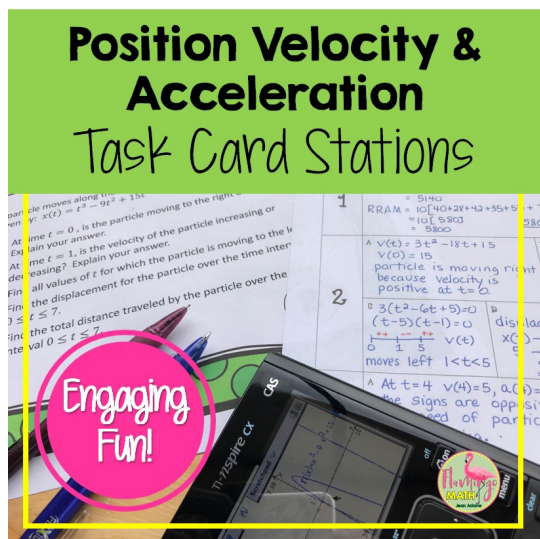


Position Velocity & Acceleration Task Card Stations

Position Velocity & Acceleration Stations Task Cards Activity

Your AP Calculus students will have 8 task cards related to your unit on Applications of Integration to provide engaging fun as a unit review.

This set of task cards is for use as a cooperative learning activity. They can be used as a station rotation or printed in reduced form as a math workshop station for general review.



Position Velocity & Acceleration Stations Activity

Use this activity as a topic-specific review for **Applications of Integration** related to connecting Position, Velocity & Acceleration. The concepts will help your students work through the rules for differential equations including:

- ★ Estimating distance using tables and Riemann Sums
- ★ Numerical problems for velocity, displacement, total distance
- ★ Graphical interpretations of position, velocity, and acceleration
- ★ Conceptual understanding for differentiability and continuity when finding velocity and acceleration.
- ★ Mean Value Theorem (Rolle's Theorem)
- ★ Intermediate Value Theorem
- ★ Accumulation functions
- ★ Particle movement and trigonometric functions
- ★ Justification practice

There are 8 question stems in the activity that can be used as a group rotation activity for 2-4 per group or as a review activity prior to assessing students on the unit.



You and a friend are driving your convertible along a winding country road and notice that the odometer is broken, but the speedometer is working. You want to use a little Calculus to estimate how long a particular stretch in the road is, just to see if you are ready for your upcoming test. You record the car's velocity (speed) at 10-second intervals and convert the miles per hour into feet per second (45 mph = 66 ft/sec). The results are shown below. Estimate the length of the road by averaging left Riemann sums and right Riemann sums.

Time (sec)	Velocity (ft/sec)	Time (sec)	Velocity (ft/sec)
0	0	70	75
10	40	80	52
20	28	90	38
30	42	100	30
40	35	110	52
50	54	120	66
60	68		

1

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A particle moves along the x -axis so that at time t its position is given by: $x(t) = t^3 - 9t^2 + 15t - 2$.

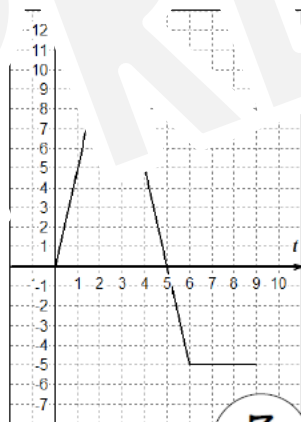
- At time $t = 0$, is the particle moving to the right or to the left? Explain your answer.
- At time $t = 1$, is the velocity of the particle increasing or decreasing? Explain your answer.
- Find all values of t for which the particle is moving to the left.
- Find the displacement for the particle over the time interval $0 \leq t \leq 7$.
- Find the total distance traveled by the particle over the time interval $0 \leq t \leq 7$.

2

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The graph at right represents the velocity, in feet per second, of a particle moving along the x -axis over the time interval from $t = 0$ to $t = 10$ seconds.

- At $t = 4$ seconds, is the speed of the particle increasing or decreasing? Explain your answer.
- Over what time interval is the particle moving to the left? Explain your answer.
- At $t = 4$ seconds, is the acceleration of the particle positive or negative? Explain your answer.
- Find the average acceleration of the particle over the interval from $2 \leq t \leq 4$. Show your computations.
- At what time t in the given interval is the particle farthest to the right? Explain your answer.



3

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The data in the table below gives values for the velocity, in meters/second, of a particle moving along the x -axis. The velocity $v(t)$, is a differentiable function of time t .

- At $t = 0$, is the particle moving to the right or to the left? Explain your answer.
- Is there a time during the time interval $0 \leq t \leq 15$ minutes when the particle is at rest? Explain your answer.
- Find an approximation for $v'(12)$ using the data. Explain the meaning of $v'(12)$ in terms of the motion of the particle. Show your computations, include units of measure.
- Let $a(t)$ represent the acceleration of the particle at time t . Is there guaranteed to be a time $t = c$ in the interval $0 \leq t \leq 15$ such that $a(t) = 0$? Justify your answer.

Time t (min)	0	2	5	6	9	11	13	15
Velocity $v(t)$ (meters/min)	-2	3	4	6	8	9	6	5

4

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Reading mathematics can be tricky. Give a definition and explanation for each:

A. $ v(t) $	B. $v_{avg} = \frac{s(t_2) - s(t_1)}{t_2 - t_1}$
C. $s'(t) = \frac{ds}{dt}$	D. $v'(t) = \frac{dv}{dt}$
E. $\int v(t) dt$	F. $\int_{t_1}^{t_2} v(t) dt$
G. $\int_{t_1}^{t_2} v(t) dt$	H. $\frac{1}{t_2 - t_1} \int_{t_1}^{t_2} v(t) dt$

5

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A stock car is moving with an initial velocity of 38 mph in the warm-up lap waiting for the race to begin. When the flag to start the race is given, the driver accelerates at the rate of $a(t) = 2.8t$ mph per second for 10 seconds.

