg*	Ligules/Green
1 *LLgg*	Ligules/Non-green
2 *Llgg*	Ligules/Non-green
1 *llGG*	Liguleless/Green
2 *llGg*	Liguleless/Green
1 *llgg*	Liguleless/Non-green

151) Stem colour of tomato plants is known to be under the genetic control of at least one pair of alleles such that *A*_ results in the production of anthocyanin pigment (purple stem). The recessive genotype *aa* lacks this pigment and hence is green. The production of two locules (seed chambers) in the tomato fruit is controlled by the dominant allele *M*, and multiple locules is determined by *mm*. Determine the genotypic and phenotypic ratios of the F_2 offspring beginning with a parental cross between an inbred tomato plant that has a purple stem and fruit with two locules, and a tomato plant that has a green stem and fruit with multiple locules. Assume independent assortment.

Answer:

#	Genotype	Phenotype
1	*AAMM*	Purple, 2 locules
2	*AaMM*	Purple, 2 locules
2	*AAMm*	Purple, 2 locules
4	*AaMm*	Purple, 2 locules
1	*aaMM*	Green, 2 locules
2	*aaMm*	Green, 2 locules
1	*AAmm*	Purple, Multi locules
2	*AAMm*	Purple, Multi locules
1	*aamm*	Green, Multi locules

152) Below is a pedigree for a human trait. Shaded symbols are for individuals exhibiting the trait. Identify mode of inheritance of the trait and apply the laws of probability to calculate the probability that indi is a heterozygous carrier of the trait.



Answer: Mode of inheritance is recessive. The probability that #4 is a carrier is 1/4, since both of his parents are carriers, and since he does not have the trait himself (i.e. 3 Aa: 1 AA).

153) In corn, three dominant genes are necessary for aleurone colour. The genotype *B_D_R_* is coloured. Any homozygous recessive for one gene is colourless. Predict the genotypes and phenotypes of the offspring of the cross *BbDdRr* × *BbDdRr*
Phenotype: 27 coloured; 37 colourless

Answer:

Ratio of Genotypes

1	*BBDDrr*
2	*BBDdrr*
2	*BbDDrr*
4	*BbDdrr*
1	*BBddrr*
2	*Bbddrr*
1	*bbDDrr*
2	*bbDdrr*
1	*bbddrr*
2	*BBDDRr*
4	*BBDdRr*
4	*BbDDRr*
8	*BbDdRr*
2	*BBddRr*
4	*BbddRr*
2	*bbDDRr*
4	*bbDdRr*
2	*bbddRr*
1	*BBDDRR*
2	*BbDDRR*

2	*BBDdRR*
4	*BbDdRR*
1	*bbDDRR*
2	*bbDdRR*
1	*BBddRR*
2	*bbDdRR*
1	*bbddRR*

154) In corn, three dominant genes are necessary for aleurone colour. The genotype *B_D_R_* is coloured. Any homozygous recessive for one gene is colourless. Predict the genotypes and phenotypes of the offspring of the cross *BbDdRR* × *BbDdRR*

Answer: Phenotype: 9 colour; 7 colourless

Ratio of Genotypes

1	*BBDDRR*
2	*BbDDRR*
2	*BBDdRR*
4	*BbDdRR*
1	*bbDDRR*
2	*bbDdRR*
1	*BBddRR*
2	*bbDdRR*
1	*bbddRR*

155) In corn, three dominant genes are necessary for aleurone colour. The genotype *B_D_R_* is coloured. Any homozygous recessive for one gene is colourless. Predict the genotypes and phenotypes of the offspring of the cross *BbDdRR* × *BbDdrr*

Answer: Phenotype: 9 colour; 7 colourless

Ratio of Genotypes

1	*BBDDRr*
2	*BBDdRr*
2	*BbDDRr*
4	*BbDdRr*
1	*BBddRr*
2	*BbddRr*
1	*bbDDRr*
2	*bbDdRr*
1	*bbddRr*

156) In rats, the gene for the pigment (*P*) is dominant to no pigment (*p*). The gene for black (*B*) is dominant to the gene for cream (*b*). If a pigment gene (*P*) is absent, genes *B* and *b* are inoperative. Predict the genotypes and phenotypes of the F_1 of a cross between a homozygous black rat and an albino homozygous for cream.

