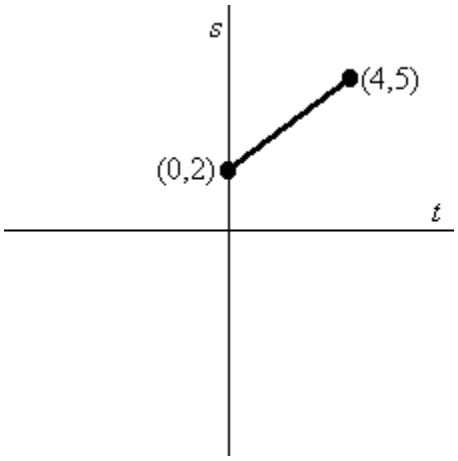
Bug 1 – Homework

Suppose a bug is moving on a number line. At time *t* (seconds), his position is *s* (feet from the origin). Draw a diagram to represent the motion of the bug.

1.



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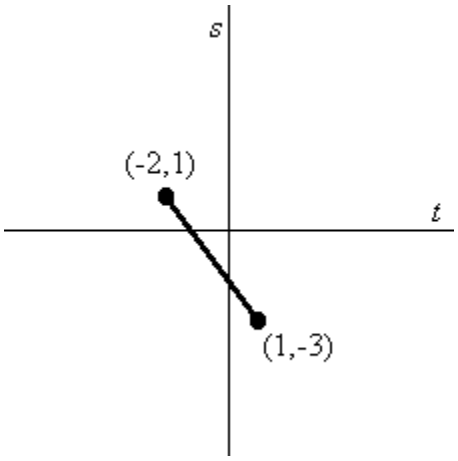

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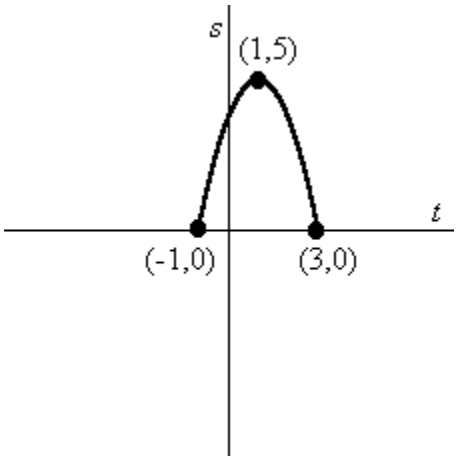

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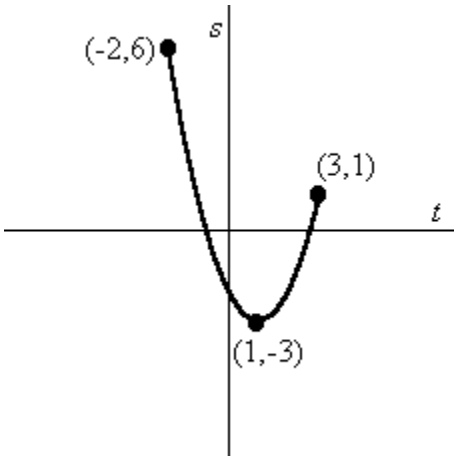

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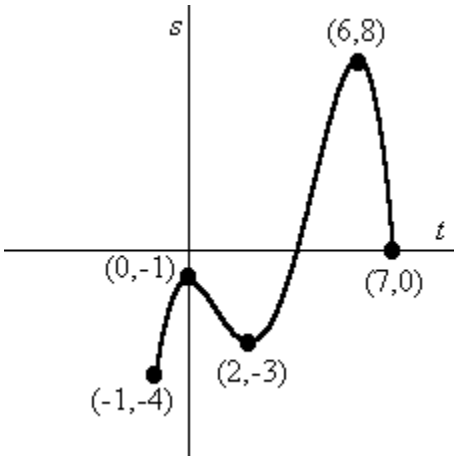

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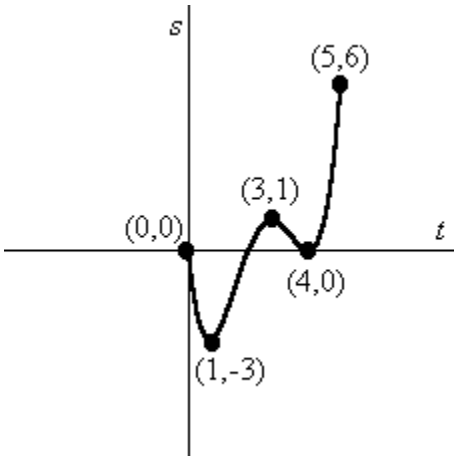
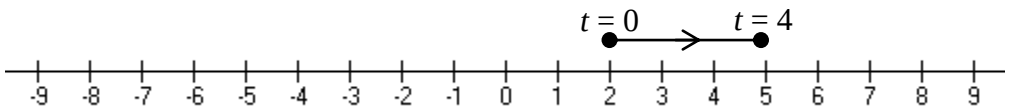


Bug 1 – Homework Answers

1.



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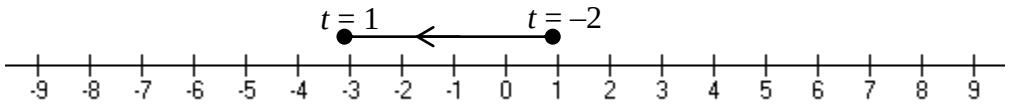

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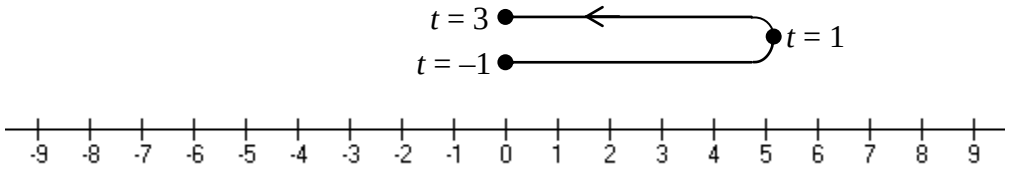

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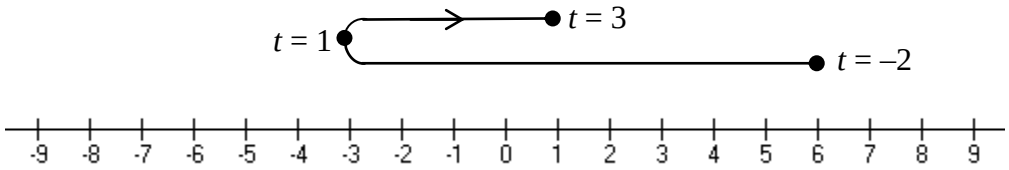

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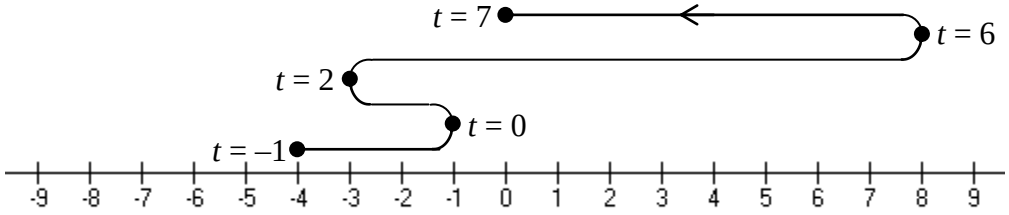

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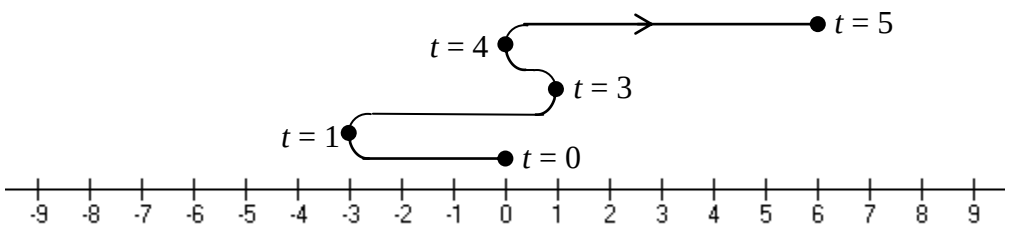


Bug 2 – Homework

Refer to **Rectilinear Motion 1 – Homework Answers**.
For each diagram answer the following questions.

1.
a. What is the bug's displacement from 0 sec to 4 sec?
b. What is the bug's average velocity from 0 sec to 4 sec?
c. What is the bug's total distance traveled from 0 sec to 4 sec?

2.
a. What is the bug's displacement from –2 sec to 1 sec?
b. What is the bug's average velocity from –2 sec to 1 sec?
c. What is the bug's total distance traveled from –2 sec to 1 sec?

3.
a. What is the bug's displacement from –1 sec to 3 sec?
b. What is the bug's average velocity from –1 sec to 3 sec?
c. What is the bug's total distance traveled from –1 sec to 3 sec?

