4.2 Velocity, Acceleration FRQ Non Calc

Name

t (seconds)	0	10	20	30	40	50	60	70	80
$v(t)$ (feet per second)	5	14	22	29	35	40	44	47	49

Rocket *A* has positive velocity *v(t)* after being launched upward from an initial height of 0 feet at time $t = 0$ seconds. The velocity of the rocket is recorded for selected values of *t* over the interval $0 \le t \le 80$ seconds, as show in the table above.

1. Find the average acceleration of rocket *A* over the time interval $0 \le t \le 80$ seconds. Indicate units of measure.

Please respond on separate paper, following directions from your teacher.

t (seconds)	0	8	20	25	32	40
$v(t)$ (meters per second)	3	5	−10	−8	−4	7

The velocity of a particle moving along the *x*-axis is modeled by a differentiable function *v*, where the position *x* is measured in meters, and time *t* is measured in seconds. Selected values of *v*(*t*) are given in the table above. The particle is at position x=7 meters when *t*=0 seconds.

2. Estimate the acceleration of the particle at *t*=36 seconds. Show the computations that lead to your answer. Indicate units of measure.

Please respond on separate paper, following directions from your teacher.

3. Sup ater than

#3 Suppose that the acceleration is positive at t = 8 seconds. Show that the position at t = 8 must be greater than 30 meters

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x=30 meters.

Please respond on separate paper, following directions from your teacher.

4. For $0 \leq t \leq 40$, must the particle change direction in any of the subintervals indicated by the data in the table? If so, identify the subintervals and explain your reasoning. If not, explain why not.

Please respond on separate paper, following directions from your teacher.

t (seconds)	0	10	40	60
$B(t)$ (meters)	100	136	9	49
$v(t)$ (meters per second)	2.0	2.3	2.5	4.6

Ben rides a unicycle back and forth along a straight east-west track. The twice-differentiable function B models Ben's position on the track, measured in meters from the western end of the track, at time t, measured in seconds from the start of the ride. The table above gives values for $B(t)$ and Ben's velocity, $v(t)$, measured in meters per second, at selected times t.

5. Use the data in the table to approximate Ben's acceleration at time t=5 seconds. Indicate units of measure.

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6. A light is directly above the western end of the track. Ben rides so that at time t, the distance $L(t)$ between Ben and the light satisfies $(L(t))^2 = 12^2+(B(t))^2$. At what rate is the distance between Ben and the light changing at time t=40?

Please respond on separate paper, following directions from your teacher.

Particle X moves along the positive x-axis sot hat its position at time $t \geq 0$ is given by $x(t)=5t^3-9t^2+7$

7. Is particle X moving toward the left or toward the right at time t=1 ? Give a reason for your answer.

Please respond on separate paper, following directions from your teacher.

A particle starts at time t=0 and moves along the x-axis so that its position at any time $t \geq 0$ is given by $x(t)=(t-1)^3(2t-3)$.

8. For what values of t is the velocity of the particle less than zero?

Please respond on separate paper, following directions from your teacher.

9. Find the velocity of the particle at any time $t \geq 0$.

Please respond on separate paper, following directions from your teacher.

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10. Find the value of t when the particle is moving and the acceleration is zero.

Please respond on separate paper, following directions from your teacher.

A particle moves along the x-axis so that its velocity at time t ,$0 \le t \le 5$, is given by $v(t) = 3(t-1)(t-3)$. At time $t = 2$, the position of the particle is $x(2)=0$.

11. Find the minimum acceleration of the particle

Please respond on separate paper, following directions from your teacher.

Two particles move along the x-axis. For $0 \le t \le 6$, the position of particle P at time t is given by $p(t)=2\cos(\pi/4t)$, while the position of particle R at time t is given by $r(t)=t^3-6t^2+9t+3$.

12. For $0 \le t \le 6$, find all times t during which the two particles travel in opposite directions.

Please respond on separate paper, following directions from your teacher.

13. Find the acceleration of particle P at time $t=3$. Is particle P speeding up, slowing down, or doing neither at time $t=3$? Explain your reasoning.

Please respond on separate paper, following directions from your teacher.

14. For $0 \le t \le 6$, find all times t during which particle R is moving to the right.

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Please respond on separate paper, following directions from your teacher.

A toy train moves along a straight set up on a table. The position $x(t)$ of the train at the time t seconds is measured in centimeters from the center of the track. At time $t=1$, the train is 6 centimeters to the left of the center, so $x(1)=-6$. For $0 \le t \le 4$, the velocity of the train at the time t is given by $v(t)=3t^2-12$, where $v(t)$ is measured in centimeters per second.

