Exponential Growth and Decay MC

Name

1. The weight of a population of yeast is given by a differentiable function *y*, where *y(t)* is measured in grams and *t* is measured in days. The weight of the yeast population increases according to the equation $\frac{dy}{dt} = ky$, where *k* is a constant. At time *t* = *0*, the weight of the yeast population is 120 grams and is increasing at the rate of 24 grams per day. Which of the following is an expression for *y(t)* ?

(A) $120e^{24t}$

(B) $120e^{t/5}$

(C) $e^{t/5} + 119$

(D) $24t + 120$

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2. A puppy weighs 2.0 pounds at birth and 3.5 pounds two months later. If the weight of the puppy during its first 6 months is increasing at a rate proportional to its weight, then how much will the puppy weigh when it is 3 months old?

(A) 4.2 pounds

(B) 4.6 pounds

(C) 4.8 pounds

(D) 5.6 pounds

(E) 6.5 pounds

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3. The population *P* of a city grows according to the differential equation $\frac{dP}{dt} = kP$, where *k* is a constant and *t* is measured in years. If the population of the city doubles every 12 years, what is the value of *k* ?

(A) 0.058

(B) 0.061

(C) 0.167

(D) 0.693

(E) 8.318

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4. Population y grows according to the equation $\frac{dy}{dt} = ky$, where k is a constant and t is measured in years. If the population doubles every 10 years, then the value of k is

(A) 0.069

(B) 0.200

(C) 0.301

(D) 3.322

(E) 5.000

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5. During a certain epidemic, the number of people that are infected at any time increases at a rate proportional to the number of people that are infected at that time. If 1,000 people are infected when the epidemic is first discovered, and 1,200 are infected 7 days later, how many people are infected 12 days after the epidemic is first discovered?

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(A) 343

(B) 1,343

(C) 1,367

(D) 1,400

(E) 2,057

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6. Bacteria in a certain culture increase at a rate proportional to the number present. If the number of bacteria doubles in three hours, in how many hours will the number of bacteria triple?

(A) 3ln3/ln2

(B) 2ln3/ln2

(C) ln3/ln2

(D) ln(27/2)

(E) ln(9/2)

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7. Extreme heat applied to a colony of microorganisms causes the size P of the colony, measured in grams, to decrease according to the exponential decay model $\frac{dP}{dt} = -0.4P$, where the time t is measured in hours. The size Q of a second colony of microorganisms, also measured in grams, decreases at the constant rate of 1 gram per hour according to the linear model $\frac{dQ}{dt} = -1$. If at time $t = 0$ the first colony has size $P(0) = 2$ and the second colony has size $Q(0) = 3$, at what time will both colonies have the same size?

(A) 1.437

(B) 1.667

(C) 2.156

(D) 2.654

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8. A kitten weighs 85 grams at birth. During the first four weeks after the kitten's birth, its weight in grams is given by the function W that satisfies the differential equation $\frac{dW}{dt} = kW$, where t is measured in days and k is some positive constant. Which of the following could be an expression for $W(t)$?

(A) $85e^{0.059t}$

(B) $4e^{0.162t} + 81$

(C) $13t + 85$

(D) $0.466t^2 + 85$

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9. During a chemical reaction, the rate of change of the amount of the chemical remaining is proportional to the amount remaining. At time $t = 0$, the amount of the chemical is 12 moles. At time $t = 4$, the amount of the chemical is 4 moles. At what time t is the amount of the chemical 3 moles? (A mole is a unit of measure used in chemistry.)

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(A) $3\sqrt{2}$

(B) $\frac{9}{2}$

(C) $\frac{4 \ln 3}{\ln 4}$

(D) $\frac{4 \ln 4}{\ln 3}$

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10. The quantity R, in grams, of a certain radioactive substance decreases according to the exponential decay model $\frac{dR}{dt} = -0.05R$, where t is measured in seconds. During an experiment, a scientist determines that the rate of decay of a second substance with the quantity S, in grams, can be represented by a linear model $\frac{dS}{dt} = -4$, where t is measured in seconds. If at time $t = 0$, $R(0) = 100$ and $S(0) = 125$, at what time t, in seconds, will there be equal quantities of both substances?

(A) $t = 6.318$

(B) $t = 6.329$

(C) $t = 23.548$

(D) $t = 31.197$

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11. During optimal conditions, the rate of change of the population of a certain organism is proportional to the population at time t, in hours. At time $t = 0$ hours, the population is 300. At time $t = 24$ hours, the population is 1000. At what time t is the population 500 ?

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(A) $t = \frac{24\sqrt{2}}{\sqrt{7}}$

(B) $t = \frac{48}{7}$

(C) $t = \frac{24 \ln 500}{\ln 1000}$

(D) $t = \frac{\ln\left(\frac{5}{3}\right)}{\frac{1}{24}\ln\left(\frac{10}{3}\right)}$

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12. A dose of 400 milligrams of a drug is administered to a patient. The amount of the drug, in milligrams, in the person's bloodstream at time t, in hours, is given by $A(t)$. The rate at which the drug leaves the bloodstream can be modeled by the differential equation $\frac{dA}{dt} = kA$, where k is a constant. Which of the following could be an expression for $A(t)$?

(A) $A(t) = 400e^{-0.3t}$

(B) $A(t) = e^{-0.3t} + 399$

(C) $A(t) = -3t + 400$

(D) $A(t) = -1.5t^2 + 400$