Answer:

Genotype	Phenotype
PpBb	Black

157) In rats, the gene for the pigment (*P*) is dominant to no pigment (*p*). The gene for black (*B*) is dominant to the gene for cream (*b*). If a pigment gene (*P*) is absent, genes *B* and *b* are inoperative. Predict the genotypes and phenotypes of the F_2 of a parental cross between a homozygous black rat and an albino homozygous for cream.

Answer: 9 Black; 3 cream; 4 colourless

	Genotype	Phenotype
1	*PPBB*	Black
2	*PPBb*	Black
2	*PpBB*	Black
4	*PpBb*	Black
1	*ppBB*	colourless
2	*ppBb*	colourless
1	*PPbb*	cream
2	*Ppbb*	cream
1	*ppbb*	colourless

158) In the common daisy, the genes *A* and *a* and *B* and *b* represent two pairs of alleles acting on flower colour. *A* and *B* are required for colour. The alleles of these two genes show recessive epistasis. The two gene pairs together thus show duplicate recessive epistasis. Predict the genotypes and phenotypes of the F_1 of a cross between two colourless plants, one homozygous for *A* and the other homozygous for *B*.

Answer:

Genotype	Phenotype
AaBb	Colour

159) In the common daisy, the genes *A* and *a* and *B* and *b* represent two pairs of alleles acting on flower colour. *A* and *B* are required for colour. The alleles of these two genes show recessive epistasis. The two gene pairs together thus show duplicate recessive epistasis. Predict the genotypes and phenotypes of the F_2 of a cross between two colourless plants, one homozygous for *A* and the other homozygous for *B*.

Answer: 9 Black; 7 colourless

	Genotype	Phenotype
1	*AABB*	Colour
2	*AABb*	Colour
2	*AaBB*	Colour
4	*AaBb*	Colour
1	*aaBB*	Colourless
2	*aaBb*	Colourless
1	*AAbb*	Colourless
2	*Aabb*	Colourless
1	*aabb*	Colourless

160) In poultry, if a Black Longshank male with feathered shanks is crossed with a Buff Rock female with unfeathered shanks the F_1 are all feathered and the F_2 show 90 feathered to 6 unfeathered. Infer the genotypes of the parents.

Answer: *AABB* × *aabb*; The ratio is a 15:1 which is a dihybrid ratio; therefore the parents are homozygous and produce a heterozygous F_1.

161) In a certain breed of plants, dark green is determined by the dominant gene *G* and light green is determined by the recessive gene *g*. The heterozygote shows 75% penetrance for the dominant phenotype. If the parental cross is *GG* × *gg,* what phenotype distribution would be expected in a population of 400 F_2 plants?

Answer: 250 dark green (*GG* + 75% *Gg*); 150 light green (*gg* + 25% *Gg*)

162) A man with blood type A whose father was blood type O married a woman of blood type B whose mother was blood type O. What are the possible blood types of their offspring?

Answer: Blood types A, B, AB, and O are possible.

163) What phenotypes and genotypes would you expect from the following cross of blood-related genotyp
$I^B\ i\ rh^+\ rh^+ \times I^A i\ rh^+\ rh$

Answer:

$I^B I^A rh^+ rh$	AB positive
$I^B I^A rh^+ rh^+$	AB positive
$I^B irh^+ rh$	B positive
$I^B irh^+ rh^+$	B positive
$I^A irh^+ rh$	A positive
$I^A irh^+ rh^+$	A positive
$ii\ rh^+ rh$	O positive
$ii\ rh^+ rh^+$	O positive

164) Coat colour in a certain species of rabbit is governed by multiple alleles. The dominance series for these alleles is as follows: coloured (c^+), chinchilla, (c^{ch}), himalayan (c^h) and albino (c). Give the phenotypes and ratios from the following crosses:

(A) $c^+ c \times c^h\ c^h$

(B) $c^+ c^+ \times c^h\ c^{ch}$

(C) $c^+\ c \times c^h c$

(D) $c\ c \times c^h c^{ch}$

(E) $c^+\ c^h \times c^h\ c^{ch}$

(F) $c^+\ c^{ch} \times c^h c^{ch}$

(G) $c\ c \times c^+ c^{ch}$.