15. Find the total distance traveled by the train during the time interval $0 \le t \le 4$.

Please respond on separate paper, following directions from your teacher.

For $0 \le t \le 12$, a particle moves along the x-axis. The velocity of the particle at time t is given by $v(t) = \cos(\pi/6t)$. The particle is at position $x = -2$ at time $t = 0$.

16. Find the acceleration of the particle at time t. Is the speed of the particle increasing, decreasing, or neither at time $t = 4$? Explain your reasoning.

Please respond on separate paper, following directions from your teacher.

17. For $0 \le t \le 12$, when is the particle moving to the left?

Please respond on separate paper, following directions from your teacher.

A particle moves on the x-axis so that its velocity at any time $t \ge 0$ is given by $v(t)=12t^2-36t+15$. At $t=1$,

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the particle is at the origin.

18. Find all values of *t* for which the particle is at rest.

Please respond on separate paper, following directions from your teacher.

19. Find the maximum velocity of the particle for $0 \le t \le 2$.

Please respond on separate paper, following directions from your teacher.

A particle moves along the *x*-axis so that its velocity at any time $t \ge 0$ is given by $v(t) = 1-\sin(2\pi t)$.

20. Find all values of *t*, $0 \le t \le 2$, for which the particle is at rest.

Please respond on separate paper, following directions from your teacher.

21. Find the acceleration *a(*t) of the particle at any time *t*.

Please respond on separate paper, following directions from your teacher.

A particle moves along the *x*-axis with position at time *t* given by $x(t) = e^{-t}\sin t, for, 0 \le t \le 2\pi.$

22. Find the time *t* at which the particle is farthest to the left. Justify your answer.

Please respond on separate paper, following directions from your teacher.

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A particle moves along the x-axis in such a way that its acceleration at time t for $t \geq 0$ is given by $a(t)=4\cos(2t)$. At time $t = 0$, the velocity of the particle is $v(0)=1$ and its position is $x(0)=0$.

23. For what values of t, $0 \leq t \leq \pi$, is the particle at rest?

Please respond on separate paper, following directions from your teacher.

t (minutes)	0	12	20	24	40
$v(t)$ (meters per minute)	0	200	240	−220	150

Johanna jogs along a straight path. For $0 \leq t \leq 40$, Johanna's velocity is given by a differentiable function v. Selected values of $v(t)$, where t is measured in minutes and $v(t)$ is measured in meters per minute, are given in the table above.

24. Bob is riding his bicycle along the same path. For $0 \leq t \leq 10$, Bob's velocity is modeled by $B(t)= t^3 - 6t^2 + 300$, where t is measured in minutes and $B(t)$ is measured in meters per minute. Find Bob's acceleration at time t=5.

Please respond on separate paper, following directions from your teacher.

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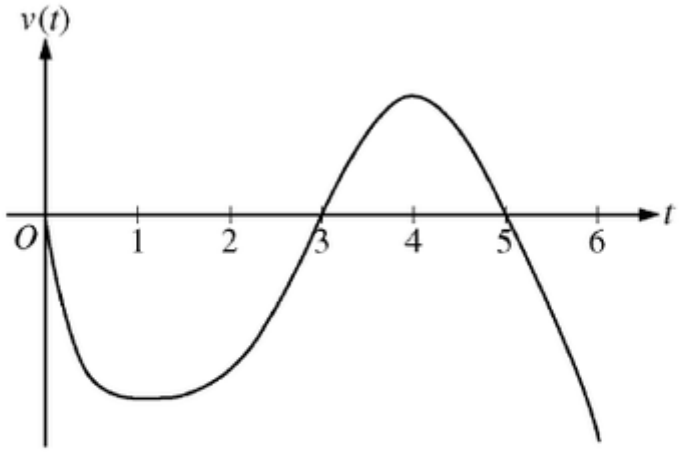

Graph of v

A particle moves along the x-axis so that its velocity at time t, for $0 \le t \le 6$, is given by a differentiable function v whose graph is shown above. The velocity is 0 at $t = 0$, $t = 3$, and $t = 5$, and the graph has horizontal tangents at $t = 1$ and $t = 4$. The areas of the regions bounded by the x-axis and the graph of v on the intervals [0,3], [3,5] and [5,6] are 8, 3, and 2 respectively. At time $t = 0$, the particle is $x = -2$.