A. How fast is the car going at the end of the 10 seconds?

B. How far did the car travel those 10 seconds?

Hint: $v(t) = I.C. + \int_0^t a(t) dt$ and 1 hr = 3600 sec

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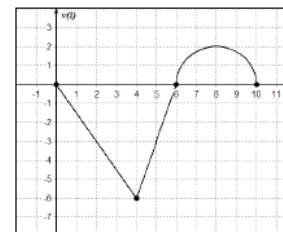
For $0 \leq t \leq 9$, a particle moves along the x-axis with velocity $v(t) = \sin\left(\frac{\pi}{4}t\right)$. The particle is at position $x = -3$ at time $t = 0$.

- For $0 \leq t \leq 9$, when is the particle moving to the left?
- Write, but do not evaluate, an integral expression that gives the total distance traveled by the particle from time $t = 0$ to time $t = 8$.
- Find the acceleration of the particle at time t . Is the speed of the particle increasing, decreasing, or neither at time $t = 5$? Explain your answer.
- Find the position of the particle at time $t = 5$.

7

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The graph at right shows the velocity $v(t)$, of a particle moving along the x-axis for $0 \leq t \leq 10$. It consists of a semicircle and two line segments. Use the graph to answer the following questions.



- At what time t , $0 \leq t \leq 10$, is the speed of the particle the greatest?
- At which of the times, $t = 2$, $t = 5$, or $t = 8$, is the acceleration of the particle the greatest? Explain your answer.
- Over what time intervals is the particle moving to the left? Explain your answer.
- Over what time intervals is the speed of the particle decreasing? Explain your answer.
- Find the total distance traveled by the particle over the time interval $0 \leq t \leq 10$.
- If the initial position of the particle is $x(0) = 5$, find the position of the particle at time $t = 10$.

8

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Position, Velocity, & Acceleration LAB STATIONS ACTIVITY

Directions:

- 1) Print and laminate the cards on colored card stock. Then, copy a recording sheet for each student. The activity is intended as a review for Calculus students in preparation for assessment on the topics after integration techniques. The activity can be used in the following ways:
 - Place one card at each station (8 stations) and have students move in groups of 3-4 from station to station. Allow about 5 minutes at each station. Have students move when time is called, even if they don't finish. Allow an additional 5 minute wild-card round to give students a chance to complete any missing questions.
 - Place students in pairs and give them a set of cards to complete. Circulate to offer assistance as they work.
 - Have students rotate through stations and ask them to get their answers verified with your signature before moving to another station. You will need to have extra card sets for slower groups.
 - Have groups go through the circuit and create a single answer key for the group. Require that each group member sign the key. Offer the group who completes the key first to give 5 points for the class.
- 2) When time is called, have students walk through the circuit and create a single answer key for the group. Require that each group member sign the key. Offer the group who completes the key first to give 5 points for the class.

4	A	B	C	D	E
5	F	G	H	I	J
6	A	B			

Position, Velocity, & Acceleration LAB NAMES _____

1					
	A	B	C	D	E
2	F	G	H	I	J
3	A	B			

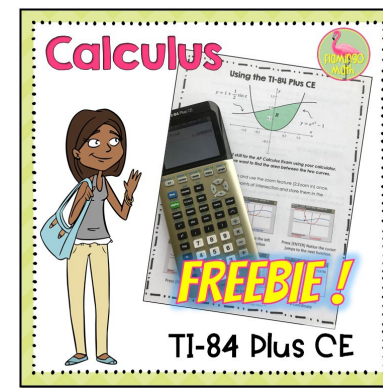
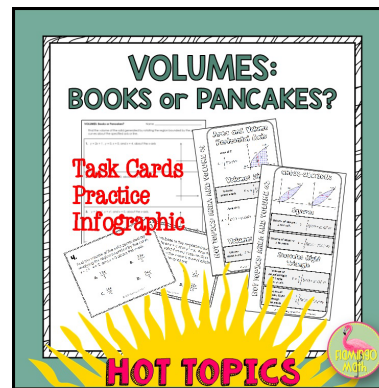
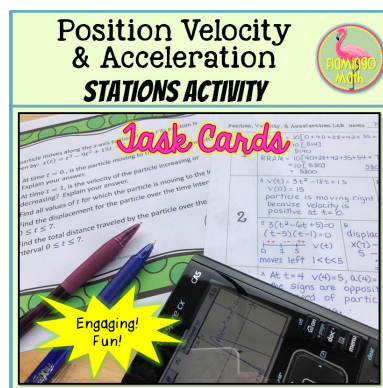
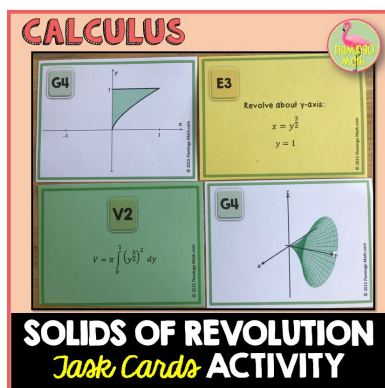
7				
8				



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