Suffolk County Community College

Michael J. Grant Campus

Department of Mathematics

Thursday, May 9, 2024 (expanded version)

MAT 106
Mathematics for Health Science

Final Exam

Instructor:

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Please print the requested information in the spaces provided:

Student:

Name:

Student Id:

Email: *include to receive the final grade via email* ONLY *if you are not getting email updates*

- *Notes and books are permitted on this exam.*
- *Graphing calculators, smartwatches, computers, cell phones and any other communication-capable devices are prohibited. Their mere presence in the open (even without use) is a sufficient reason for an immediate dismissal from this exam with a failing grade.*
- *You will not receive full credit if there is no work shown, even if you have the right answer. Please don't attach additional pieces of paper: if you run out of space, please ask for another blank final.*

Problem 1. ST-Elevation Myocardial Infarction (STEMI) is a very serious type of heart attack during which one of the heart's major arteries is blocked. To prevent clots and improve blood flow to heart, 12 USP units/kg/hr (max 1000 units/hr per person) continuous IV infusion of heparin is indicated for STEMI patients.

(1). A STEMI patient weighs 70 Kg. Determine the dose of heparin in units per hour for this patient.

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(2). Heparin is available in IV solution bag with label:

Determine the flow rate, in mL/hour, for the same patient.

Space for your solution:

(3). If 15 gtt/mL tubing is used for administering the infusion, what should the flow rate be in drops per minute? (Round the answer to the nearest integer.)

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(4). How long will this bag last?

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Problem 2. This problem will introduce you to the *Rhesus Factor*.

Phenotype. An individual either has, or does not have, the *Rhesus factor D antigen* [1] on the surface of their erythrocytes. These two phenotypes are usually indicated by Rh+ (does have the the Rh(D) antigen) or Rh- (does not have the Rh(D) antigen) suffix appended to the ABO blood type.

Distribution. For example, the most typical blood type in the United States is O (Rh+) with 39% of the population having it; the least typical is AB (Rh-) shared only by 1% of Americans. In the African American population, 7% have the Rh- phenotype. Among the Americans of European descent, 16% have the Rh- phenotype.

Genetics. Rhesus factor is controlled by one gene [2], called Rh(D), located on chromosome one. The Rh- phenotype is recessive; the Rh+ phenotype is dominant.

Clinical Significance. An Rh- individual can get *immunized* against the Rh(D) antigen. Immunization can generally occur only through blood transfusion or — for women only — through placental exposure when giving birth. Immunized individuals produce anti-D antibodies. A woman who is

- Rh-
- immunized against the Rh(D) antigen, and
- pregnant with an Rh+ fetus (which may happen only if the father is Rh+),

will pass her anti-D antibodies to her fetus through placenta. Those antibodies will agglutinate the erythrocytes of the fetus, resulting in a severe anaemia or even death. This condition is called *Rh D Hemolytic* [3] *disease of the newborn* [4].

(1). Suppose a pregnant woman had no prior pregnancies or blood transfusions. Determine the probability of her current pregnancy being complicated by the Hemolytic disease of the newborn.

Space for your solution:

[1] or *Rh(D) antigen* for short
[2] this is somewhat of an oversimplification
[3] literally: destroying blood cells
[4] also called the *Rhesus disease*

(2). How many alleles of the Rh(D) gene does one cell of each of the following types have?

- erythrocyte (red blood cell in the blood);
- neuron;
- sperm cell;
- ova cell.

Space for your solution:

(3). Suppose a pregnant Rh- woman has two children: one Rh+, and another one is Rh- [5]. Her children, as well as her pregnancy, are from the same partner. What is the probability that the current pregnancy will be complicated by the Hemolytic disease of the newborn?

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[5] and has neither prior terminated pregnancies, nor deceased children

(4). Determine the frequency of the Rh- and Rh+ alleles in African American population, assuming that this population is in the state of Hardy-Weinberg equilibrium in regards to Rh(D) alleles. Round the answer to the nearest whole percent.

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(5). Assuming that African American population is in the state of Hardy-Weinberg equilibrium in regards to Rh(D) alleles, determine the probabilities that an African American person is 1) Rh+ and Rh(D) heterozygous and 2) Rh+ and Rh(D) homozygous. Round the answer to the nearest whole percent.

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(6). Using the results from the sub-problem (5), determine the probabilities that an Rh+ African American person is 1) Rh(D) heterozygous and 2) Rh(D) homozygous. Round the answer to the nearest whole percent.

Space for your solution:

(7). Suppose a European American woman has her second pregnancy from the father of her first child, and had no prior pregnancies [6] or blood transfusions. What is the probability of the current pregnancy being complicated by the Hemolytic disease of the newborn? Round the answer to the nearest whole percent. Assume that the father is Rh+ homozygous.

Space for your solution:

(8). Same as the previous sub-problem, but assume that the father is Rh(D) heterozygous.

Space for your solution:

[6] meaning pregnancies from other partners

(9). Suppose a European American woman has her second pregnancy from the African American father of her first child, and had no prior pregnancies [7] or blood transfusions. What is the probability of the current pregnancy being complicated by the Hemolytic disease of the newborn? Use results from sub-problems (5), as needed. Round the answer to the nearest whole percent.

Space for your solution:

[7]meaning pregnancies from other partners

(10). Using the Hardy-Weinberg principle, explain the difference in Rh(D) allele frequencies in African American and in European American populations.

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(11). Suppose a European American woman has her third pregnancy from the African American father of her first two children, and had no prior pregnancies or blood transfusions. Both of her children are healthy, i.e. did not suffer from the Hemolytic disease of the newborn. What is the probability of the current pregnancy being complicated by the Hemolytic disease of the newborn? Use results from all previous sub-problems, as needed. Round the answer to the nearest whole percent.

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