Answer: (A) *2 coloured : 2 himalayan*

(B) *all coloured*

(C) *2 coloured : 1 himalayan : 1 albino*

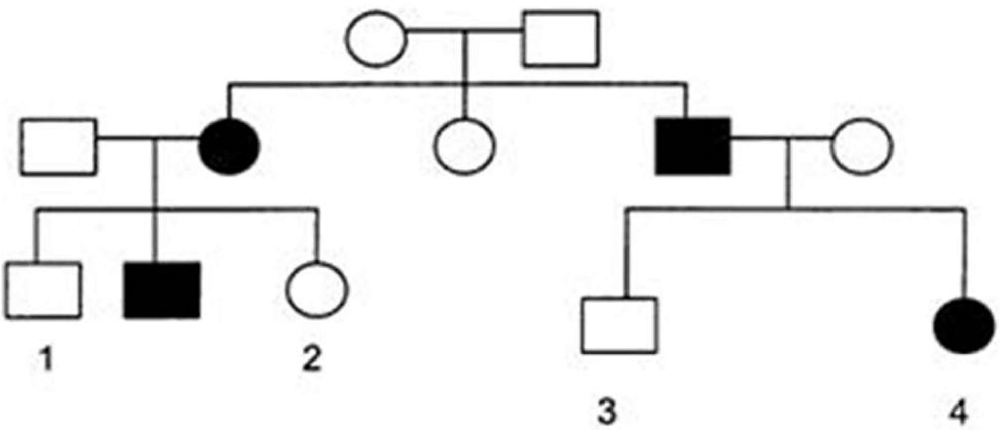
(D) *2 himalayan : 2 chinchilla*

(E) *2 coloured : 1 himalayan : 1 chinchilla*

(F) *2 coloured : 2 chinchilla*

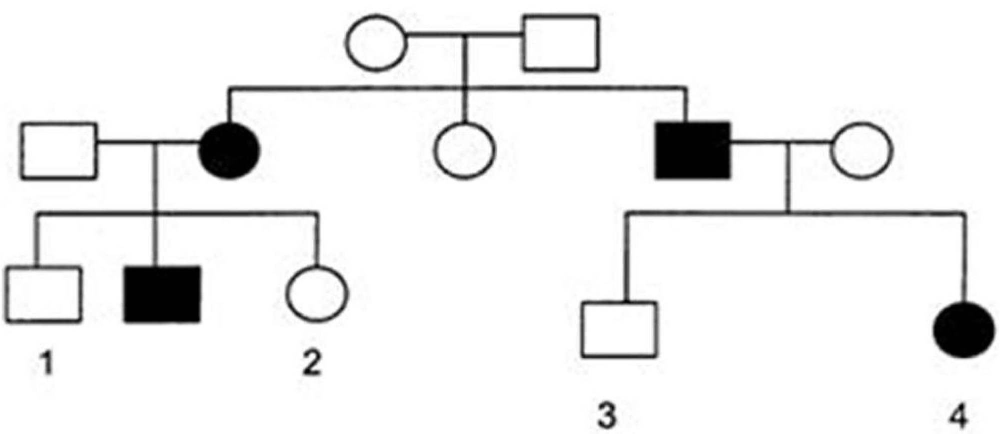
(G) *2 coloured : 2 chinchilla.*

165) Affected individuals in the following pedigree are homozygous for the allele that causes the trait. Wh possible genotypes of persons 1, 2, 3 and 4?



Answer: Persons 1, 2, 3 are Aa. Person 4 is AA.

166) The pedigree shown is for a human genetic disease in which solid colour indicates affected individuals. Affected individuals in the pedigree are homozygous for the allele that causes the trait. Apply the laws of probability and calculate the probability, the offspring of the cousin marriage (individual 2 × individual 3) will exhibit the disease.



Answer: The trait is a recessive trait. Individual #2 and individual #3 are both carriers, therefore, there is a 1/4 chance their offspring will be homozygous for the recessive allele.