4.
a. What is the bug's displacement from –2 sec to 3 sec?
b. What is the bug's average velocity from –2 sec to 3 sec?
c. What is the bug's total distance traveled from –2 sec to 3 sec?

5.
a. What is the bug's displacement from –1 sec to 7 sec?
b. What is the bug's average velocity from –1 sec to 7 sec?
c. What is the bug's total distance traveled from –1 sec to 7 sec?
d. What is the bug's displacement from 0 sec to 2 sec?
e. What is the bug's average velocity from 0 sec to 2 sec?
f. What is the bug's total distance traveled from 0 sec to 2 sec?

6.
a. What is the bug's displacement from 0 sec to 5 sec?
b. What is the bug's average velocity from 0 sec to 5 sec?
c. What is the bug's total distance traveled from 0 sec to 5 sec?
d. What is the bug's displacement from 1 sec to 4 sec?
e. What is the bug's average velocity from 1 sec to 4 sec?
f. What is the bug's total distance traveled from 1 sec to 4 sec?

Bug 2 – Homework Answers

1.
a. 3 ft
b. 3/4 ft/sec
c. 3 ft

2.
a. –4 ft
b. –4/3 ft/sec
c. 4 ft

3.
a. 0 ft
b. 0 ft/sec
c. 10 ft

4.
a. –5 ft
b. –1 ft/sec
c. 13 ft

5.
a. 4 ft
b. 1/2 ft/sec
c. 24 ft
d. –2 ft
e. –1 ft/sec
f. 2 ft

6.
a. 6 ft
b. 6/5 ft/sec
c. 14 ft
d. 3 ft
e. 1 ft/sec
f. 5 ft

Bug 3 – Homework

Suppose a bug is moving on a number line. At time t (seconds), his position is s (feet from the origin). Let $f(t) = s$.

1. $s = 2t - 1$

a. Where is the bug at 5 sec?
b. Where is the bug at 0 sec?
c. Where is the bug at 100 sec?
d. Where is the bug at –5 sec?
e. When is the bug at 7 ft?
f. When is the bug at 0 ft?
g. When is the bug at 10 ft?
h. When is the bug at –3 ft?
i. What is the bug's displacement from 1 sec to 4 sec?
j. What is the bug's displacement from 10 sec to 20 sec?
k. What is the bug's displacement from 0 sec to 5 sec?
l. What is the bug's displacement from –15 sec to –7 sec?
m. What is the bug's average velocity from 1 sec to 4 sec?
n. What is the bug's average velocity from –1 sec to 9 sec?
o. What is the bug's average velocity from 0 sec to 9 sec?
p. What is the bug's average velocity from –7 sec to –5 sec?

2. $f(t) = -3t + 2$

a. Where is the bug at 0 sec?
b. Where is the bug at 10 sec?
c. Where is the bug at –6 sec?
d. Where is the bug at 3 sec?
e. When is the bug at 0 ft?
f. When is the bug at 11 ft?
g. When is the bug at –13 ft?
h. When is the bug at 7 ft?
i. What is the bug's displacement from 2 sec to 6 sec?
j. What is the bug's displacement from –5 sec to –3 sec?
k. What is the bug's displacement from –2 sec to 5 sec?
l. What is the bug's displacement from 0 sec to 3 sec?
m. What is the bug's average velocity from 2 sec to 6 sec?
n. What is the bug's average velocity from 1 sec to 10 sec?
o. What is the bug's average velocity from –6 sec to –1 sec?
p. What is the bug's average velocity from –2 sec to 2 sec?

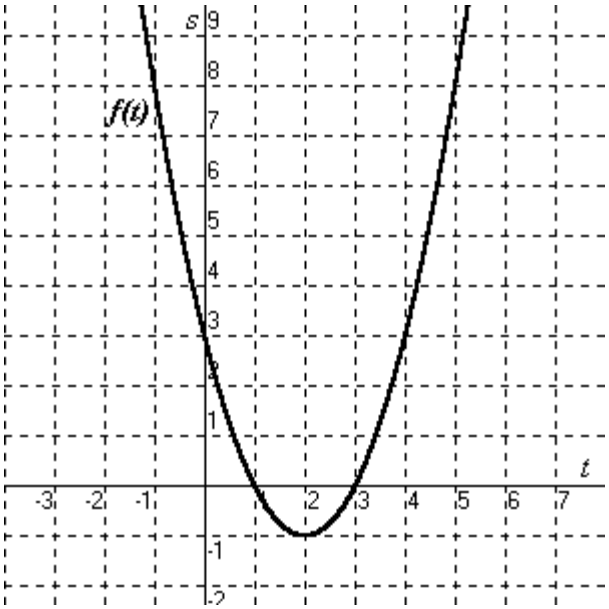
3. $f(t) = t^2$

a. Where is the bug at 2 sec?
b. Where is the bug at –3 sec?
c. Where is the bug at 0 sec?
d. Where is the bug at –10 sec?
e. When is the bug at 16 ft?
f. When is the bug at 1 ft?
g. When is the bug at 5 ft?
h. When is the bug at –4 ft?
i. What is the bug's displacement from 1 sec to 4 sec?
j. What is the bug's displacement from –2 sec to 2 sec?
k. What is the bug's displacement from –3 sec to 1 sec?
l. What is the bug's displacement from –5 sec to –1 sec?
m. What is the bug's average velocity from 1 sec to 4 sec?
n. What is the bug's average velocity from –1 sec to 1 sec?
o. What is the bug's average velocity from –2 sec to 4 sec?
p. What is the bug's average velocity from –7 sec to –1 sec?

4. $f(t) = -t^2 + 2$

a. Where is the bug at 0 sec?
b. Where is the bug at 1 sec?
c. Where is the bug at 2 sec?
d. Where is the bug at –5 sec?
e. When is the bug at –7 ft?
f. When is the bug at 0 ft?
g. When is the bug at 3 ft?
h. When is the bug at –4 ft?
i. What is the bug's displacement over the time interval [1, 4]?
j. What is the bug's displacement over the time interval [4, 5]?
k. What is the bug's displacement over the time interval [–2, 2]?
l. What is the bug's displacement over the time interval [–7, –3]?
m. What is the bug's average velocity over the time interval [1, 4]?
n. What is the bug's average velocity over the time interval [–5, –3]?
o. What is the bug's average velocity over the time interval [–4, 4]?
p. What is the bug's average velocity over the time interval [–6, 10]?

5.



a. Where is the bug at 4 sec?
b. Where is the bug at 0 sec?
c. Where is the bug at –1 sec?
d. Where is the bug at 1 sec?
e. When is the bug at –1 ft?
f. When is the bug at 0 ft?
g. When is the bug at 3 ft?
h. When is the bug at 8 ft?
i. What is the bug's displacement over the time interval [–1, 1]?
j. What is the bug's displacement over the time interval [4, 5]?
k. What is the bug's displacement over the time interval [–1, 4]?
l. What is the bug's displacement over the time interval [0, 4]?
m. What is the bug's average velocity over the time interval [–1, 1]?
n. What is the bug's average velocity over the time interval [–1, 5]?
o. What is the bug's average velocity over the time interval [1, 4]?
p. What is the bug's average velocity over the time interval [0, 2]?
q. When is the bug at rest?
r. Where is the bug at rest?
s. What is the bug's total distance traveled over the time interval [–1, 1]?
t. What is the bug's total distance traveled over the time interval [1, 3]?
u. What is the bug's total distance traveled over the time interval [0, 3]?
v. What is the bug's total distance traveled over the time interval [0, 5]?

6.

t	–3	–2	–1	0	1	2	3
$f(t)$	10	7	3	5	8	3	–1

a. Where is the bug at 1 sec?
b. Where is the bug at –2 sec?
c. Where is the bug at 0 sec?
d. Where is the bug at 3 sec?
e. Name one time that the bug is at –1 ft.
f. Name one time that the bug is at 5 ft.
g. Name one time that the bug is at 10 ft.
h. Name two times that the bug is at 3 ft.
i. What is the bug's displacement over the time interval [–2, 1]?
j. What is the bug's displacement over the time interval [–3, 3]?
k. What is the bug's displacement over the time interval [0, 1]?
l. What is the bug's displacement over the time interval [0, 2]?
m. What is the bug's average velocity over the time interval [–2, 1]?
n. What is the bug's average velocity over the time interval [–1, 2]?
o. What is the bug's average velocity over the time interval [–2, 3]?
p. What is the bug's average velocity over the time interval [0, 3]?

7. $f(t) = 5$

a. Where is the bug at 3 sec?
b. Where is the bug at 0 sec?
c. Where is the bug at –1 sec?
d. Where is the bug at 100 sec?
e. When is the bug at 0 ft?
f. When is the bug at 2 ft?
g. When is the bug at 5 ft?
h. When is the bug at –3 ft?
i. What is the bug's displacement over the time interval [1, 2]?
j. What is the bug's displacement over the time interval [2, 10]?
k. What is the bug's displacement over the time interval [–3, 0]?
l. What is the bug's displacement over the time interval [–7, 5]?
m. What is the bug's average velocity over the time interval [1, 3]?
n. What is the bug's average velocity over the time interval [5, 9]?
o. What is the bug's average velocity over the time interval [–8, –4]?
p. What is the bug's average velocity over the time interval [–10, 100]?

