1st SEM. 2014/2015

UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER

PROGRAMMES: BSc ANIMAL SCIENCE II
BSc. ANIMAL SCIENCE (DAIRY OPTION) II
BSc AGRONOMY II
BSc HORTICULTURE II
BSc AGRICULTURAL EDUCATION II

COURSE CODE: AS 204

TITLE OF PAPER: PRINCIPLES OF GENETICS

TIME ALLOWED: TWO (2) HOURS

INSTRUCTIONS: ANSWER ANY FOUR QUESTIONS

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QUESTION 1 (Use the answer grid provided to answer this question)

i) B is a dominant allele coding for black fur on rabbits and b is a recessive allele coding for white fur on rabbits. Choose the letter matching the cross that would produce the offspring distribution specified:

a) All (100%) of the offspring are white: **A)** *BB* x *bb*; **B)** *Bb* x *Bb*; **C)** *bb* x *bb*; **D)** *Bb* x *bb*. **(1 Mark)**

b) One quarter (25%) of the offspring are white: **A)** *BB* x *bb*; **B)** *Bb* x *Bb*; **C)** *bb* x *bb*; **D)** *Bb* x *bb*. **(1 Mark)**

c) All (100%) of the offspring are black: **A)** *BB* x *bb*; **B)** *Bb* x *Bb*; **C)** *bb* x *bb*; **D)** *Bb* x *bb*. **(1 Mark)**

d) Three-quarters (75%) of the offspring are black: **A)** *BB* x *bb*; **B)** *Bb* x *Bb*; **C)** *bb* x *bb*; **D)** *Bb* x *bb*. **(1 Mark)**

e) One-half (50%) of the offspring are white: **A)** *BB* x *bb*; **B)** *Bb* x *Bb*; **C)** *bb* x *bb*; **D)** *Bb* x *bb*. **(1 Mark)**

ii) In cats with the Manx trait, the M (dominant) allele causes a short or absent tail, whereas the m allele confers a normal, long tail. Cats of genotype MM die as embryos. If two Manx cats mate, what is the probability that each living kitten has a long tail?

A) $\frac{1}{2}$; **B)** $\frac{1}{4}$; **C)** $\frac{1}{2}$; **D)** $\frac{2}{3}$ **D)** None of these. **(2 Marks)**

iii) A pea plant is heterozygous for both seed shape and seed colour. S is the allele for the dominant, spherical shape characteristic; s is the allele for the recessive, dented shape characteristic. Y is the allele for the dominant, yellow colour characteristic; y is the allele for the recessive, green colour characteristic. What will be the distribution of these two alleles in this plant's gametes? **(2 Marks)**

A). 50% of gametes are Sy; 50% of gametes are sY
B). 25% of gametes are SY; 25% of gametes are Sy; 25% of gametes are sY; 25% of gametes are sy
C). 50% of gametes are sy; 50% of gametes are SY
D). 100% of the gametes are SsYy
E). 50% of gametes are SsYy; 50% of gametes are SSYY

iv) A phenotype ratio of 9:3:3:1 in the offspring of a mating of two organisms heterozygous for two traits is only expected if: **(2 Marks)**

A). The genes reside on the same chromosome
B). Each gene contains two mutations
C). The gene pairs assort independently during meiosis
D). Only recessive traits are scored
E). None of these

v) The gametes of a plant of genotype SSYy should have the genotypes: **(2 Marks)**

A). Ss and Yy
B). SY and sy
C). SY, Sy, sY, and sy
D). Ss, Yy, SY and sy
E). SS, ss, YY, and yy

vi) A pea plant of unknown genotype is selfed and produces 395 progeny which were classified as follows: 296 tall and yellow, 99 short and yellow. What is the genotype of the tall pea plant of unknown genotype? (Tall and yellow are dominant). **(2 Marks)**

A). TTYy
B). TtYy
C). TtYY
D). Ttyy
E). None of these

vii) In a dihybrid cross, SsYy x SsYy, what fraction of the offspring will be homozygous for both traits? **(2 Marks)**

A. 1/16
B. 1/8
C. 3/16
D. 1/4
E. 3/4

viii) If the dominant allele K is necessary for hearing, and the dominant allele M of another independent loci (i.e., not linked) results in deafness no matter what other genes are present, what percentage of the offspring produced by the cross kkMm x Kkmm will be deaf? **(2 Marks)**

A). 100%
B). 25%
C). 75%
D). 50%
E). None of these

ix) Albinism, the total lack of pigment, is due to a recessive gene. A boy and girl who are both normally pigmented but the boy's father was an albino while the girl's mother was an albino. If these two get married what is the probability that they will produce an albino child? **(2 Marks)**

