Rates of change, optimization and related rates worksheet – Grade 12

Grade 12 · Mixed level · 20 questions · **Version X5732**

Name: _____ Date: _____ Score: ___ / 20

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1. A particle's position, in metres, after t seconds is $s(t) = -t^3 + 8t^2 + 17t + 1$. What is its velocity at t = 3 s, in m/s?

   Answer: _____

2. A particle moves with position $s(t) = t^3 - 9t^2 + 15t + 4$, t ≥ 0. At what times is it at rest? Type both, separated by a comma.

   Answer: _____

3. The cost, in dollars, of making x items is $C(x) = 1929 + 2x + 0.04x^2$. Find the marginal cost C′(40), in dollars per item.

   Answer: _____

4. The cost, in dollars, of making x items is $C(x) = 654 + 39x + 0.02x^2$. Find the marginal cost C′(210), in dollars per item.

   Answer: _____

5. A particle's position, in metres, after t seconds is $s(t) = t^3 + 10t^2 - 5t + 3$. What is its velocity at t = 1 s, in m/s?

   Answer: _____

6. A particle moves with position $s(t) = t^3 - 12t^2 + 21t + 8$, t ≥ 0. At what times is it at rest? Type both, separated by a comma.

   Answer: _____

7. A particle moves with position $s(t) = t^3 - 21t^2 + 144t + 6$, t ≥ 0. At what times is it at rest? Type both, separated by a comma.

   Answer: _____

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8. An open-top box is made from an 18 cm by 18 cm sheet of cardboard by cutting equal squares from the corners and folding up the sides. What side length of square gives the largest volume, in cm?

   Answer: _____ cm³

9. An open-top box is made from a 48 cm by 48 cm sheet of cardboard by cutting equal squares from the corners and folding up the sides. What is the largest possible volume, in cm³?

   Answer: _____ cm³

10. At a price of p dollars, a store sells $q = 540 - 6p$ items a week. What price gives the greatest weekly revenue, in dollars?

    Answer: $_____

11. A rectangular field along a straight river is fenced on three sides (none along the river), using 284 m of fence. What is the largest possible area, in m²?

    Answer: _____ m²

12. At a price of p dollars, a store sells $q = 2520 - 21p$ items a week. What price gives the greatest weekly revenue, in dollars?

    Answer: $_____

13. An open-top box is made from a 66 cm by 66 cm sheet of cardboard by cutting equal squares from the corners and folding up the sides. What side length of square gives the largest volume, in cm?

    Answer: _____ cm³

14. A rectangular field along a straight river is fenced on three sides (none along the river), using 740 m of fence. To make the area as large as possible, how long should each side that meets the river be, in metres?

    Answer: _____ m

15. Air is pumped into a spherical balloon at 188 cm³/s. How fast is the radius growing when the radius is 34 cm, in cm/s, to three decimal places?

    Answer: _____

16. A circular ripple spreads so that its radius grows at 5 cm/s. How fast is the area growing when the radius is 18 cm, in cm²/s, to one decimal place?

    Answer: _____ cm²

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17. A 10 m ladder leans against a wall. The bottom slides away from the wall at 1.5 m/s. How fast is the top sliding down when the bottom is 6 m from the wall, in m/s? (Give a positive number, as a fraction or to two decimal places.)

    Answer: _____

18. A circular ripple spreads so that its radius grows at 0.5 cm/s. How fast is the area growing when the radius is 27 cm, in cm^2/s, to one decimal place?

    Answer: _____ cm^2

19. A 5 m ladder leans against a wall. The bottom slides away from the wall at 1.5 m/s. How fast is the top sliding down when the bottom is 3 m from the wall, in m/s? (Give a positive number, as a fraction or to two decimal places.)

    Answer: _____

20. Air is pumped into a spherical balloon at 167 cm^3/s. How fast is the radius growing when the radius is 20 cm, in cm/s, to three decimal places?

    Answer: _____

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Answer key · Version X5732

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1. **38**
2. **1,5**
3. **5.20**
4. **47.40**
5. **18**
6. **1,7**
7. **6,8**
8. **3**
9. **8192**
10. **45**
11. **10082**
12. **60**
13. **11**
14. **185**
15. **0.013**
16. **565.5**
17. **1.13**
18. **84.8**
19. **1.13**
20. **0.033**

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