Bug 3 – Homework Answers

	1.	2.	3.	4.	5.	6.	7.
a	9 ft	2 ft	4 ft	2 ft	3 ft	8 ft	5 ft
b	–1 ft	–28 ft	9 ft	1 ft	3 ft	7 ft	5 ft
c	199 ft	20 ft	0 ft	–2 ft	8 ft	5 ft	5 ft
d	–11 ft	–7 ft	100 ft	–23 ft	0 ft	–1 ft	5 ft
e	4 sec	2/3 sec	±4 sec	±3 sec	2 sec	3 sec	never
f	1/2 sec	–3 sec	±1 sec	$\pm\sqrt{2}$ sec	1,3 sec	0 sec	never
g	11/2 sec	5 sec	$\pm\sqrt{5}$ sec	never	0,4 sec	–3 sec	always
h	–1 sec	–5/3 sec	never	$\pm\sqrt{6}$ sec	–1,5 sec	–1,2 sec	never
i	6 ft	–12 ft	15 ft	–15 ft	–8 ft	1 ft	0 ft
j	20 ft	–6 ft	0 ft	–9 ft	5 ft	–11 ft	0 ft
k	10 ft	–21 ft	–8 ft	0 ft	–5 ft	3 ft	0 ft
l	16 ft	–9 ft	–24 ft	40 ft	0 ft	–2 ft	0 ft
m	2 ft/sec	–3 ft/sec	5 ft/sec	–5 ft/sec	–4 ft/sec	1/3 ft/sec	0 ft/sec
n	2 ft/sec	–3 ft/sec	0 ft/sec	8 ft/sec	0 ft/sec	0 ft/sec	0 ft/sec
o	2 ft/sec	–3 ft/sec	2 ft/sec	0 ft/sec	1 ft/sec	–8/5 ft/sec	0 ft/sec
p	2 ft/sec	–3 ft/sec	–8 ft/sec	–4 ft/sec	–2 ft/sec	–2 ft/sec	0 ft/sec
q					2 sec		
r					–1 ft		
s					8 ft		
t					2 ft		
u					5 ft		
v					13 ft		

Bug 4 – Homework

Suppose a bug is moving on a number line. At time t (seconds), his position is s (feet from the origin). Let $f(t) = s$.

1. $f(t) = 3t + 4$

a. Fill in the table.

time interval	displacement	average velocity
[1, 2]	ft	ft/sec
[1.5, 2]	ft	ft/sec
[1.9, 2]	ft	ft/sec
[1.99, 2]	ft	ft/sec
[2, 2.01]	ft	ft/sec
[2, 2.1]	ft	ft/sec
[2, 2.5]	ft	ft/sec
[2, 3]	ft	ft/sec

b. What is the bug's instantaneous velocity at 2 sec?

c. What can you say about the instantaneous velocity when the position function is linear?

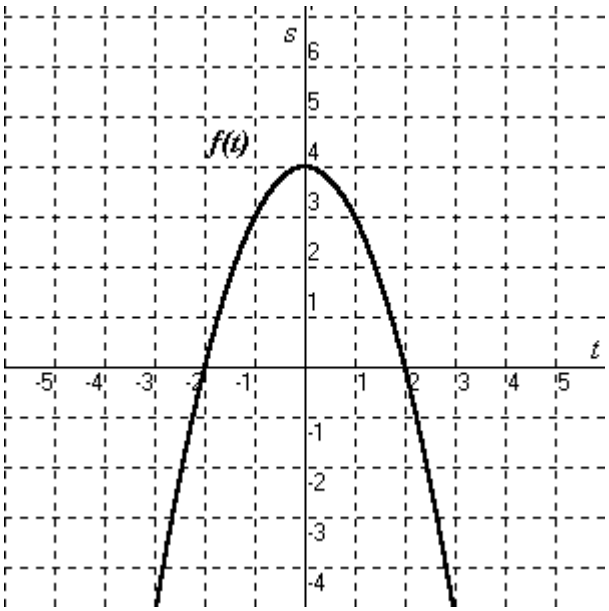
2. $f(t) = 4 - t^2$

a. Fill in the table.

time interval	displacement	average velocity
[0, 1]	ft	ft/sec
[0.5, 1]	ft	ft/sec
[0.9, 1]	ft	ft/sec
[0.99, 1]	ft	ft/sec
[1, 1.01]	ft	ft/sec
[1, 1.1]	ft	ft/sec
[1, 1.5]	ft	ft/sec
[1, 2]	ft	ft/sec

b. What is the bug's instantaneous velocity at 1 sec?

c. The graph of the position function is below. Draw a line that is related to the intantaneous velocity at 1 sec.



d. How is the line related to the intantaneous velocity at 1 sec?

e. What is the line called?

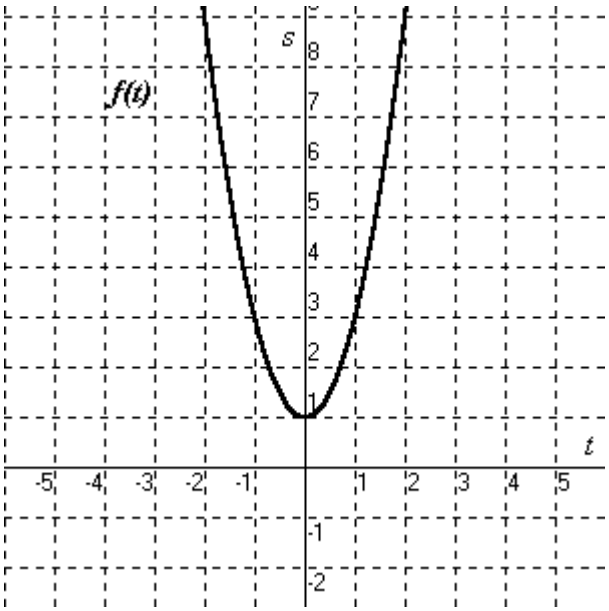
3. $f(t) = 2t^2 + 1$

a. Fill in the table.

time interval	displacement	average velocity
[–2, –1]	ft	ft/sec
[–1.5, –1]	ft	ft/sec
[–1.1, –1]	ft	ft/sec
[–1.01, –1]	ft	ft/sec
[–1, –0.99]	ft	ft/sec
[–1, –0.9]	ft	ft/sec
[–1, –0.5]	ft	ft/sec
[–1, 0]	ft	ft/sec

b. What is the bug's instantaneous velocity at –1 sec?

c. The graph of the position function is below. Draw a line that is related to the intantaneous velocity at –1 sec.



d. How is the line related to the intantaneous velocity at –1 sec?

e. What is the line called?

Bug 4 – Homework Answers

1.

a.

t. i.	disp.	a. v.
[1, 2]	3 ft	3 ft/sec
[1.5, 2]	1.5 ft	3 ft/sec
[1.9, 2]	0.3 ft	3 ft/sec
[1.99, 2]	0.03 ft	3 ft/sec
[2, 2.01]	0.03 ft	3 ft/sec
[2, 2.1]	0.3 ft	3 ft/sec
[2, 2.5]	1.5 ft	3 ft/sec
[2, 3]	3 ft	3 ft/sec

b. 3 ft/sec

c. The instantaneous velocity is the slope of the linear function.

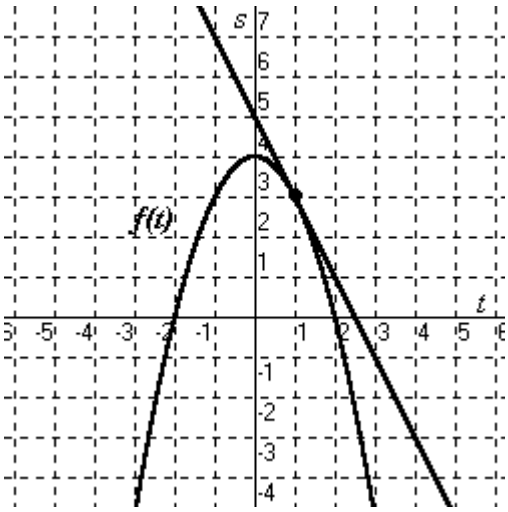
2.

a.

t. i.	disp.	a. v.
[0, 1]	–1 ft	–1 ft/sec
[0.5, 1]	–0.75 ft	–1.5 ft/sec
[0.9, 1]	–0.19 ft	–1.9 ft/sec
[0.99, 1]	–0.0199 ft	–1.99 ft/sec
[1, 1.01]	–0.0201 ft	–2.01 ft/sec
[1, 1.1]	–0.21 ft	–2.1 ft/sec
[1, 1.5]	–1.25 ft	–2.5 ft/sec
[1, 2]	–3 ft	–3 ft/sec

b. –2 ft/sec

c.