A). 0; **B)** $\frac{1}{2}$ **C)** $\frac{1}{4}$; **D)** $\frac{1}{4}$; **E)** $\frac{3}{4}$

x) Suppose that gene "*b*" is sex-linked, recessive, and embryonic lethal. A man marries a woman who is heterozygous for this gene. If this couple had many normal children, what would be the predicted sex ratio of these children? **(2 Marks)**

A). 0.50 male : 0.50 female
B). 0.25 male : 0.75 female
C). 0.67 male : 0.33 female
D). 0.33 male : 0.67 female
E). None of these

xi) Mr. Ndlela has type B blood. His wife Jenne is unsure of her blood type. If their first child, Magnifica, is type B, their second offspring, Melody, is AB and the twins, Maud and Lyn, are type A, what is Mr Ndlela's genotype at this locus (i.e. the Blood group locus)? **(2 Marks)**

A). BB
B). BO
C). AB
D). None of these

QUESTION 2

a) In tabular form, list the similarities and differences between mitosis and meiosis **(16 Marks)**

b) In humans, in which sex (male or female) does red-green colour blindness occur more frequently? What is the scientific explanation for this observation? **(5 Marks)**

c) Drones (male bees) are haploid yet they produce viable sperm. Explain how this is possible **(4 Marks)**

QUESTION 3

A). In humans, sickle-cell anaemia is caused by a recessive lethal allele Hb^s. The normal allele is designated H^a. Individuals who are Hb^aHb^s have sickle-cell trait, but are healthy.

i) What is the probability that two heterozygous individuals would give birth to a child with sickle-cell trait? **(4 Marks)**

ii) What is the probability that two heterozygous individuals would give birth to a child with sickle-cell anaemia? **(4 Marks)**

iii) If a normal Hb^aHb^a individual receives a blood transfusion from a Hb^aHb^s individual (heterozygous for sickle cell) what are the chances that the Hb^aHb^a man and his Hb^aHb^a wife will have Hb^aHb^s children? **(2 Marks)**

B). In pea plants the allele for tall is dominant to the allele for short. At another locus the allele for smooth seed is dominant to the one for wrinkled seed. You are presented with a tall plant that produces smooth seed. Give a step by step explanation of what you would do to determine the genotype of this pea plant. **(15 Marks)**

QUESTION 4

a) Most societies/countries have legal statutes/laws that criminalize consanguineous marriages. Briefly explain the scientific basis behind this. **(8 Marks)**

b) In summer squash, white fruit colour (W) is dominant over yellow fruit colour (w) and disk-shaped fruit (D) is dominant over sphere-shaped fruit (d). If a squash plant true-breeding for white, sphere-shaped fruit is crossed with a plant true-breeding for yellow, disk-shaped fruit to produce F1 plants. The F1 plants are then test crossed to produce F2 plants.

i) What are the phenotypic and genotypic ratios for the F1 generation? **(2 Marks)**

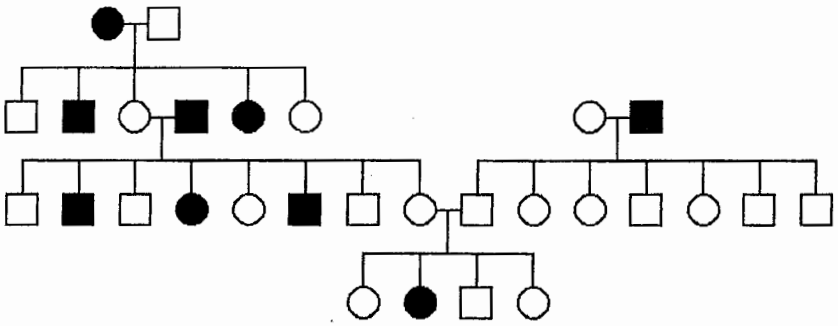
ii) List all the phenotypes expected in the F2 and give their ratios? **(6 Marks)**

iii) What fraction of the F2 plants would breed true for both fruit colour and fruit shape? **(4 Marks)**

iv) What fraction of the F2 plants would exhibit the dominant phenotype for both fruit colour and fruit shape? **(5 Marks)**

QUESTION 5

Study the diagram below and answer the questions below it.



a) State the most likely mode of inheritance? **(4 Marks)**
b) List <u>two</u> reasons to justify your choice for mode of inheritance in 5) a. **(4 Marks)**
c) What do we call this type of diagram? **(3 Marks)**
d) Is there a consanguineous marriage in this pedigree? **(3 Marks)**
e) What is the probability that II.1 is not a carrier? **(2 Marks)**
f) What is the probability that III.9 is a carrier? **(2 Marks)**
g) What is the probability that III.5 is a carrier? **(2 Marks)**
h) If III.3 married III.10 what is the probability that their first baby could be affected? **(3 Marks)**
i) What is the probability that a fifth baby from III.8 and III.9 will be a carrier? **(2 Marks)**