167) The following five mothers, (a) through (e), with phenotypes given, each produced one child whose p
is described as to blood group (A, B, O), M or N antigens, and Rh factor. For each child, select as the
one of the five males whose genotypes are given. For some children, more than one male may be a po
father.
(*ii* = Type O blood, *rr* = rh & **R** = rh$^+$]

	Maternal Phenotype	**Child Phenotype**	**Genotype of Male**
(a)	A M R	O M R	1. I^Ai MN rr
(b)	B N r	O N r	2. I^Bi MN RR
(c)	O M r	A MN R	3. iiNNrr
(d)	A N R	AB MN R	4. iiMMrr
(e)	AB MN r	A MN r	5. I^AI^AMNRR

Answer: For the child of mother (a), the father could be 1 or 4. For the child of mother (b), the father could be 1 or 3. For the child of mother (c), the father could be 5. For the child of mother (d), the father could be 2. For the child of mother (e), the father could be 1 or 3 or 4.

168) You have obtained an interesting flower for your garden from your neighbour. The neighbour has given you two pure lines of the plant, one with red flowers and one with yellow flowers. You decide to cross them and find that you obtain all orange flowers. The curious molecular geneticist in you decides to test two independent hypotheses: Hypothesis 1: Incomplete dominance; Hypothesis 2: Recessive epistasis. The first step in your test is to self the F_1 orange plants, which you complete only to find that the results do not statistically distinguish the two hypotheses. a) What ratio of yellow, orange, and red would you expect in the F_2 population for each hypothesis and b) what cross would you complete next to definitively test your two hypotheses?

Answer: a) The expected phenotypic ratio for recessive epistasis is 9:3:4, and for incomplete dominance, 1:2:1. b) Cross the yellow F_2 flowers with true breeding red flowers. If the hypothesis for incomplete dominance is correct, the yellow colour will be determined by a single gene and all F_2 yellow flowers will be homozygous recessive and give rise to only orange flowers in the F_3 population [$aa \times AA = Aa$]. However, if the hypothesis for recessive epistasis is correct, a cross of F_2 yellow and true breeding red flowers will give rise to some red and some orange flowers [$Yyrr \times yyRR$ = either $yyRr$ or $YyRr$].

169) Genes *A* and *B* are required for colour. If *A* or *B* is absent (that is, *aa* or *bb*) the result is colourless. Give the genotypes and phenotypes for each F_1 and F_2 progeny of the cross *AAbb* × *aabb*

Answer: F_1 = *Aabb*/All colourless; F_2 = 1*AAbb*: 2*Aabb*: 1*aabb*/All colourless

170) Genes *A* and *B* are required for colour. If *A* or *B* is absent (that is, *aa* or *bb*) the result is colourless. Give the genotypes and phenotypes for each F_1 and F_2 progeny of the cross *aaBB* × *aabb*

Answer: F_1 = *aaBb*/All colourless; F_2 = 1*aaBB*: 2*aaBb*: 1*aabb*/All colourless

171) Genes *A* and *B* are required for colour. If *A* or *B* is absent (that is, *aa* or *bb*) the result is colourless. Give the genotypes and phenotypes for each F_1 and F_2 progeny of the cross *AAbb* × *aaBB*

Answer: F_1 = *AaBb* coloured; F_2 = 9 coloured; 7 colourless

Genotype	Phenotype
For F_1:	
AaBb	Coloured
For F_2:	
1*AABB*	Coloured
2*AABb*	Coloured
2*AaBB*	Coloured
4*AaBb*	Coloured
1*aaBB*	Colourless
1*AAbb*	Colourless
2*aaBb*	Colourless
2*Aabb*	Colourless
1*aabb*	Colourless

1) E
2) D
3) E
4) C
5) A
6) A
7) C
8) D
9) D
10) D
11) B
12) B
13) E
14) C
15) A
16) A
17) D
18) A
19) C
20) C
21) B
22) D
23) A
24) A
25) C
26) E
27) B
28) C
29) D
30) C
31) E
32) C
33) E
34) B
35) B
36) D
37) D
38) D
39) B
40) A
41) A
42) D
43) B
44) D
45) B
46) A
47) C
48) C
49) B
50) A