2.

d. The slope of the line is the instantaneous velocity.

e. tangent line

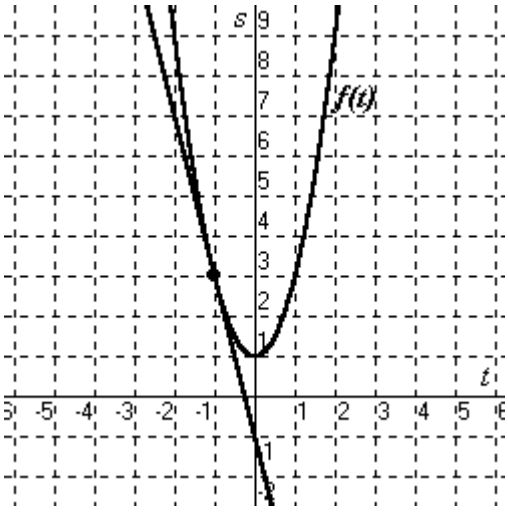
3.

a.

t. i.	disp.	a. v.
[–2, –1]	–6 ft	–6 ft/sec
[–1.5, –1]	–2.5 ft	–5 ft/sec
[–1.1, –1]	–0.42 ft	–4.2 ft/sec
[–1.01, –1]	–0.0402 ft	–4.02 ft/sec
[–1, –0.99]	–0.0398 ft	–3.98 ft/sec
[–1, –0.9]	–0.38 ft	–3.8 ft/sec
[–1, –0.5]	–1.5 ft	–3 ft/sec
[–1, 0]	–2 ft	–2 ft/sec

b. –4 ft/sec

c.



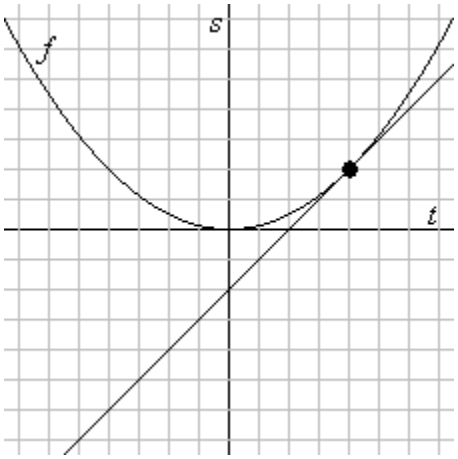
d. The slope of the line is the instantaneous velocity.

e. tangent line

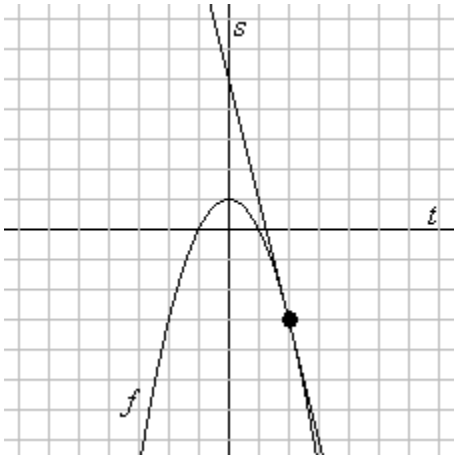
Bug 5 – Homework

Suppose a bug is moving on a number line. At time t (seconds), his position is s (feet from the origin). Let $f(t) = s$. Each graph contains f and a tangent line to a point on f. Use that point to find the bug's time, position, and instantaneous velocity.

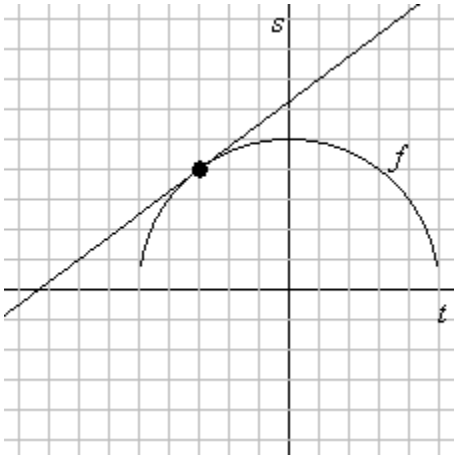
1.



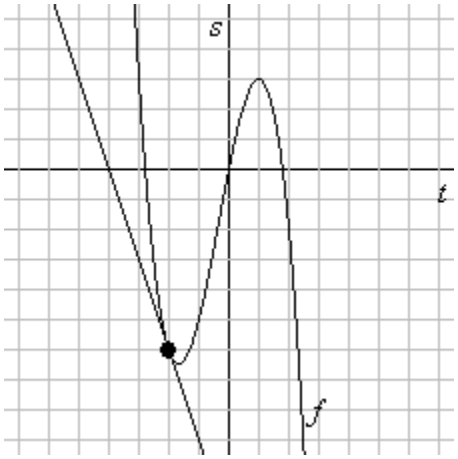
2.



3.



4.



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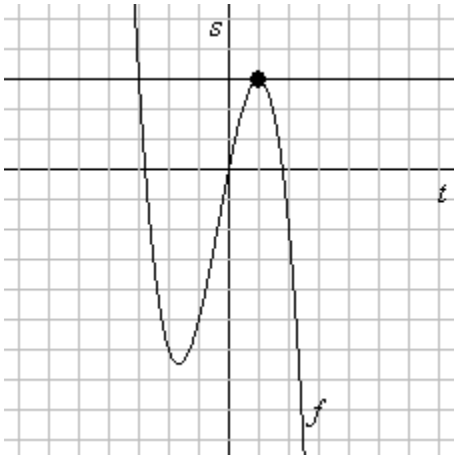
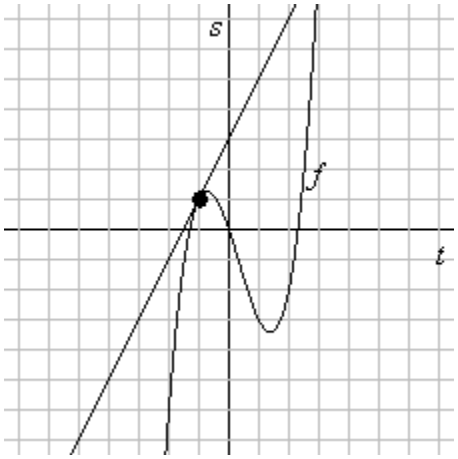


6.



Bug 5 – Homework Answers

1.	time = 4 sec	position = 2 ft	velocity = 1 ft/sec
2.	time = 2 sec	position = –3 ft	velocity = –4 ft/sec
3.	time = –3 sec	position = 4 ft	velocity = ¾ ft/sec
4.	time = –2 sec	position = –6 ft	velocity = –3 ft/sec
5.	time = 1 sec	position = 3 ft	velocity = 0 ft/sec
6.	time = –1 sec	position = 1 ft	velocity = 2 ft/sec

Bug 6 – Homework

Suppose a bug is moving on a number line. At time t (seconds), his position is s (feet from the origin). Let $f(t) = s$. For each position function do the following.

a. Compute the difference quotient.
b. Compute the velocity function.
c. Find the bug's (instantaneous) velocity at 2 sec.
d. Find the bug's velocity at –1 sec.

1. $f(t) = 5t + 1$

2. $f(t) = t^2 - 4$

3. $f(t) = 3 - 2t^2$

4. $f(t) = 3t^2 - 5t + 4$

5. $f(t) = 6t^2 + 3t - 1$

6. $f(t) = -4t^2 - 9t + 2$

7. $f(t) = t^3 + 2t - 4$

8. $f(t) = t^3 + 2t^2 - 3t + 5$

Bug 6 – Homework Answers

1. a. DQ = 5
   b. $v(t) = 5$
   c. 5 ft/sec
   d. 5 ft/sec

2. a. DQ = $2t + h$
   b. $v(t) = 2t$
   c. 4 ft/sec
   d. –2 ft/sec

3. a. DQ = $-4t - 2h$
   b. $v(t) = -4t$
   c. –8 ft/sec
   d. 4 ft/sec

4. a. DQ = $6t + 3h - 5$
   b. $v(t) = 6t - 5$
   c. 7 ft/sec
   d. –11 ft/sec

5. a. DQ = $12t + 6h + 3$
   b. $v(t) = 12t + 3$
   c. 27 ft/sec
   d. –9 ft/sec

6. a. DQ = $-8t - 4h - 9$
   b. $v(t) = -8t - 9$
   c. –25 ft/sec
   d. –1 ft/sec

7. a. DQ = $3t^2 + 3ht + h^2 + 2$
   b. $v(t) = 3t^2 + 2$
   c. 14 ft/sec
   d. 5 ft/sec

8. a. DQ = $3t^2 + 3ht + h^2 + 4t + 2h - 3$
   b. $v(t) = 3t^2 + 4t - 3$
   c. 17 ft/sec
   d. –4 ft/sec

Bug 7 – Homework

Suppose a bug is moving on a number line. At time t (seconds), his position is s (feet from the origin). Let $f(t) = s$.

