1. A bacteria culture initially contains 200 cells and grows at a rate proportional to its size. After 2 hours, the culture contains 600 cells. How many bacteria are in the culture after 3 hours?

   A. $200\, e^{2 \ln 3}$

   B. $200\, e^{3 \ln 2}$

   C. $600\, e^{\frac{3}{2} \ln 2}$

   D. $200\, e^{\frac{3}{2} \ln 3}$

   E. $600\, e^{2 \ln 3}$

2. A particle is traveling on the ellipse $x^2 + 4y^2 = 8$ (in the first quadrant). When $y = 1$, $\dfrac{dy}{dt} = 1$. Find $\dfrac{dx}{dt}$.

   A. -1

   B. 1

   C. -4

   D. 2

   E. -2

3. The volume of a sphere ($V = \frac{4}{3}\pi r^3$) is increasing at a rate of 4 $cm^3/\min$. How fast is the radius increasing when the radius is 4 cm?

A. $\dfrac{1}{16\pi}\ cm/\min$

B. $\dfrac{1}{4\pi}\ cm/\min$

C. $\dfrac{1}{12\pi}\ cm/\min$

D. $\dfrac{1}{24\pi}\ cm/\min$

E. $\dfrac{1}{32\pi}\ cm/\min$

4. Use linear approximation to compute the approximate value of $\sqrt{24.5}$.

A. 4.90

B. 4.95

C. 4.99

D. 4.80

E. 4.995

5. Compute $\frac{d}{dx}(\cosh(\ln x))$ when $x = 2$.

A. $\frac{5}{8}$

B. $\frac{3}{4}$

C. $\frac{3}{8}$

D. $\frac{7}{8}$

E. $\frac{1}{2}$

6. Find the absolute minimum of $f(x) = \frac{x}{x^2 + 2}$ on the interval $[-4, 4]$.

A. $\frac{-1}{3}$

B. $\frac{\sqrt{2}}{4}$

C. $-\frac{1}{4}$

D. $-\frac{2}{9}$

E. $-\frac{\sqrt{2}}{4}$

7. Find the absolute minimum of $f(x) = 3x^4 - 4x^3 - 12x^2$ on the interval $[-2, 2]$.

A. 16

B. 0

C. -32

D. -16

E. -24

8. Assume f is continuous in $[1, 4]$ and differentiable in $(1, 4)$. If $f(1) = -2$ and $3 \leq f'(x) \leq 5$, how small can $f(4)$ be?

A. $f(4) \geq 5$

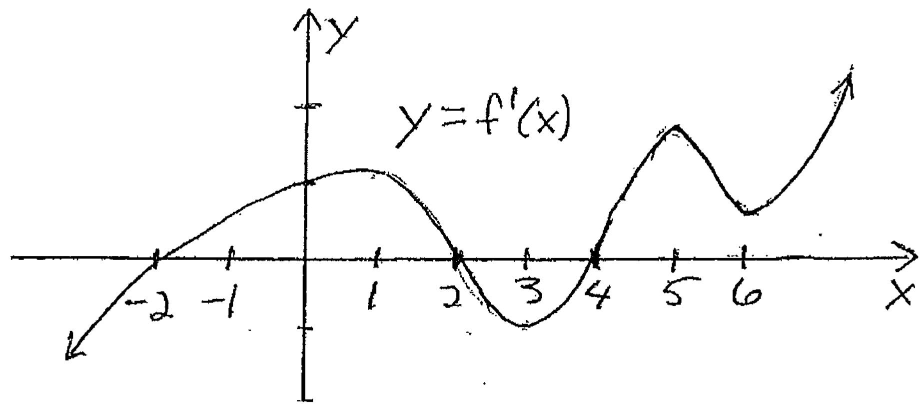
B. $f(4) \geq 9$

C. $f(4) \geq 6$

D. $f(4) \geq 7$

E. $f(4) \geq 11$

9. Assume f is a differentiable function whose derivative, $f'(x)$, has the graph given by:



Which of the following describes all intervals on which f is increasing?

A. $(-2, 2) \cup (4, \infty)$.

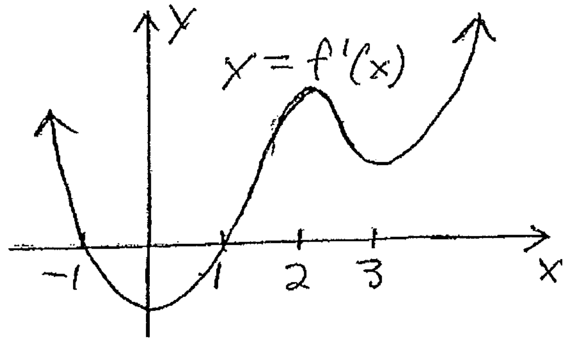
B. $(-2, 2) \cup (4, 6)$.

C. $(-2, 1) \cup (3, 5)$.

D. $(-\infty, 1) \cup (6, \infty)$.

E. $(-\infty, 1) \cup (3, 5) \cup (6, \infty)$.

10. For the function f whose derivative, $f'(x)$, has the graph given by:



find all values of x at which the graph of f has an inflection point.

A. $x = -1, 2$, and 3

B. $x = -1$ and 1

C. $x = 0, 2$, and 3

D. $x = 1.5$ and 2.5

E. $x = -1, 0, 2$, and 3

11. If $f(x) = 2x^3 - 15x^2 - 36x + 1$, find all values of x at which f has a local maximum.

A. $x = -6$

B. $x = -1$

C. $x = 1$

D. $x = 6$

E. $x = 7$

12. Assume $f(t) = 4\sin t + t^2$ for $-\frac{\pi}{2} < t < \frac{3\pi}{2}$. Find all intervals on which f is concave down.

A. $(-\frac{\pi}{2}, \frac{\pi}{3}) \cup (\frac{4\pi}{3}, \frac{3\pi}{2})$

B. $(-\frac{\pi}{2}, \frac{\pi}{6}) \cup (\frac{5\pi}{6}, \frac{3\pi}{2})$

C. $(\frac{\pi}{6}, \frac{5\pi}{6}) \cup (\frac{7\pi}{6}, \frac{3\pi}{2})$

D. $(\frac{\pi}{3}, \frac{4\pi}{3})$

E. $(\frac{\pi}{6}, \frac{5\pi}{6})$

13. Evaluate $\lim_{x\to\infty} \frac{\ln(1+x^2)}{\ln x}$.

A. 0

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

C. 1

D. 2

E. 4

14. The graph of $y = xe^x$ looks most like: