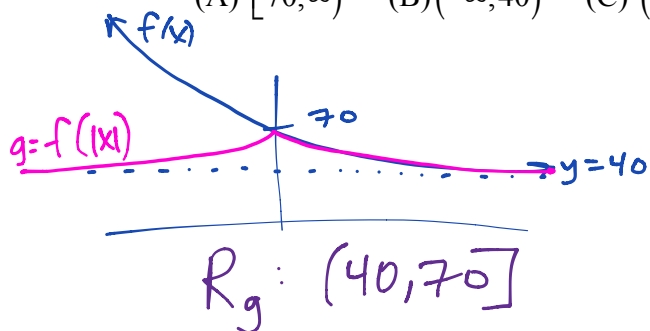


I. Multiple Choice: Place the capital letter of the answer choice in the blank to the left of the number.

E 1. If $f(x) = 30e^{-x} + 40$, in interval notation, what is the range of the function $g(x) = f(|x|)$?

- (A) $[70, \infty)$ (B) $(-\infty, 40)$ (C) $(40, 70)$ (D) $[40, 70)$ (E) $(40, 70]$



E 2. What is the decay **factor** in the equation $J(t) = 13\left(\frac{4}{5}\right)^t$?

- (A) 0.2 (B) 20% (C) 80% (D) 1.8 (E) 0.8

$$\text{factor} = \text{base} = \frac{4}{5} = 0.8$$

A 3. Which of the following is equivalent to the function $f(x) = \sqrt{\frac{1}{a^4}} \cdot (a^{x+2})$, for some $a > 1$?

- (A) $g(x) = a^x$ (B) $g(x) = a^{x-2}$ (C) $g(x) = a^{-2x+2}$ (D) $g(x) = a^{-2(x+2)}$ (E) $g(x) = \left(\frac{1}{a}\right)^{x+2}$

$$\begin{aligned} g &= (a^{-4})^{1/2} \cdot a^{x+2} \\ g &= a^{-2} \cdot a^{x+2} \\ g &= a^{x+2-2} \\ g &= a^x \end{aligned}$$

- C 4. The graph of the function $g(x) = 27^x$ can be obtained from the graph of $f(x) = 3^x$ by
- (A) Horizontally shifting f left one unit (B) Horizontally stretching f by a factor of 3
 (C) Horizontally compressing f by a factor of 3 (D) Horizontal shifting f right one unit
 (E) None of these

$$g = 27^x$$

$$g = (3^3)^x$$

$$g = 3^{3x}$$

Horz Comp bfo 3

- B 5. What is the equation of the exponential model, $y = Ab^t$, t in weeks, for a quantity that starts with an initial value of 2, and **increases** 700% every week?

- (A) $y = 2(7)^t$ (B) $y = 2^{3t+1}$ (C) $y = 2(1.7)^t$ (D) $y = 8^{t+1}$ (E) $y = y = 2(8)^{t+1}$

$$y = 2 \cdot (1+7)^{t/1}$$

$$y = 2 \cdot 8^t$$

$$y = 2 \cdot (2^3)^t$$

$$y = 2^1 \cdot 2^{3t}$$

$$y = 2^{3t+1}$$

- D 6. What is the equation of the exponential model, $y = Ab^t$, t in days, for a quantity that starts with an initial value of 7, and **decreases** by 45% every week? 1 week = 7 days

- (A) $y = 7(1.45)^{-t}$ (B) $y = 7(.45)^t$ (C) $y = 7(.55)^t$ (D) $y = 7(.55)^{t/7}$ (E) $y = 7(.45)^{t/7}$

$$y = 7(1-.45)^{t/7}$$

$$y = 7(.55)^{t/7}$$

- D 7. What is constant percentage **decay rate** of $P(t) = 3.85(0.0753)^t$?

- (A) 0.0753% (B) 0.9247% (C) 7.53% (D) 92.47% (E) 1.0753%

$$(1 - 0.0753) \times 100$$

$$= 92.47\%$$

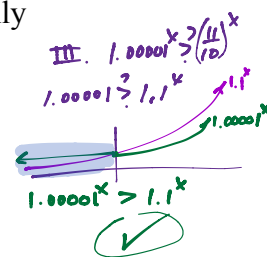
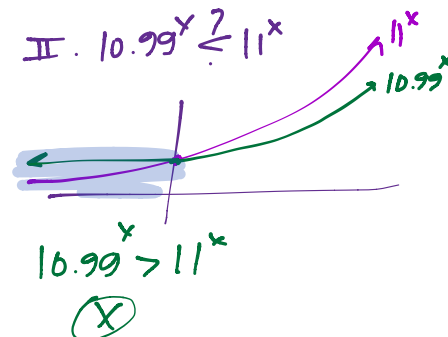
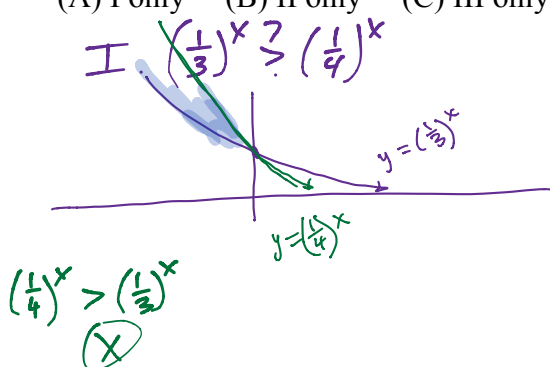
C 8. For $x < 0$, which of the following is true?

I. $3^{-x} > \left(\frac{1}{4}\right)^x$

II. $10.99^x < 11^x$

III. $1.00001^x > \left(\frac{10}{11}\right)^{-x}$

(A) I only (B) II only (C) III only (D) I and II only (E) II and III only



B 9. A group of 10 bacteria triples every 6 hours. At this rate, about how many hours will it take the population of bacteria to reach 1 million?

(A) 57 (B) 63 (C) 68 (D) 48 (E) 53

$$y = 10(3)^{t/6}$$

$$1,000,000 = 10(3^{t/6})$$

Y1 Y2 intersect at
 $t = 62.877 \text{ hrs}$
 $\approx 63 \text{ hrs}$

Window
 $X[0, 80]$
 $Y[0, 2,000,000]$

B 10. A certain bank offers the following deal: If you deposit exactly \$7.50 into one of its Deluxe Dividend Accounts, the bank will increase the amount in your account by 1.234% every hour for 25 hours. Because you're a ~~sa~~ person interested in the power of compound interest, when you take the bank up on this offer, to the nearest cent, how much money will you have made/profited at the end of 25 hours?

(A) \$10.19 (B) \$2.69 (C) \$30.85 (D) \$23.35 (E) \$1.76

$$y = 7.50(1 + 0.01234)^{t/1}$$

$$y = 7.50(1.01234)^t$$

$$y(25) = 7.50(1.01234)^{25}$$

$$= \$10.19116306$$

Profit
 $= 10.19 - 7.50$
 $= \$2.69$

II. Free Response: Show all work in the space provided. Use correct units where appropriate.

10. The number of people at Wurstfest on Tuesday, November 10, 2015 infected with the not-uncommon Polka Virus t minutes after eating a sausage on a stick is modeled by the function



$$W(t) = \frac{5500}{1 + 28e^{-0.05t}}$$

① E ④ C ⑧ C
 ② E ⑤ B ⑨ B
 ③ A ⑥ D ⑩ B
 ⑦ D



- (a) To the nearest person, how many Wurstfesters initially had the Polka Virus? Show the work/notation that leads to your answer.

$$W(0) = 189.655$$

189 or 190 people

- (b) To the nearest person, how many Wurstfesters are infected with the Polka Virus after 50 minutes? Show the work/notation that leads to your answer.

$$W(50) = 1667.485$$

≈ 1667 people

- (c) To the nearest whole minute, after how many minutes will the number of infected Wurstfesters be 3000? Show the work/notation that leads to your answer.

$$W(t) = 3000$$

$$t = 70.290$$

$t \approx 70$ min

- (d) To the nearest minute, after how many minutes is the Polka Virus spreading the fastest? Show the work/notation that leads to your answer.

$$W(t) = 5500/2$$

or

$$W(t) = 2750$$

$$t = 66.640$$

$t \approx 66$ or 67 min

- (e) According to the model, how many people attended Wurstfest on this particular Tuesday night?

$$\lim_{t \rightarrow \infty} W(t) = 5500 \text{ people}$$

- (f) If the International Sausage and Dance Commission (ISDC) plans to shut down the Wurstfest festivities if 80% of the Wurstfesters become infected with the Polka Virus, to the nearest minute, after how many minutes will the ISDC need to intervene on behalf of the public's general welfare? Show the work/notation that leads to your answer.

$$W(t) = (0.8)(5500)$$

or

$$W(t) = 4400$$

$$t = 94.369$$

$t \approx 94$ min

units \checkmark