51) B
52) D
53) C
54) E
55) A
56) C
57) C
58) C
59) D
60) A
61) A
62) D
63) E
64) C
65) C
66) B
67) B
68) A
69) E
70) A
71) C
72) D
73) B
74) C
75) B
76) B
77) B
78) D
79) TRUE
80) TRUE
81) FALSE
82) TRUE
83) TRUE
84) TRUE
85) FALSE
86) FALSE
87) TRUE
88) FALSE
89) FALSE
90) TRUE
91) TRUE
92) FALSE
93) TRUE
94) TRUE
95) TRUE
96) TRUE
97) FALSE
98) FALSE
99) TRUE
100) FALSE

101) FALSE
102) FALSE
103) TRUE
104) TRUE
105) TRUE
106) TRUE
107) TRUE
108) FALSE
109) FALSE
110) TRUE
111) TRUE
112) FALSE
113) TRUE
114) FALSE
115) FALSE
116) TRUE
117) TRUE
118) TRUE
119) TRUE
120) TRUE
121) TRUE
122) FALSE
123) FALSE
124) TRUE
125) TRUE
126) TRUE
127) TRUE
128) TRUE
129) The fact that the young man can hear is not evidence against his being the son of the wealthy man. Two deaf individuals can, via complementation, give rise to hearing offspring if the mutation they carry is on different genes (hearing is a polygenic trait.) The blood type evidence is definitive in favour of the wealthy man not being the father of the young man. Although both putative parents and the son in question have O blood type, the wealthy man is genetically type A and phenotypically type O because of recessive homozygosity of the *h* allele which leads to Bombay phenotype; the protein to which the A sugar attaches is missing thereby making the wealthy man phenotypically type O. Any son of his would be highly likely to have A-antigen, as the *h* allele is very rare in humans, making homozygous recessive offspring extremely unlikely except in consanguineous matings.
130) No
131) $1/4 \times 1/4 \times 1/2 \times 1 \times 1/4 \times 1/4 = 1/512$
132) 2/3
133) 40%

134)

Genotype	Phenotype
$fk^+fk^+gls^+gls^+$	Wild Type
$fk^+fk^+gls^+gls$	Wild Type
$fk^+fk\ gls^+gls^+$	Wild Type
$fk^+fk\ gls^+gls$	Wild Type

135) Set up a selective breeding experiment. Provide rats with water and with a solution of water and alcohol in a low concentration. Measure the consumption of the alcohol-containing solution per day for all rats. Breed the high-drinking male rats with the high-drinking females, and the low-drinking males with low-drinking females. Test the offspring for alcohol solution consumption, and do the same in subsequent generations. If the rats bred for high drinking continue to increase their drinking levels from generation to generation, and the low drinkers decrease their drinking levels in the same way, this is evidence that alcohol consumption is genetically determined. Your data will also show that the individual rats differ in amount of consumption, and when plotted together the data will show a continuous distribution, indicating a quantitative trait (interactions of more than one gene and interactions with the environment contribute to the alcohol drinking trait).

136)

Genotype	Phenotype
LlGg	Ligules/Green
Llgg	Ligules/Non-green
llGg	Liguleless/Green
llgg	Liguleless/Non-green

137)

#	Genotype	Phenotype
1	$l^+l^+\ b^+b^+$	Short Black
2	$l^+l\ \ b^+b^+$	Short Black
2	$l^+l^+\ b^+b$	Short Black
4	$l^+l\ \ b^+b$	Short Black
1	$l^+l^+\ bb$	Short Brown
2	$l^+l\ \ bb$	Short Brown
1	$ll\ b^+b^+$	Long Black
2	$ll\ b^+b$	Long Black
1	$ll\ bb$	Long Brown

138) Sex unspecified

139) You need to determine the dominant/recessive nature of each trait. Set up crosses between reddish orange, sweet tasting, long in root, and short in leaf carrot plants and true orange, plain tasting, short in root, and long in leaf carrot plants to determine each dominant trait. Then create a "tester plant" that is recessive for all four traits. Cross your favourite carrot plants with the tester and observe the offspring. The traits shown in the offspring are indicative of the genotype of your original carrot plant.