1. $f(t) = t^2 + 6t - 1$

a. Compute the velocity function.

b. Where is the bug at 2 sec?
c. What is the bug's velocity at 2 sec?
d. Where is the bug at 0 sec?
e. What is the bug's velocity at 0 sec?
f. Where is the bug at –4 sec?
g. What is the bug's velocity at –4 sec?

h. When is the bug at velocity –10 ft/sec?
i. Where is the bug at velocity –10 ft/sec?
j. When is the bug at velocity 4 ft/sec?
k. Where is the bug at velocity 4 ft/sec?
l. When is the bug at velocity 14 ft/sec?
m. Where is the bug at velocity 14 ft/sec?

n. When is the bug at rest?
o. Where is the bug at rest?

p. When is the bug traveling in the positive direction?
q. When is the bug traveling in the negative direction?
r. Draw a diagram to represent the motion of the bug.

s. What is the bug's displacement over the time interval [–5, 2]?
t. What is the bug's average velocity over the time interval [–5, 2]?
u. What is the bug's total distance traveled over the time interval [–5, 2]?

v. What is the bug's displacement over the time interval [–6, 0]?
w. What is the bug's average velocity over the time interval [–6, 0]?
x. What is the bug's total distance traveled over the time interval [–6, 0]?

y. What is the bug's displacement over the time interval [–7, –4]?
z. What is the bug's average velocity over the time interval [–7, –4]?
☺. What is the bug's total distance traveled over the time interval [–7, –4]?

2. $f(t) = -t^2 + 4t + 1$

a. Compute the velocity function.

b. Where is the bug at 7 sec?
c. What is the bug's velocity at 7 sec?
d. Where is the bug at 0 sec?
e. What is the bug's velocity at 0 sec?
f. Where is the bug at –1 sec?
g. What is the bug's velocity at –1 sec?

h. When is the bug at velocity 12 ft/sec?
i. Where is the bug at velocity 12 ft/sec?
j. When is the bug at velocity –2 ft/sec?
k. Where is the bug at velocity –2 ft/sec?
l. When is the bug at velocity 3 ft/sec?
m. Where is the bug at velocity 3 ft/sec?

n. When is the bug at rest?
o. Where is the bug at rest?

p. When is the bug traveling in the positive direction?
q. When is the bug traveling in the negative direction?
r. Draw a diagram to represent the motion of the bug.

s. What is the bug's displacement over the time interval [–1, 7]?
t. What is the bug's average velocity over the time interval [–1, 7]?
u. What is the bug's total distance traveled over the time interval [–1, 7]?

v. What is the bug's displacement over the time interval [–2, 0]?
w. What is the bug's average velocity over the time interval [–2, 0]?
x. What is the bug's total distance traveled over the time interval [–2, 0]?

y. What is the bug's displacement over the time interval [–4, 4]?
z. What is the bug's average velocity over the time interval [–4, 4]?
☺. What is the bug's total distance traveled over the time interval [–4, 4]?

3. $f(t) = t^3 - 3t^2 - 2$

a. Compute the velocity function.

b. Where is the bug at –1 sec?
c. What is the bug's velocity at –1 sec?

d. When is the bug at velocity 24 ft/sec?
e. Where is the bug at velocity 24 ft/sec?

f. When is the bug at rest?
g. Where is the bug at rest?

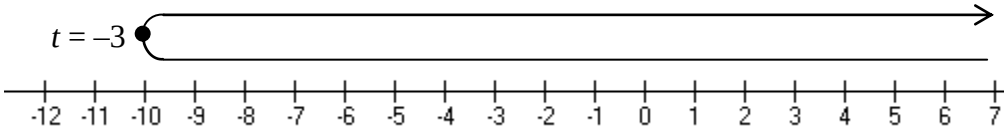
h. When is the bug traveling in the positive direction?
i. When is the bug traveling in the negative direction?
j. Draw a diagram to represent the motion of the bug.

k. What is the bug's displacement over the time interval [–2, 4]?
l. What is the bug's average velocity over the time interval [–2, 4]?
m. What is the bug's total distance traveled over the time interval [–2, 4]?

Bug 7 – Homework Answers

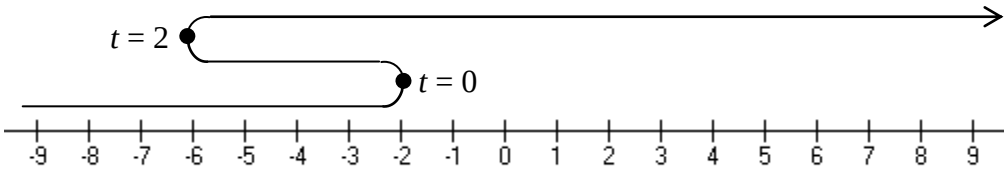
	1.	2.	3.
a	$v(t) = 2t + 6$	$v(t) = -2t + 4$	$v(t) = 3t^2 - 6t$
b	15 ft	–20 ft	–6 ft
c	10 ft/sec	–10 ft/sec	9 ft/sec
d	–1 ft	1 ft	–2, 4 sec
e	6 ft/sec	4 ft/sec	–22, 14 ft
f	–9ft	–4ft	0, 2 sec
g	–2 ft/sec	6 ft/sec	–2, –6 ft
h	–8 sec	–4 sec	$t < 0$ or $t > 2$
i	15 ft	–31 ft	$0 < t < 2$
j	–1 sec	3 sec	(next page)
k	–6 ft	4 ft	36 ft
l	4 sec	1/2 sec	6 ft/sec
m	39 ft	11/4 ft	44 ft
n	–3 sec	2 sec	
o	–10 ft	5 ft	
p	$t > -3$	$t < 2$	
q	$t < -3$	$t > 2$	
r	(next page)	(next page)	
s	21 ft	–16 ft	
t	3 ft/sec	–2 ft/sec	
u	29 ft	34 ft	
v	0 ft	12 ft	
w	0 ft/sec	6 ft/sec	
x	18 ft	12 ft	
y	–15 ft	32 ft	
z	–5 ft/sec	4 ft/sec	
☺	15 ft	40 ft	

1r.



2r.

3j.



Bug 8 – Homework

Suppose a bug is moving on a number line. At time t (seconds), his position is s (feet from the origin). Let $f(t) = s$.

For each position function, find the bug's **speed** at 3 sec.

1. $f(t) = 13$

2. $f(t) = 2t + 1$

3. $f(t) = 7 - 4t$

4. $f(t) = 2t^2 - 15t + 1$

5. $f(t) = -t^2 + 4t + 7$

6. $f(t) = t^3 - t^2 - 8t - 5$

7. $f(t) = t^3 - 5t^2 - 6t + 4$

Bug 8 – Homework Answers

1. 0 ft/sec
2. 2 ft/sec
3. 4 ft/sec
4. 3 ft/sec
5. 2 ft/sec
6. 13 ft/sec
7. 9 ft/sec

Bug 9 – Homework

Suppose a bug is moving on a number line. At time t (seconds), his position is s (feet from the origin). For each position function do the following.

a. Find the bug's velocity at 1 sec.
b. Find the bug's acceleration at 1 sec.
c. At 1 sec, is the bug speeding up, slowing down, or neither?

1. $s(t) = t^2 - 6t$

2. $s(t) = -t^2 - 4t$

3. $s(t) = 3t^2 - 6t$

4. $s(t) = 2t^2 + 3t + 1$

5. $s(t) = -4t^2 + 9t - 7$

6. $s(t) = t^3 - 6t^2 + 2$

7. $s(t) = -t^3 + 3t^2 + 3$

8. $s(t) = t^3 - t^2 - 5t - 4$

9. $s(t) = 2t^3 + 3t^2 - 12t + 5$

10. $s(t) = -2t^3 + 4t^2 + 5t - 6$

Bug 9 – Homework Answers

1. a. –4 ft/sec
   b. 2 ft/sec^2
   c. slowing down

2. a. –6 ft/sec
   b. –2 ft/sec^2
   c. speeding up

3. a. 0 ft/sec
   b. 6 ft/sec^2
   c. neither

4. a. 7 ft/sec
   b. 4 ft/sec^2
   c. speeding up

5. a. 1 ft/sec
   b. –8 ft/sec^2
   c. slowing down

6. a. –9 ft/sec
   b. –6 ft/sec^2
   c. speeding up

7. a. 3 ft/sec
   b. 0 ft/sec^2
   c. neither

8. a. –4 ft/sec
   b. 4 ft/sec^2
   c. slowing down

9. a. 0 ft/sec
   b. 18 ft/sec^2
   c. neither

10. a. 7 ft/sec
    b. –4 ft/sec^2
    c. slowing down

Bug 10 – Homework

Suppose a bug is moving on a number line. At time t (seconds), his position is s (feet from the origin). For each position function and time interval do the following.

a. Find the bug's average velocity over the time interval.
b. Find all the times that satisfy the conclusion of the Mean Value Theorem. Round irrational answers to the nearest hundredth.