25. On the interval 2

Please respond on separate paper, following directions from your teacher.

26. During what time intervals, if any, is the acceleration of the particle negative? Justify your answer.

Please respond on separate paper, following directions from your teacher.

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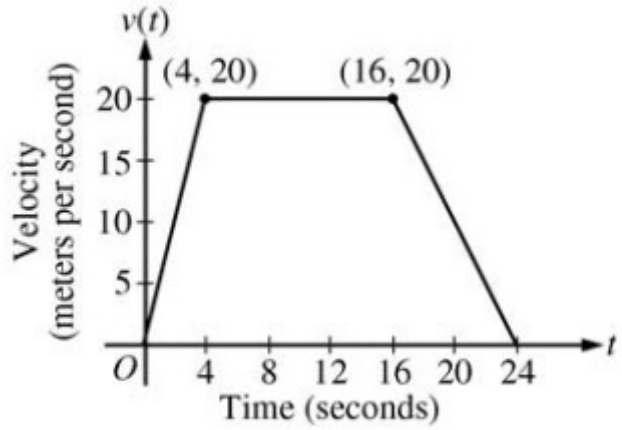
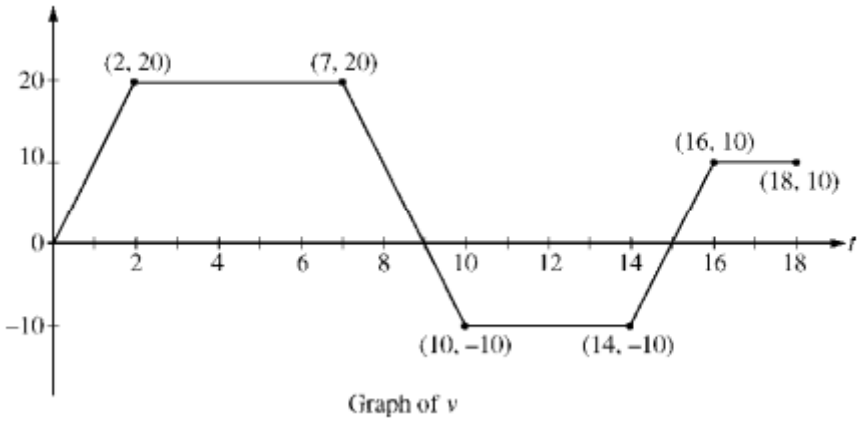


A car is traveling on a straight road. For $0 \leq t \leq 24$ seconds, the car's velocity *v(t)*, in meters per second, is modeled by the piecewise-linear function defined by the graph above.

27. Let *a(t)* be the car's acceleration at time *t*, in meters per second per second. For 0 t a(t).

Please respond on separate paper, following directions from your teacher.



Graph of *v*

A squirrel starts at building *A* at time *t*=0 and travels along a straight,horizontal wire connected to building *B*. For 0≤*t*≤18 , the squirrel's velocity is modeled by the piecewise-linear function defined by the graph

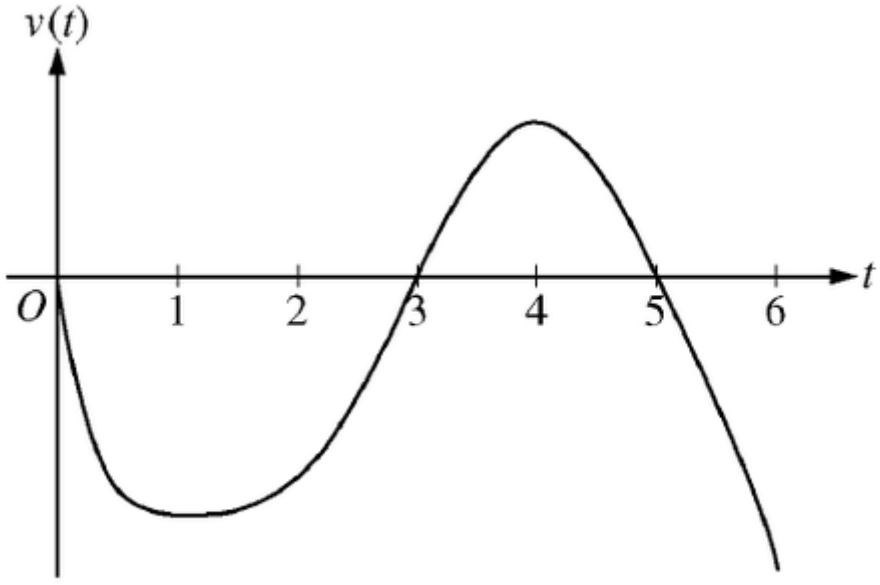
above.