140) Affected children always have at least one affected parent, there is vertical pattern of inheritance, the trait shows up in every generation, two affected parents can produce unaffected children (if the parents are heterozygous).

141)

#	Genotype	Phenotype
1	$fk^+fk^+\ gls^+gls^+$	Wild type
2	$fk^+fk^+\ gls^+gls$	Wild type
2	$fk^+fk\ gls^+gls^+$	Wild type
4	$fk^+fk\ gls^+gls$	Wild type
1	$fk^+fk^+\ gls\ gls$	Glassy eyes
2	$fk^+fk\ gls\ gls$	Glassy eyes
1	$fk\ fk\ gls^+gls^+$	Forked bristles
2	$fk\ fkgls^+gls$	Forked bristles
1	$fk\ fk\ gls\ gls$	Forked bristles and glassy eyes

142)

Genotype	Phenotype
$fk^+fk\ gls^+gls$	Wild type

143)

Genotype	Phenotype
$l^+l\ b^+b$	short, black

144)

Genotype	Phenotype
AaMm	purple, 2 locules

145)

Genotype	Phenotype
LlGg	Ligules/Green

146) reciprocal cross

147) A) Assuming these are not endangered plants and you are not in a protected area, obtain several specimens from each location. Plant seeds of both types of plants in both low- and high-altitude locations. Observe the offspring. If the offspring look the same as their parental stock, then the differences are simply genetic in nature. If the offspring look short and bushy with small fragrant, bright purple flowers in the lower altitu tall and sparse with larger flowers of the same colour and fragrance in the higher altitude, then the differenc to environmental influences.
B) Yes, a combination of the traits would indicate that both environmental and genetic influences play a rol differences you have identified.

148) Hypercholesterolaemia, Huntington

149) Sickle-cell anemia, cystic fibrosis, Tay-Sachs Phenylketonuria, Thalassemia.

150)

# Genotype	Phenotype
1 *LLGG*	Ligules/Green
2 *LLGg*	Ligules/Green
2 *LlGG*	Ligules/Green
4 *LlGg*	Ligules/Green
1 *LLgg*	Ligules/Non-green
2 *Llgg*	Ligules/Non-green
1 *llGG*	Liguleless/Green
2 *llGg*	Liguleless/Green
1 *llgg*	Liguleless/Non-green

151)

#	Genotype	Phenotype
1	*AAMM*	Purple, 2 locules
2	*AaMM*	Purple, 2 locules
2	*AAMm*	Purple, 2 locules
4	*AaMm*	Purple, 2 locules
1	*aaMM*	Green, 2 locules
2	*aaMm*	Green, 2 locules
1	*AAmm*	Purple, Multi locules
2	*AAMm*	Purple, Multi locules
1	*aamm*	Green, Multi locules

152) Mode of inheritance is recessive. The probability that #4 is a carrier is 1/4, since both of his parents are carriers, and since he does not have the trait himself (i.e. 3 Aa: 1 AA).

153)

Ratio of Genotypes

1	*BBDDrr*
2	*BBDdrr*
2	*BbDDrr*
4	*BbDdrr*
1	*BBddrr*
2	*Bbddrr*
1	*bbDDrr*
2	*bbDdrr*
1	*bbddrr*
2	*BBDDRr*
4	*BBDdRr*
4	*BbDDRr*
8	*BbDdRr*
2	*BBddRr*
4	*BbddRr*
2	*bbDDRr*
4	*bbDdRr*
2	*bbddRr*
1	*BBDDRR*
2	*BbDDRR*
2	*BBDdRR*
4	*BbDdRR*
1	*bbDDRR*
2	*bbDdRR*
1	*BBddRR*
2	*bbDdRR*
1	*bbddRR*

154) Phenotype: 9 colour; 7 colourless

Ratio of Genotypes

1	*BBDDRR*
2	*BbDDRR*
2	*BBDdRR*
4	*BbDdRR*
1	*bbDDRR*
2	*bbDdRR*
1	*BBddRR*
2	*bbDdRR*
1	*bbddRR*

