

Student's Name: _____

Grade 11th

13th November, 2025

Q1) A new solar panel system is installed on a school rooftop. Due to dust buildup and gradual wear, the panel's energy output (in kWh per day) decreases over time.

- On installation day, the output is **60 kWh/day**.
- After **30 days**, the output drops to **54 kWh/day**, and after **90 days**, it's **42 kWh/day**.

Assume the decrease in energy output follows a **quadratic pattern** over time.⁴

- Find a quadratic equation $E(t) = at^2 + bt + c$ modeling the energy output, where t is days since installation.
- Predict after how many days the output will drop below **30 kWh/day**.
- Interpret what this means in terms of maintenance scheduling.

Q2) A ride-share company charges fares based on both time and distance.

- For the first 5 km, the cost increases linearly at a rate of 2.5 currency units per km.
- Beyond 5 km, the company adds a congestion fee that grows quadratically with distance due to traffic conditions.

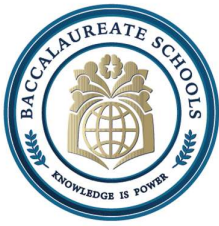
The additional cost is $0.1(x - 5)^2$, where x is the total distance traveled (km).

- Construct a **piecewise function** for the total cost $C(x)$.
- Graph the function for $0 \leq x \leq 15$.
- Find the distance at which the **rate of increase** in cost (the derivative) first exceeds **4 currency units per km**, and explain its meaning for long trips.

Q3) A farmer has 800 meters of fencing and wants to build a rectangular pen divided into two equal smaller pens by one internal fence parallel to one side.

The area of the total enclosure depends on how she allocates the fencing.

- Express the total area A as a quadratic function of the width w .
- Determine the dimensions that maximize the area.
- Explain how the result would change if one internal fence were removed.



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Q4) An engineer is designing a parabolic section of a roller coaster.

- The car enters the section at ground level at $x = 0$, rises to a maximum height of 30 meters at $x = 50$ meters, then descends back to ground level at $x = 100$ meters.
- a. Write the quadratic function $h(x)$ representing the height of the car.
b. Determine the slope (rate of ascent/descent) at $x = 25$ and $x = 75$.
c. If the car must never exceed a **slope magnitude of 1.2**, determine if this design meets the safety requirement.

Q5) A tech startup's monthly **revenue** and **costs** are modeled as follows:

- Revenue grows **linearly** with time: $R(t) = 50,000t + 80,000$, where t is in months.
 - Costs grow **quadratically** due to scaling expenses: $C(t) = 10,000t^2 + 60,000$.
- a. Find the month when the company breaks even.
b. Determine the time interval during which the company operates at a loss.
c. Discuss how changing the rate of revenue growth would shift profitability (qualitatively).