28. At what times in the interval 0t

Please respond on separate paper, following directions from your teacher.

29. Write expressions for the squirrel's acceleration $a(t)$, velocity $v(t)$, and distance $x(t)$ from building A that are valid for the time interval 7t

Please respond on separate paper, following directions from your teacher.



Graph of v

A particle moves along the x-axis so that its velocity at time t, for $0 \le t \le 6$, is given by a differentiable function v whose graph is shown above. The velocity is 0 at $t = 0$, $t = 3$, and $t = 5$, and the graph has horizontal tangents at $t = 1$ and $t = 4$. The areas of the regions bounded by the t-axis and the graph of v on the intervals [0, 3], [3, 5], and [5, 6] are 8, 3, and 2, respectively. At time $t = 0$, the particle is at $x = -2$.

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30. On the interval 2 t 3, is the speed of the particle increasing decreasing? Give a reason for your answer.

Please respond on separate paper, following directions from your teacher.

31. During what time intervals, if any, is the acceleration of the particle negative? Justify your answer.

Please respond on separate paper, following directions from your teacher.

32. NO CALCULATOR IS ALLOWED FOR THIS QUESTION.

Show all of your work, even though the question may not explicitly remind you to do so. Clearly label any functions, graphs, tables, or other objects that you use. Justifications require that you give mathematical reasons, and that you verify the needed conditions under which relevant theorems, properties, definitions, or tests are applied. Your work will be scored on the correctness and completeness of your methods as well as your answers. Answers without supporting work will usually not receive credit.

Unless otherwise specified, answers (numeric or algebraic) need not be simplified. If your answer is given as a decimal approximation, it should be correct to three places after the decimal point.

Unless otherwise specified, the domain of a function f is assumed to be the set of all real numbers x for which $f(x)$ is a real number.

t (hours)	0	1	2	3	4
$B(t)$ (miles per hour)	1	8	1.5	-5	11

Brandon and Chloe ride their bikes for 4 hours along a flat, straight road. Brandon's velocity, in

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miles per hour, at time t hours is given by a differentiable function B for $0 \le t \le 4$. Values of $B(t)$ for selected times t are given in the table above. Chloe's velocity, in miles per hour, at time t hours is given by the piecewise function C defined by

$$C(t) = \begin{cases} te^{4-t^2} & \text{for } 0 \le t \le 2 \\ 12 - 3t - t^2 & \text{for } 2 < t \le 4. \end{cases}$$

(a) How many miles did Chloe travel from time $t = 0$ to time $t = 2$?

Please respond on separate paper, following directions from your teacher.

(b) At time $t = 3$, is Chloe's speed increasing or decreasing? Give a reason for your answer.

Please respond on separate paper, following directions from your teacher.

(c) Is there a time t, for $0 \le t \le 4$, at which Brandon's acceleration is equal to 2.5 miles per hour per hour? Justify your answer.

Please respond on separate paper, following directions from your teacher.

(d) Is there a time t, for $0 \le t \le 2$, at which Brandon's velocity is equal to Chloe's velocity? Justify your answer.

Please respond on separate paper, following directions from your teacher.

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Unless otherwise specified, the domain of a function f is assumed to be the set of all real numbers x for which $f(x)$ is a real number.

A particle moves along the y-axis so that its position at time t is given by $y(t) = t^2 \tan\left(\frac{1}{t}\right)$ for $t > 1$.

(a) Show that the velocity of the particle at time t is given by $v(t) = 2t\tan\left(\frac{1}{t}\right) - \sec^2\left(\frac{1}{t}\right)$ for $t > 1$.

Please respond on separate paper, following directions from your teacher.

(b) At time $t = \frac{4}{\pi}$, is the particle moving toward the origin or away from the origin? Give a reason for your answer.

Please respond on separate paper, following directions from your teacher.

(c) The velocity of the particle at time t can be written as $v(t) = \frac{2\tan\left(\frac{1}{t}\right)}{\frac{1}{t}} - \sec^2\left(\frac{1}{t}\right)$ for $t > 1$. Find $\lim_{t\to\infty} v(t)$. Show the work that leads to your answer.

Please respond on separate paper, following directions from your teacher.