155) Phenotype: 9 colour; 7 colourless

Ratio of Genotypes

1	*BBDDRr*
2	*BBDdRr*
2	*BbDDRr*
4	*BbDdRr*
1	*BBddRr*
2	*BbddRr*
1	*bbDDRr*
2	*bbDdRr*
1	*bbddRr*

156)

Genotype	Phenotype
PpBb	Black

157) 9 Black; 3 cream; 4 colourless

	Genotype	Phenotype
1	*PPBB*	Black
2	*PPBb*	Black
2	*PpBB*	Black
4	*PpBb*	Black
1	*ppBB*	colourless
2	*ppBb*	colourless
1	*PPbb*	cream
2	*Ppbb*	cream
1	*ppbb*	colourless

158)

Genotype	Phenotype
AaBb	Colour

159) 9 Black; 7 colourless

	Genotype	Phenotype
1	*AABB*	Colour
2	*AABb*	Colour
2	*AaBB*	Colour
4	*AaBb*	Colour
1	*aaBB*	Colourless
2	*aaBb*	Colourless
1	*AAbb*	Colourless
2	*Aabb*	Colourless
1	*aabb*	Colourless

160) *AABB* × *aabb*; The ratio is a 15:1 which is a dihybrid ratio; therefore the parents are homozygous and produce a heterozygous F_1.

161) 250 dark green (*GG* + 75% *Gg*); 150 light green (*gg* + 25% *Gg*)

162) Blood types A, B, AB, and O are possible.

163)

$I^B I^A rh^+ rh$	AB positive
$I^B I^A rh^+ rh^+$	AB positive
$I^B i rh^+ rh$	B positive
$I^B i rh^+ rh^+$	B positive
$I^A i rh^+ rh$	A positive
$I^A i rh^+ rh^+$	A positive
$ii\ rh^+ rh$	O positive
$ii\ rh^+ rh^+$	O positive

164) (A) *2 coloured : 2 himalayan*
(B) *all coloured*
(C) *2 coloured : 1 himalayan : 1 albino*
(D) *2 himalayan : 2 chinchilla*
(E) *2 coloured : 1 himalayan : 1 chinchilla*
(F) *2 coloured : 2 chinchilla*
(G) *2 coloured : 2 chinchilla.*

165) Persons 1, 2, 3 are Aa. Person 4 is AA.

166) The trait is a recessive trait. Individual #2 and individual #3 are both carriers, therefore, there is a 1/4 chance their offspring will be homozygous for the recessive allele.

167) For the child of mother (a), the father could be 1 or 4. For the child of mother (b), the father could be 1 or 3. For the child of mother (c), the father could be 5. For the child of mother (d), the father could be 2. For the child of mother (e), the father could be 1 or 3 or 4.

168) a) The expected phenotypic ratio for recessive epistasis is 9:3:4, and for incomplete dominance, 1:2:1. b) Cross the yellow F_2 flowers with true breeding red flowers. If the hypothesis for incomplete dominance is correct, the yellow colour will be determined by a single gene and all F_2 yellow flowers will be homozygous recessive and give rise to only orange flowers in the F_3 population [$aa \times AA = Aa$]. However, if the hypothesis for recessive epistasis is correct, a cross of F_2 yellow and true breeding red flowers will give rise to some red and some orange flowers [$Yyrr \times yyRR$ = either $yyRr$ or $YyRr$].

169) F_1 = *Aabb*/All colourless; F_2 = 1*AAbb*: 2*Aabb*: 1*aabb*/All colourless

170) F_1 = *aaBb*/All colourless; F_2 = 1*aaBB*: 2*aaBb*: 1*aabb*/All colourless

171) F_1 = *AaBb* coloured; F_2 = 9 coloured; 7 colourless

Genotype	Phenotype
For F_1:	
AaBb	Coloured
For F_2:	
1*AABB*	Coloured
2*AABb*	Coloured
2*AaBB*	Coloured
4*AaBb*	Coloured
1*aaBB*	Colourless
1*AAbb*	Colourless
2*aaBb*	Colourless
2*Aabb*	Colourless
1*aabb*	Colourless