1. A stone is thrown straight up from the top of a building with initial velocity 40 ft/sec and hits the ground 4 seconds later. The height of the building in feet is:
   a. 88 b. 96 c. 112 d. 128 e. 144
2. If a car accelerates from 0 to 60 mph in 10 seconds, what distance does it travel in those 10 seconds? (assume the acceleration is constant and note that 60 mph = 88 ft/sec)
   a. 40 ft b. 44 ft c. 88 ft d. 400 ft e. 440 ft
3. If the velocity of a car traveling in a straight line at time $t$ is $v(t)$, then the difference in its odometer readings between times $t = a$ and $t = b$ is:
   a. $\int_a^b v(t)\,dt$ b. $\int_a^b v(t)\,dt$
   c. the net displacement of the car’s position from $t=a$ to $t=b$.
   d. the change in the car’s position from $t=a$ to $t=b$.
   e. none of these.
4. If an object is moving up and down along the y-axis with velocity $v(t)$ and $s'(t) = v(t)$, then it is false that $\int_a^b v(t)\,dt$ gives:
   a. $s(b) - s(a)$
   b. the net distance traveled by the object between $t=a$ and $t=b$.
   c. the total change in $s(t)$ between $t=a$ and $t=b$.
   d. The shift in the object’s position from $t=a$ and $t=b$.
   e. The total distance covered by the object from $t=a$ and $t=b$.
5. The function $f(x)$ which satisfies the equations $f(x)f'(x) = x$ and $f(0) = 1$ is:
   a. $f(x) = \sqrt{x^2 + 1}$ b. $f(x) = \sqrt{1 - x^2}$ c. $f(x) = x$
   d. $f(x) = e^x$ e. None of these
6. The curve that passes through the point (1,1) and whose slope at any point (x,y) is equal to $\frac{3y}{x}$ has the equation:
   a. $3x - 2 = y$ b. $y^3 = x$ c. $y = \sqrt[3]{x}$ d. $3y^2 = x^2 + 2$ e. $3y^2 - 2x = 1$
7. If $\frac{dy}{dx} = \frac{y}{2\sqrt{x}}$ and $y = 1$, when $x = 4$, then:
   a. $y^2 = 4\sqrt{x} - 7$ b. $\ln y = 4\sqrt{x} - 8$ c. $\ln y = \sqrt{x - 2}$ d. $y = e^{\sqrt{x}}$ e. $y = e^{\sqrt{x} - 2}$
8. If \( \frac{dy}{dx} = e^y \) and \( y = 0 \) when \( x = 1 \), then:
   a. \( y = \ln|x| \)  
   b. \( y = \ln(2-x) \)  
   c. \( e^{-y} = 2-x \)  
   d. \( y = -\ln|x| \)  
   e. \( e^{-y} = x-2 \)

9. If \( \frac{dy}{dx} = \frac{x}{\sqrt{9+x^2}} \) and \( y = 5 \) when \( x = 4 \), then:
   a. \( y = \sqrt{9+x^2} - 5 \)  
   b. \( y = \sqrt{9+x^2} \)  
   c. \( y = 2\sqrt{9+x^2} - 5 \)  
   d. \( y = \frac{\sqrt{9+x^2} + 5}{2} \)  
   e. None of these

10. If a substance decomposes at a rate proportional to the amount of the substance present, and if the amount decreases from 40 gm to 10 gm in 2 hours, then the constant of proportionality is:
    a. \(-\ln 2\)  
    b. \(-\frac{1}{2}\)  
    c. \(-\frac{1}{4}\)  
    d. \(\frac{\ln 1}{4}\)  
    e. \(\ln \frac{1}{8}\)

11. A cup of coffee at temperature 180°F is placed on a table in a room at 68°F. The differential equation for its temperature at time \( t \) is \( \frac{dy}{dx} = -0.11(y-68) \); \( y(0) = 180 \). After 10 minutes, the temperature (in °F) of the coffee is:
    a. 96  
    b. 100  
    c. 105  
    d. 110  
    e. 115

12. Approximately how long does it take the temperature of the coffee in question 11 to drop to 75°F?
    a. 10 min  
    b. 15 min  
    c. 18 min  
    d. 20 min  
    e. 25 min

13. According to Newton’s law of cooling, the temperature of an object decreases at a rate proportional to the difference between its temperature and that of the surrounding air. Suppose a corpse at temperature 32°C arrives at a mortuary where the temperature is kept at 10°C. Then the differential equation satisfied by the temperature \( T \) of the corpse \( t \) hours later is:
    a. \( \frac{dT}{dt} = -k(T-10) \)  
    b. \( \frac{dT}{dt} = k(T-32) \)  
    c. \( \frac{dT}{dt} = 32e^{-kt} \)  
    d. \( \frac{dT}{dt} = -kT(T-10) \)  
    e. \( \frac{dT}{dt} = kT(T-32) \)

14. If the corpse in Question 13 cools to 27°C in 1 hour, then its temperature is given by the equation:
    a. \( T = 22e^{-0.205t} \)  
    b. \( T = 10e^{1.163t} \)  
    c. \( T = 10 + 22e^{-0.258t} \)  
    d. \( T = 32e^{-0.169t} \)  
    e. \( T = 32 - 10e^{-0.093t} \)

15. The population of a city increases continuously at a rate proportional, at any time, to the population at that time. The population doubles in 50 years. After 75 years, the ratio of the population \( P \) to the initial population \( P_0 \) is:
    a. \( \frac{9}{4} \)  
    b. \( \frac{5}{2} \)  
    c. \( \frac{4}{1} \)  
    d. \( \frac{2\sqrt{2}}{1} \)  
    e. None of these