3.3 The Product and Quotient Rules

1. \( \frac{d}{dx} (x^2e^x) = \)
   (a) \( 2xe^x \)
   (b) \( x^2e^x \)
   (c) \( 2xe^x + x^2e^{x-1} \)
   (d) \( 2xe^x + x^2e^x \)

2. \( \frac{d}{dx} (xe^x) = \)
   (a) \( xe^x + x^2e^x \)
   (b) \( e^x + xe^x \)
   (c) \( 2xe^x + xe^x \)
   (d) \( e^x \)

3. \( \frac{d}{dt} ((t^2 + 3)e^t) = \)
   (a) \( 2te^t + (t^2 + 3)e^t \)
   (b) \( (2t + 3)e^t + (t^2 + 3)e^t \)
   (c) \( 2te^t \)
   (d) \( 2te^t + t^2e^t \)
   (e) \( (t^2 + 3)e^t \)

4. \( \frac{d}{dx} (x^34^x) = \)
   (a) \( 3x^24^x \ln 4 \)
   (b) \( x^34^x + x^34^x \ln 4 \)
   (c) \( 3x^24^x + x^34^x \)
   (d) \( 3x^24^x + x^34^x \ln 4 \)
5. When differentiating a constant multiple of a function (like $3x^2$) the Constant Multiple Rule tells us $\frac{d}{dx} cf(x) = c \frac{d}{dx} f(x)$ and the Product Rule says $\frac{d}{dx} cf(x) = c \frac{d}{dx} f(x) + f(x) \frac{d}{dx} c$. Do these two rules agree?

   (a) Yes, they agree, and I am very confident.
   (b) Yes, they agree, but I am not very confident.
   (c) No, they do not agree, but I am not very confident.
   (d) No, they do not agree, and I am very confident.

6. $\frac{d}{dx} xe^x =$

   (a) $e^x + xe^x$
   (b) $e^x - xe^x$
   (c) $\frac{xe^x - e^x}{e^x}$
   (d) $\frac{xe^x - e^x}{e^x}$

7. $\frac{d}{dx} \frac{x^{1.5}}{3^x} =$

   (a) $\frac{1.5x^{0.5} - 3^x \ln 3}{3^{2x}}$
   (b) $\frac{1.5x^{0.5} - 3^{1.5}x \ln 3}{3^{2x}}$
   (c) $\frac{1.5x^{0.5} - 3^{1.5}x \ln 3}{1.5x^{0.5}}$
   (d) $1.5x^{0.5}3^x + x^{1.5}3^x \ln 3$

8. If $e^a - \frac{b}{a^2} = 5$, find $\frac{db}{da}$.

   (a) $\frac{db}{da} = e^a$
   (b) $\frac{db}{da} = a^2 e^a$
   (c) $\frac{db}{da} = a^2 e^a - 5a^2$
   (d) $\frac{db}{da} = 2ae^a + a^2 e^a - 10a$
   (e) $\frac{db}{da} = 2ae^a + a^2 e^a - 10ae^a - 5a^2 e^a$
   (f) Cannot be determined from this expression

9. $\frac{d}{dx} (25x^2 e^x) =$

   (a) $50x^2 e^x + 25x^2 e^x$
   (b) $25xe^x + 25x^2 e^x$
10. \( \frac{d}{dt} \frac{3t+1}{t^2+1} = \)

(a) \( \frac{3(5t+2)-(3t+1)5}{(5t+2)^2} \)

(b) \( \frac{3(5t+2)-(3t+1)5}{(3t+1)^2} \)

(c) \( \frac{(3t+1)(5t+2)-(3t+1)5}{(5t+2)^2} \)

(d) \( \frac{3(5t+2)-(3t+1)(5t+2)}{(5t+2)^2} \)

11. \( \frac{d}{dt} \sqrt{t^2+1} = \)

(a) \( \frac{\frac{t}{2} - \frac{1}{t} - 2t}{(t^2+1)^{\frac{3}{2}}} \)

(b) \( \frac{\frac{t}{2} - \frac{1}{t^2} - 2t\sqrt{t}}{(t^2+1)^{\frac{3}{2}}} \)

(c) \( \frac{\frac{t}{2} - \frac{1}{(t^2+1)^{\frac{1}{2}}} - 2t\sqrt{t}}{(t^2+1)^{\frac{3}{2}}} \)

(d) \( \frac{\frac{t}{2} - \frac{1}{(t^2+1)^{\frac{1}{2}}} - 2t\sqrt{t}}{(t^2+1)^{\frac{3}{2}}} \)

12. If \( f(3) = 2, \; f'(3) = 4, \; g(3) = 1, \; g'(3) = 3, \) and \( h(x) = f(x)g(x) \), then what is \( h'(3) \)?

(a) 2
(b) 10
(c) 11
(d) 12
(e) 14

13. If \( f(3) = 2, \; f'(3) = 4, \; g(3) = 1, \; g'(3) = 3, \) and \( h(x) = \frac{f(x)}{g(x)} \), then what is \( h'(3) \)?

(a) \(-2\)
(b) 2
(c) \(-\frac{2}{9}\)
(d) \(\frac{2}{9}\)
(e) 5
14. If \( h = \frac{ab^2e^b}{c^3} \) then what is \( \frac{dh}{db} \)?

(a) \( \frac{2abe^b}{c^3} \)
(b) \( \frac{2abe^b}{3c^2} \)
(c) \( \frac{2abe^b + ab^2e^b}{c^3} \)
(d) \( \frac{2abe^b - 3c^2ab^2e^b}{c^3} \)

15. My old uncle Stanley has a collection of rare and valuable books: He has a total of 4,000 books, that are worth an average of $60 each. His books are rising in value over time, so that each year, the average price per book goes up by $0.50. However he also has to sell 30 books per year in order to pay for his snowboarding activities. The value of the collection is

(a) increasing by approximately $240,000 per year.
(b) increasing by approximately $2000 per year.
(c) increasing by approximately $200 per year.
(d) decreasing by approximately $1,800 per year.
(e) decreasing by approximately $119,970 per year.

16. The functions \( f(x) \) and \( h(x) \) are plotted below. The function \( g = 2fh \). What is \( g'(2) \)?

(a) \( g'(2) = -1 \)
(b) \( g'(2) = 2 \)
(c) \( g'(2) = 4 \)
(d) \( g'(2) = 32 \)
(e) None of the above