Task

Student Text Page
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Suggested Timing
60–75 min

Tools
- computer
- Internet

Related Resources
- BLM 3–11 Task: ZENN and Now Rubric

Ongoing Assessment
Use **BLM 3–11 Task: ZENN and Now Rubric** to assess student achievement.

ZENN and Now

Teaching Suggestions

Have the students read the question in pairs but then go back to their desks and work on their own. This will help ESL and ELL students, as well as give students another pair of eyes to interprete the questions so there is no mistaking what is being asked. The Task could be assigned as an in-class assignment or as an independent assignment to be completed outside of class.

Assess student responses for the level of mathematical understanding they represent. As you assess each response, consider the following questions:

- Has the student used their knowledge of algebra to substitute in and re-arrange for the information given in the question?
- Did the student comprehend the given information?
- Has the student provided written calculations to determine the solutions?
- Has the student provided clearly communicated responses to parts a), b), c), d), and e)?

Level 3 Sample Response

a) The first part of the graph, between 0 h and 2 h, has an exponential shape, and this is also defined by the equation $V = a(10^{-kt})$. The second part of the graph, between 2 h and 10 h, has a shape consistent with the equation $V = b + \sqrt{c - t}$. The third part of the graph, from 10 h to 12 h, has a quadratic shape that is consistent with the power of 2 found in the equation $V = n(t - p)^2 + q$.

b) Between 12 h and 24 h the car must have been parked and the battery recharging, because at 24 h the battery was once again fully charged.

c) The first part of the graph has an exponential shape, and is defined by $V = a(10^{-kt})$.

The domain is $0 \leq t \leq 2$ and the range is $53.6 \leq V \leq 70$.

When $t = 0$, $V = 72$. Substitute in $V = a(10^{-kt})$.

$72 = a(10^0)$

So, $a = 72$.

Now, in $V = 72(10^{-kt})$, substitute $t = 2$, $V = 53.6$ to find the value of k.

$53.6 = 72(10^{-2t})$

$0.744 \doteq 10^{-2t}$

By guess and test, $k \doteq 0.0642$.

The equation for the first part of the graph is $V = 72(10)^{-0.0642t}$.

The second part of the graph has a shape consistent with the radical equation $V = b + \sqrt{c - t}$.

The domain is $2 \leq t \leq 10$ and the range is $50.4 \leq V \leq 53.6$.

Substitute $t = 2$, $V = 53.6$.

$V = b + \sqrt{c - t}$

$53.6 = b + \sqrt{c - 2}$ (1)

Substitute $t = 10$, $V = 50.4$.

$V = b + \sqrt{c - t}$

$50.4 = b + \sqrt{c - 10}$ (2)

Subtract (1) − (2) to eliminate b.

$3.2 = \sqrt{c - 2} - \sqrt{c - 10}$ Isolate one radical.

$3.2 + \sqrt{c - 10} = \sqrt{c - 2}$ Square both sides.

$3.2^2 + 6.4\sqrt{c - 10} + c - 10 = c - 2$

$6.4\sqrt{c - 10} = -2.24$ Square both sides.

$40.96(c - 10) = 5.0176$

$40.96c = 414.6176$

$c = 10.1225$

Substitute $c = 10.1225$ into (1) to find the value of b.

$53.6 = b + \sqrt{8.1225}$

$b = 50.75$

The equation for the second part of the curve is $V = 50.75 + \sqrt{10.1225} - t$.

The third part of the graph is quadratic and has an equation of the form $V = n(t - p)^2 + q$.

The domain is $10 \leq t \leq 12$ and the range is $0 \leq V \leq 50.4$.

From the graph, the vertex is at (12, 0), so substitute $p = 12$ and $q = 0$.

$V = n(t - 12)^2 + 0$

Substitute $t = 10$, $V = 50.4$.

$50.4 = n(10 - 12)^2$

$50.4 = 4n$

$n = 12.6$

The equation for the third part is $V = 12.6(t - 12)^2$.

d) If the new rechargeable battery has a discharge time of 20 h, there are several possibilities. The graph could be stretched horizontally to cover 20 h, or any one of the three parts of the graph could be stretched out, or any two of the three parts could be stretched out. This would change my answers in part c) because the two parts that are parabolic may have a wider or narrower opening. The exponential part may decay slower or faster.

e) The report should include items such as environmental concerns, costs of running a battery operated car, as well as limitations in running the car. The report should clearly outline these concerns.

Dear Courier Company,

I have been looking over your proposal to purchase battery-operated cars for your in-town courier service. In my opinion it is a great idea. It will not only benefit you as a company, but the future existence of the planet as we know it.

We know that the environment is a big concern to our youth of today. They are hoping that the planet will still be inhabitable when their grandchildren are fully grown. A fleet of battery-operated cars would help with this endeavour because each time a regular car gasses up it is reducing our fossil fuels. A battery-operated car merely re-charges and is ready to go again. With the ever rising cost of fuel (right now we are sitting at $1.25/L) it would not be beneficial to your company to invest in gas-operated vehicles. With in-town driving a car can idle for a long time. If it is run by gas this consumes a great deal of gas.

The cost of recharging the car's battery is very minimal compared to the cost of fuelling up at the pumps. A company that wishes to make a profit will have an initial investment cost (the cost of this new equipment), but after several years they will have paid for themselves.

Thanks again to you and your company for putting the planet first.

Sincerely,

A. Stu. Dent.