1. $s(t) = t^2 + 3t - 4$; [1, 4]

2. $s(t) = -t^2 + t + 5$; [1, 5]

3. $s(t) = t^3 - t^2 - 3t - 2$; [1, 4]

4. $s(t) = t^3 - t^2 - t + 1$; [0, 3]

5. $s(t) = t^3 + 2t^2 - 3t - 5$; [–3, –1]

6. $s(t) = 2t^3 + 3t^2 - 6t + 2$; [–3, 2]

7. $s(t) = -t^3 + t^2 + t + 2$; [–2, 1]

8. $s(t) = -t^3 - 3t^2 + 4t - 5$; [–5, 2]

9. $s(t) = -t^3 - 4t^2 - t + 3$; [–2, 2]

10. $s(t) = t^3 - 6t^2 + 10t - 3$; [0, 2]

11. $s(t) = t^3 - 10t^2 + 32t - 34$; [2, 5]

Bug 10 – Homework Answers

1. a. 8 ft/sec
   b. 5/2 sec

2. a. –5 ft/sec
   b. 3 sec

3. a. 13 ft/sec
   b. 8/3 sec

4. a. 5 ft/sec
   b. 1.79 sec

5. a. 2 ft/sec
   b. –2.12 sec

6. a. 5 ft/sec
   b. –1.94 sec and 0.94 sec

7. a. –3 ft/sec
   b. –0.87 sec

8. a. –6 ft/sec
   b. –3.08 sec and 1.08 sec

9. a. –5 ft/sec
   b. 0.43 sec

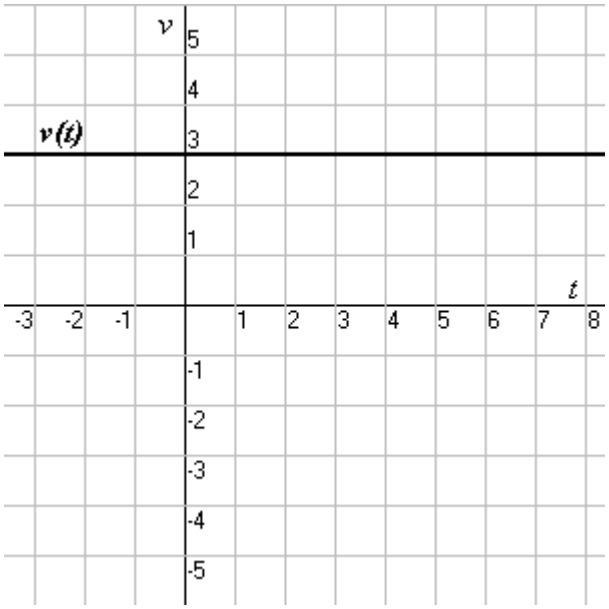
10. a. 2 ft/sec
    b. 0.85 sec

11. a. 1 ft/sec
    b. 2.45 sec and 4.22 sec

Bug 11 – Homework

Suppose a bug is moving on a number line. At time *t* (seconds), his position is *s* (feet from the origin), and his velocity is *v*. The graph of the velocity function is given.

1.



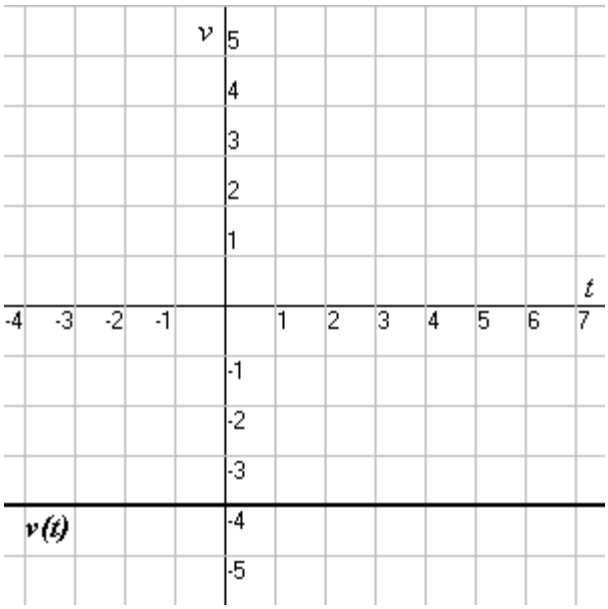
a. What is the bug's velocity at 1 sec?
b. What is the bug's velocity at 5 sec?
c. What is the bug's velocity at –2 sec?

d. What is the bug's displacement over the time interval [1, 5]?
e. What is the bug's average velocity over the time interval [1, 5]?
f. What is the bug's total distance traveled over the time interval [1, 5]?

g. What is the bug's displacement over the time interval [–2, 7]?
h. What is the bug's average velocity over the time interval [–2, 7]?
i. What is the bug's total distance traveled over the time interval [–2, 7]?

j. What is the bug's displacement over the time interval [2, 4]?
k. What is the bug's average velocity over the time interval [2, 4]?
l. What is the bug's total distance traveled over the time interval [2, 4]?

2.



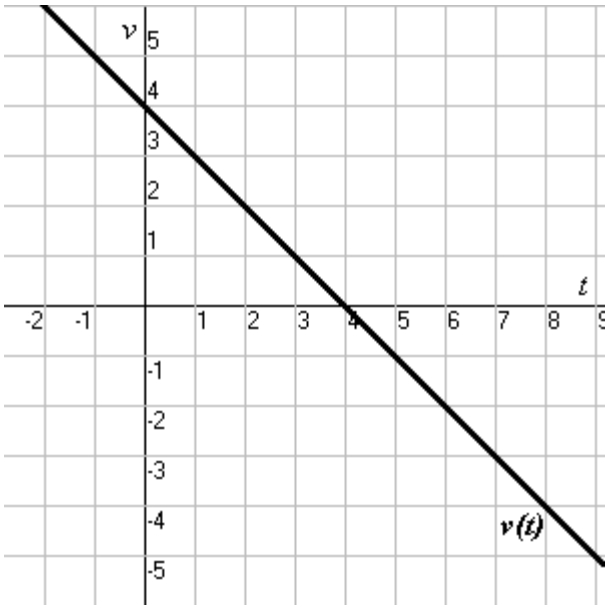
a. What is the bug's velocity at 3 sec?
b. What is the bug's velocity at –2 sec?
c. What is the bug's velocity at 7 sec?

d. What is the bug's displacement over the time interval [2, 7]?
e. What is the bug's average velocity over the time interval [2, 7]?
f. What is the bug's total distance traveled over the time interval [2, 7]?

g. What is the bug's displacement over the time interval [–1, 2]?
h. What is the bug's average velocity over the time interval [–1, 2]?
i. What is the bug's total distance traveled over the time interval [–1, 2]?

j. What is the bug's displacement over the time interval [–3, –2]?
k. What is the bug's average velocity over the time interval [–3, –2]?
l. What is the bug's total distance traveled over the time interval [–3, –2]?

3.



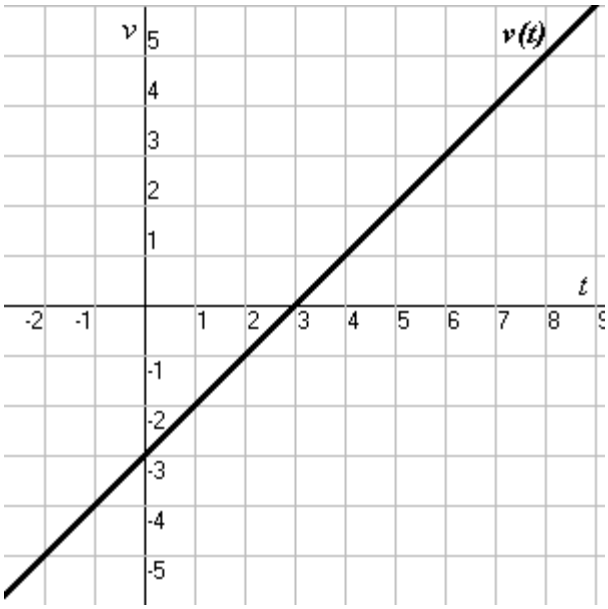
a. What is the bug's velocity at 1 sec?
b. What is the bug's velocity at 5 sec?
c. What is the bug's velocity at 4 sec?

d. What is the bug's displacement over the time interval [2, 4]?
e. What is the bug's average velocity over the time interval [2, 4]?
f. What is the bug's total distance traveled over the time interval [2, 4]?

g. What is the bug's displacement over the time interval [4, 7]?
h. What is the bug's average velocity over the time interval [4, 7]?
i. What is the bug's total distance traveled over the time interval [4, 7]?

j. What is the bug's displacement over the time interval [1, 8]?
k. What is the bug's average velocity over the time interval [1, 8]?
l. What is the bug's total distance traveled over the time interval [1, 8]?

4.



