1. At time 0 a ball is thrown directly upward from a platform 10m tall. Its height above the ground after t seconds is $s = -5t^2 + 5t + 10$, where s is in meters. The ball hits the ground after 2 seconds. What is its velocity at impact?

   A. 0

   B. -5 m/s

   C. -10 m/s

   D. -15 m/s

   E. -20 m/s

2. At which point(s) does the curve $y = x^3 - 6x^2 + 12x + 7$ have a horizontal tangent?

   A. $x = 0$ and $x = 1$

   B. $x = 1$ and $x = 2$

   C. $x = 0$ and $x = 2$

   D. $x = 1$

   E. $x = 2$

3. If $f(x) = \sqrt{x}\ e^{x-4}$, then $f'(4) =$

     A. $\dfrac{9}{4}$

     B. $\dfrac{1}{2}$

     C. 0

     D. $\dfrac{5}{4}$

     E. $\dfrac{3}{4}$

4. If $f(x) = (1 + \sin 2x)^{10}$, then $f'\left(\dfrac{\pi}{2}\right) =$

     A. 1

     B. 10

     C. -10

     D. 20

     E. -20

5. If $g(x) = \tan\left(\dfrac{\pi}{2} \, f(x)\right)$, where $f(0) = 0$ and $f'(0) = 2$, then $g'(0) =$

    A. 4

    B. $\dfrac{\pi}{2}$

    C. π

    D. 2

    E. Cannot be determined

6. If $f(x) = \ln\sqrt{\dfrac{x^3}{1 - x^2}}$, then $f'(x) =$

    A. $\dfrac{1}{2}\left(\dfrac{3}{x} - 1\right)$

    B. $\dfrac{1}{2}\left(\dfrac{3}{x} + \dfrac{2x}{1 - x^2}\right)$

    C. $\dfrac{1}{2}\left(\dfrac{3}{x} - \dfrac{2x}{1 - x^2}\right)$

    D. $\dfrac{1}{2}\left(\dfrac{3}{x} + 1\right)$

    E. $\dfrac{1}{2}\left(\dfrac{5}{x}\right)$

7. Find an equation for the line tangent to the graph of $y = \dfrac{x^3}{\ln x}$ at the point (e, e^3).

     A. $y = 2e^2 x - e^3$

     B. $y = 2e^2 x + e^3 - 3$

     C. $y = 2e^2 x + e$

     D. $y = -e^2 x + e$

     E. $y = -e^2 x - e$

8. Use implicit differentiation to find $\dfrac{dy}{dx}$ at the point $(1, 2)$ if $x^4 - 3x^2 y + y^2 + y^3 = 7$.

     A. $\dfrac{-2}{5}$

     B. $\dfrac{1}{2}$

     C. $\dfrac{4}{13}$

     D. $-\dfrac{3}{5}$

     E. $\dfrac{8}{13}$

9. Let $y = x^{\tan x}$. Find $\dfrac{dy}{dx}$.

     A. $\dfrac{dy}{dx} = x^{\tan x} \left(\sec x \tan x \ln x + \tan x \right)$

     B. $\dfrac{dy}{dx} = x^{\tan x} \ \sec^2 x) \left(\dfrac{1}{x} \right)$

     C. $\dfrac{dy}{dx} = x^{\tan x} \left(\sec^2 x \ln x + \dfrac{\tan x}{x} \right)$

     D. $\dfrac{dy}{dx} = x^{\tan x - 1} \left(\tan x \right)$

     E. $\dfrac{dy}{dx} = x^{\tan x} \ \sec^2 x)$

10. 60% of a radioactive substance decays in 3 hours. What is the half–life of the substance?

     A. $3 \left(\ln \dfrac{1}{5} \right)$ hours

     B. $3 \left(\dfrac{\ln \frac{1}{2}}{\ln \frac{2}{5}} \right)$ hours

     C. $3 \left(\dfrac{\ln \frac{1}{2}}{\ln \frac{5}{2}} \right)$ hours

     D. $3 \left(\dfrac{\ln \frac{5}{2}}{\ln \frac{1}{2}} \right)$ hours

     E. $3 \left(\dfrac{\ln \frac{2}{5}}{\ln \frac{1}{2}} \right)$ hours