CLASS QUIZ: JANUARY 6: EXPONENTIAL GROWTH

MATH 153, SECTION 55 (VIPUL NAIK)

Your name (print clearly in capital letters): _____

(1) A species of unicellular micro-organisms doubles in number every one hour at room temperature and remains constant when placed in a refrigerator. Given that the initial number of micro-organisms in a dish is N_0, and the dish is kept at room temperature for A hours and in a refrigerator for B hours, what is the **total number** of micro-organisms at **the end**? *Last year:* 29/29 *correct*
(A) $N_0 \cdot 2^{A-B}$
(B) $N_0 \cdot 2^{A+B}$
(C) $N_0 \cdot 2^{AB}$
(D) $N_0 \cdot 2^{A}$
(E) $N_0 \cdot 2^{B}$

Your answer: _____

(2) A radioactive substance has a half-life of 3 years. **Determine the integer** n such that 90% of the substance decays within somewhere between $n - (1/2)$ and $n + (1/2)$ years. *Last year:* 23/29 *correct*
(A) 5
(B) 10
(C) 15
(D) 20
(E) 25

Your answer: _____

(3) A, B, and C are three species of unicellular micro-organisms. Under specified conditions, species A doubles in number every 2 hours, species B triples in number every 3 hours, and species C quadruples (i.e., becomes 4 times) in number every 4 hours. Assume that they start off in the same quantities at the beginning. What can we say about their relative rates of growth? *Last year:* 22/29 *correct*
(A) They are all growing at the same rate.
(B) Species A is growing fastest, species C is growing slowest, and species B is growing at an intermediate rate.
(C) Species A is growing slowest, species C is growing fastest, and species B is growing at an intermediate rate.
(D) Species A and C are both growing at the same rate, which is faster than the rate at which species B is growing.
(E) Species A and C are both growing at the same rate, which is slower than the rate at which species B is growing.

Your answer: _____

(4) A species of bacteria doubles in number every hour. It takes 9 hours for a given initial quantity of this species to fill up a petri dish volume. How many hours from the start did the species occup half the petri dish volume (assume that the volume occupied is proportional to the quantity)? *Last year:* 28/29 *correct*
(A) 1 hour from the beginning
(B) 3 hours from the beginning
(C) 4.5 hours from the beginning
(D) 6 hours from the beginning

(E) 8 hours from the beginning

Your answer: _____

(5) Suppose the populations in two countries A and B are growing exponentially at possibly different rates. Which of the following statements is **false**? *Last year:* 24/29 *correct*
(A) If the initial population of A is more, and the exponential population growth rate of A is greater, then the population of A will always be greater than that of B.
(B) If the initial population of A is more, and the exponential population growth rate of B is greater, then the population of B will eventually overtake the population of A.
(C) If the initial population of A is more, and the exponential population growth rates of A and B are equal, then the populations of A and B will eventually become equal.
(D) All of the above.
(E) None of the above.

Your answer: _____

(6) (**) It takes time T for 1/5 of a radioactive substance to decay. How much time does it take for 2/5 of the same radioactive substance to decay? *Last year:* 7/28 *correct*
(A) Precisely $T/2$
(B) Between $T/2$ and T
(C) Between T and $2T$
(D) Precisely $2T$
(E) Between $2T$ and $3T$

Your answer: _____

(7) (**) The population in the island of Androgynesia as a function of time is believed to be an exponential function. On January 1, 1984, the population was measured to be $3 * 10^5$ with a measurement error of up to 10^5 on either side, i.e., the population was measured to be between $2 * 10^5$ and $4 * 10^5$. On January 1, 1998, the population was measured to be $1.2 * 10^6$ with a measurememt error of up to $4 * 10^5$ on either side, i.e., the population was measured to be between $8 * 10^5$ and $1.6 * 10^6$. If the population is an exponential function of time (i.e., the increment in population per year is a fixed proportion of the population that year), what is the **range of possible values** of the population measured on January 1, 2012? *Last year:* 4/29 *correct*
(A) Between $3.2 * 10^6$ and $6.4 * 10^6$
(B) Between $3.2 * 10^6$ and $1.28 * 10^7$
(C) Between $1.6 * 10^6$ and $3.2 * 10^6$
(D) Between $1.6 * 10^6$ and $6.4 * 10^6$
(E) Between $1.6 * 10^6$ and $1.28 * 10^7$

Your answer: _____