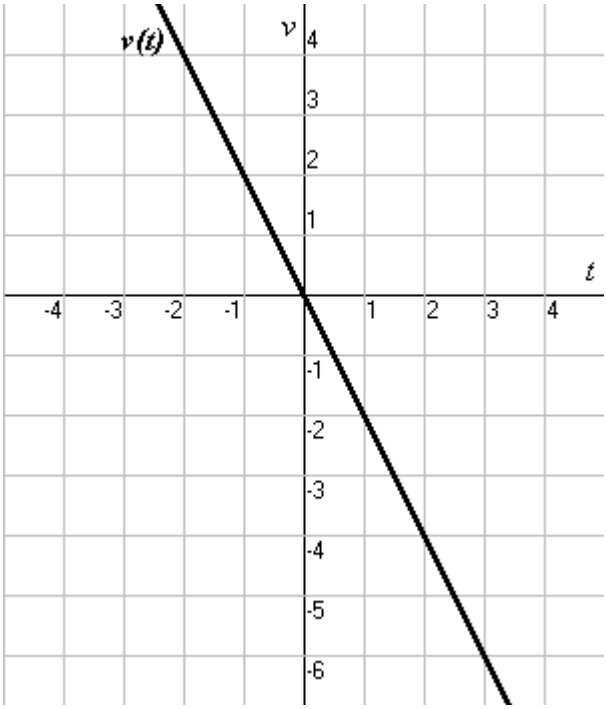
a. What is the bug's velocity at 0 sec?
b. What is the bug's velocity at 2 sec?
c. What is the bug's velocity at 5 sec?

d. What is the bug's displacement over the time interval [0, 4]?
e. What is the bug's average velocity over the time interval [0, 4]?
f. What is the bug's total distance traveled over the time interval [0, 4]?

g. What is the bug's displacement over the time interval [1, 7]?
h. What is the bug's average velocity over the time interval [1, 7]?
i. What is the bug's total distance traveled over the time interval [1, 7]?

j. What is the bug's displacement over the time interval [1, 2]?
k. What is the bug's average velocity over the time interval [1, 2]?
l. What is the bug's total distance traveled over the time interval [1, 2]?

5.



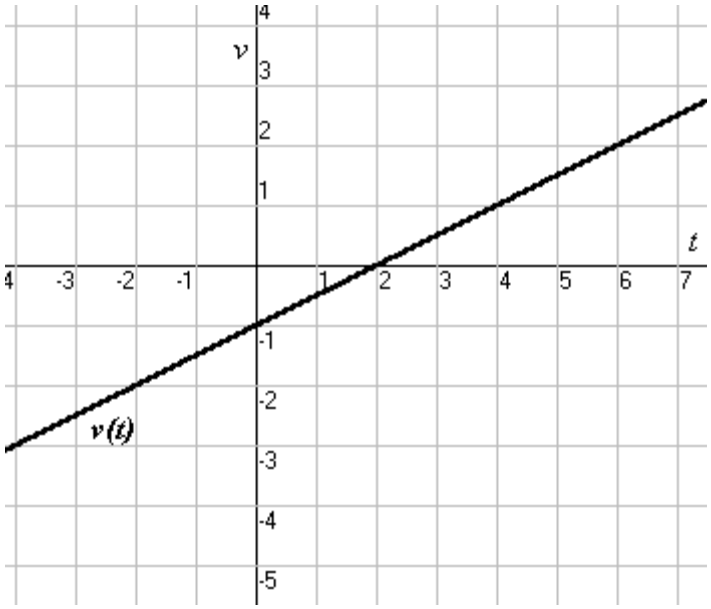
a. What is the bug's velocity at 3 sec?
b. What is the bug's velocity at –2 sec?
c. What is the bug's velocity at 0 sec?

d. What is the bug's displacement over the time interval [–2, 3]?
e. What is the bug's average velocity over the time interval [–2, 3]?
f. What is the bug's total distance traveled over the time interval [–2, 3]?

g. What is the bug's displacement over the time interval [–1, 1]?
h. What is the bug's average velocity over the time interval [–1, 1]?
i. What is the bug's total distance traveled over the time interval [–1, 1]?

j. What is the bug's displacement over the time interval [–2, 1]?
k. What is the bug's average velocity over the time interval [–2, 1]?
l. What is the bug's total distance traveled over the time interval [–2, 1]?

6.



a. What is the bug's velocity at 6 sec?
b. What is the bug's velocity at 3 sec?
c. What is the bug's velocity at –1 sec?

d. What is the bug's displacement over the time interval [1, 5]?
e. What is the bug's average velocity over the time interval [1, 5]?
f. What is the bug's total distance traveled over the time interval [1, 5]?

g. What is the bug's displacement over the time interval [–1, 5]?
h. What is the bug's average velocity over the time interval [–1, 5]?
i. What is the bug's total distance traveled over the time interval [–1, 5]?

j. What is the bug's displacement over the time interval [–3, 6]?
k. What is the bug's average velocity over the time interval [–3, 6]?
l. What is the bug's total distance traveled over the time interval [–3, 6]?

Bug 11 – Homework Answers

	1.	2.	3.	4.	5.	6.
a.	3 ft/sec	–4 ft/sec	3 ft/sec	–3 ft/sec	–6 ft/sec	2 ft/sec
b.	3 ft/sec	–4 ft/sec	–1 ft/sec	–1 ft/sec	4 ft/sec	0.5 ft/sec
c.	3 ft/sec	–4 ft/sec	0 ft/sec	2 ft/sec	0 ft/sec	–1.5 ft/sec
d.	12 ft	–20 ft	2 ft	–4 ft	–5 ft	2 ft
e.	3 ft/sec	–4 ft/sec	1 ft/sec	–1 ft/sec	–1 ft/sec	0.5 ft/sec
f.	12 ft	20 ft	2 ft	5 ft	13 ft	2.5 ft
g.	27 ft	–12 ft	–4.5 ft	6 ft	0 ft	0 ft
h.	3 ft/sec	–4 ft/sec	–1.5 ft/sec	1 ft/sec	0 ft/sec	0 ft/sec
i.	27 ft	12 ft	4.5 ft	10 ft	2 ft	4.5 ft
j.	6 ft	–4 ft	–3.5 ft	–1.5 ft	3 ft	–2.25 ft
k.	3 ft/sec	–4 ft/sec	–0.5 ft/sec	–1.5 ft/sec	1 ft/sec	–0.25 ft/sec
l.	6 ft	4 ft	12.5 ft	1.5 ft	5 ft	10.25 ft

Bug 12 – Homework

Suppose a bug is moving on a number line. At time t (seconds), his position is s (feet from the origin), his velocity is v, and his acceleration is a.

1. $v(t) = 3$ If $s(3) = 2$, then find s.

2. $v(t) = -1$ If $s(2) = 4$, then find s.

3. $v(t) = 2t - 3$ If $s(0) = 5$, then find s.

4. $v(t) = -8t - 2$ If $s(2) = -19$, then find s.

5. $v(t) = 16t + 1$ If $s(1) = -1$, then find s.

6. $v(t) = -10t + 7$ If $s(-1) = -14$, then find s.

7. $v(t) = 6t$ If $s(-2) = 16$, then find s.

8. $v(t) = 4t - 5$ If $s(4) = 12$, then find s.

9. $a(t) = 6$ If $v(3) = 22$ and $s(3) = 38$, then find v and s.

10. $a(t) = -10$ If $v(1) = -2$ and $s(1) = 7$, then find v and s.

11. $a(t) = 24t - 2$ If $v(1) = 8$ and $s(1) = 4$, then find v and s.

12. $a(t) = -6t + 10$ If $v(2) = 5$ and $s(2) = 4$, then find v and s.

13. $a(t) = 0$ If $v(2) = 10$ and $s(2) = 7$, then find v and s.

14. $a(t) = 12t$ If $v(3) = 53$ and $s(3) = 51$, then find v and s.

Bug 12 – Homework Answers

1. $s(t) = 3t - 7$

2. $s(t) = -t + 6$

3. $s(t) = t^2 - 3t + 5$

4. $s(t) = -4t^2 - 2t + 1$

5. $s(t) = 8t^2 + t - 10$

6. $s(t) = -5t^2 + 7t - 2$

7. $s(t) = 3t^2 + 4$

8. $s(t) = 2t^2 - 5t$

9. $v(t) = 6t + 4$
   $s(t) = 3t^2 + 4t - 1$

10. $v(t) = -10t + 8$
    $s(t) = -5t^2 + 8t + 4$

11. $v(t) = 12t^2 - 2t - 2$
    $s(t) = 4t^3 - t^2 - 2t + 3$

12. $v(t) = -3t^2 + 10t - 3$
    $s(t) = -t^3 + 5t^2 - 3t - 2$

13. $v(t) = 10$
    $s(t) = 10t - 13$

14. $v(t) = 6t^2 - 1$
    $s(t) = 2t^3 - t$

Bug 13 – Homework

Suppose a bug is moving on a number line. At time t (seconds), his position is s (feet from the origin), and his velocity is v. For each velocity function and time interval do the following.

a. Find the bug's displacement over the time interval.
b. Find the bug's average velocity over the time interval.
c. Find the bug's total distance traveled over the time interval.
d. Find all the times that satisfy the conclusion of the Mean Value Theorem. Round irrational answers to the nearest hundredth.

1. $v(t) = 3t^2 - 3$; $[0, 4]$
2. $v(t) = 3t^2 - 3$; $[-1, 2]$
3. $v(t) = 3t^2 - 3$; $[-1, 0]$

4. $v(t) = -6t^2 + 24$; $[1, 4]$
5. $v(t) = -6t^2 + 24$; $[-1, 3]$
6. $v(t) = -6t^2 + 24$; $[-2, 1]$

7. $v(t) = 6t^2 - 9t$; $[1, 3]$
8. $v(t) = 6t^2 - 9t$; $[-1, 1]$
9. $v(t) = 6t^2 - 9t$; $[0, 2]$

10. $v(t) = -3t^2 + 12t$; $[3, 6]$
11. $v(t) = -3t^2 + 12t$; $[-1, 3]$
12. $v(t) = -3t^2 + 12t$; $[-2, 5]$

13. $v(t) = 3t^2 - 6t - 9$; $[-2, 0]$
14. $v(t) = 3t^2 - 6t - 9$; $[1, 4]$
15. $v(t) = 3t^2 - 6t - 9$; $[-3, 5]$

Bug 13 – Homework Answers

	a.	b.	c.	d.
1.	52 ft	13 ft/sec	56 ft	2.31 sec
2.	0 ft	0 ft/sec	8 ft	1 sec
3.	–2 ft	–2 ft/sec	2 ft	–0.58 sec
4.	–54 ft	–18 ft/sec	74 ft	2.65 sec
5.	40 ft	10 ft/sec	68 ft	1.53 sec
6.	54 ft	18 ft/sec	54 ft	–1 sec
7.	16 ft	8 ft/sec	17.75 ft	2.13 sec
8.	4 ft	2 ft/sec	9 ft	–0.20 sec
9.	–2 ft	–1 ft/sec	4.75 ft	0.12, 1.38 sec
10.	–27 ft	–9 ft/sec	37 ft	4.65 sec
11.	20 ft	5 ft/sec	34 ft	0.47 sec
12.	–7 ft	–1 ft/sec	71 ft	–0.08, 4.08 sec
13.	2 ft	1 ft/sec	12 ft	–1.08 sec
14.	–9 ft	–3 ft/sec	23 ft	2.73 sec
15.	32 ft	4 ft/sec	96 ft	–1.31, 3.31 sec

Bug 14 – Homework

Suppose a bug is moving on the *xy*-plane. At time t (seconds), his position is (x feet, y feet). For each pair of position functions, answer the following questions.

a. Where is the bug at the given time?
b. What is the bug's horizontal velocity at the given time?
c. What is the bug's vertical velocity at the given time?
d. What is the bug's slope at the given time?
e. What is the bug's speed at the given time? (Round to the nearest hundredth.)

1.	$x = t^2 + 3$,	$y = -t^2 + 2t$,	$t = 2$ sec
2.	$x = -2t^2 - 1$,	$y = 3t^2 + t$,	$t = 1$ sec
3.	$x = -3t^2 - t$,	$y = -t^2$,	$t = -1$ sec
4.	$x = 4t^2 - 11t$,	$y = 2t^2 + 5$,	$t = 2$ sec
5.	$x = -t^2 + 3t - 4$,	$y = t^2 - 4t + 3$,	$t = 3$ sec
6.	$x = 3t^2 - 8t - 1$,	$y = -2t^2 - 6t + 4$,	$t = 0$ sec
7.	$x = t^3 + 2t^2 - t + 1$,	$y = -t^2$,	$t = 1$ sec
8.	$x = t^2 - 4$,	$y = -t^3 + 7t$,	$t = -2$ sec

Bug 14 – Homework Answers

	a.	b.	c.	d.	e.
1.	(7, 0)	4 ft/sec	–2 ft/sec	–1/2	4.47 ft/sec
2.	(–3, 4)	–4 ft/sec	7 ft/sec	–7/4	8.06 ft/sec
3.	(–2, –1)	5 ft/sec	2 ft/sec	2/5	5.39 ft/sec
4.	(–6, 13)	5 ft/sec	8 ft/sec	8/5	9.43 ft/sec
5.	(–4, 0)	–3 ft/sec	2 ft/sec	–2/3	3.61 ft/sec
6.	(–1, 4)	–8 ft/sec	–6 ft/sec	3/4	10 ft/sec
7.	(3, –1)	6 ft/sec	–2 ft/sec	–1/3	6.32 ft/sec
8.	(0, –6)	–4 ft/sec	–5 ft/sec	5/4	6.40 ft/sec

Bug 15 – Homework

Suppose a bug is moving in 3-space. At time t sec, his position is (x ft, y ft, z ft). Let the bug's position, velocity, and acceleration vectors be denoted by $\mathbf{r}(t)$, $\mathbf{v}(t)$ and $\mathbf{a}(t)$, respectively.

1. $\mathbf{r}(t) = \langle t^2 - 3t, 2t^2 + 1, -3t + 2 \rangle$

   a. Compute the velocity vector.
   b. Compute the acceleration vector.
   c. What is the bug's position vector at 2 sec?
   d. What is the bug's velocity vector at 2 sec?
   e. What is the bug's speed at 2 sec? (Round to the nearest hundredth.)

2. $\mathbf{r}(t) = \langle 2t^3 - t^2 + t + 7, -t^3 + 5t - 2, 3t^3 + t^2 - 2t \rangle$

   a. Compute the velocity vector.
   b. Compute the acceleration vector.
   c. What is the bug's position vector at 1 sec?
   d. What is the bug's velocity vector at 1 sec?
   e. What is the bug's speed at 1 sec? (Round to the nearest hundredth.)

3. $\mathbf{a}(t) = \langle 6, -2, 10 \rangle$ $\mathbf{v}(1) = \langle 6, 1, 14 \rangle$ $\mathbf{r}(1) = \langle 2, 6, 9 \rangle$

   a. Compute the velocity vector.
   b. Compute the position vector.
   c. What is the bug's position vector at 2 sec?
   d. What is the bug's velocity vector at 2 sec?
   e. What is the bug's speed at 2 sec? (Round to the nearest hundredth.)

4. $\mathbf{a}(t) = \langle 2, 6t, 4 \rangle$ $\mathbf{v}(2) = \langle -1, 10, 9 \rangle$ $\mathbf{r}(2) = \langle 5, -1, 2 \rangle$

   a. Compute the velocity vector.
   b. Compute the position vector.
   c. What is the bug's position vector at 1 sec?
   d. What is the bug's velocity vector at 1 sec?
   e. What is the bug's speed at 1 sec? (Round to the nearest hundredth.)

5. $\mathbf{r}(t) = \langle \cos t, \sin t, 2t \rangle$
   Find the bug's total distance traveled over the time interval [1, 20].
   (Round to the nearest hundredth.)

6. $\mathbf{r}(t) = \langle t, 4\sqrt{t}, 2 \ln t \rangle$
   Find the bug's total distance traveled over the time interval [2, 8].
   (Round to the nearest hundredth.)

Bug 15 – Homework Answers

1. a. $\mathbf{v}(t) = \langle 2t - 3, 4t, -3 \rangle$
   b. $\mathbf{a}(t) = \langle 2, 4, 0 \rangle$
   c. $\langle -2, 9, -4 \rangle$
   d. $\langle 1, 8, -3 \rangle$
   e. 8.60 ft/sec

2. a. $\mathbf{v}(t) = \langle 6t^2 - 2t + 1, -3t^2 + 5, 9t^2 + 2t - 2 \rangle$
   b. $\mathbf{a}(t) = \langle 12t - 2, -6t, 18t + 2 \rangle$
   c. $\langle 9, 2, 2 \rangle$
   d. $\langle 5, 2, 9 \rangle$
   e. 10.49 ft/sec

3. a. $\mathbf{v}(t) = \langle 6t, -2t + 3, 10t + 4 \rangle$
   b. $\mathbf{r}(t) = \langle 3t^2 - 1, -t^2 + 3t + 4, 5t^2 + 4t \rangle$
   c. $\langle 11, 6, 28 \rangle$
   d. $\langle 12, -1, 24 \rangle$
   e. 26.85 ft/sec

4. a. $\mathbf{v}(t) = \langle 2t - 5, 3t^2 - 2, 4t + 1 \rangle$
   b. $\mathbf{r}(t) = \langle t^2 - 5t + 11, t^3 - 2t - 5, 2t^2 + t - 8 \rangle$
   c. $\langle 7, -6, -5 \rangle$
   d. $\langle -3, 1, 5 \rangle$
   e. 5.92 ft/sec

5. 42.49 ft

6. 8.77 ft

Bug 16 – Homework

Suppose a bug is moving in 2-space. At time t sec, his position is (x ft, y ft).

Let the bug's position vector be denoted by $\mathbf{r}(t)$.

Is the bug speeding up or slowing down at $t = -1$, and by how much?

Round to the nearest hundredth.

1. $\mathbf{r}(t) = \left\langle \frac{1}{t}, \frac{t^2}{2} \right\rangle$

2. $\mathbf{r}(t) = \left\langle \frac{1}{e^t}, e^t \right\rangle$

1. speeding up by 0.71 ft/s^2 2. slowing down by 2.64 ft/s^2