Group 1 Part I

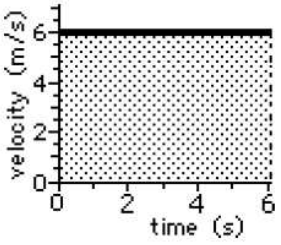
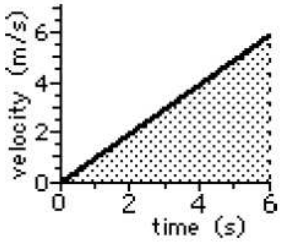
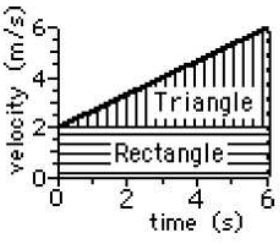
1. Motion diagrams for an amusement park ride are shown. The diagrams indicate the positions of the car at regular time intervals. For each of these diagrams, indicate whether the car is accelerating or moving with constant velocity. If accelerating, indicate the direction (right or left) of acceleration. Support your answer with reasoning.

	Acceleration: Y/N	Dir'n
a.  Reason: The spacing between consecutive positions is constant; this indicates a constant speed and no acceleration.	No	--
b.  Reason: The spacing between consecutive positions is increasing; this indicates a speeding up motion and thus, an acceleration. An object that is speeding up has an acceleration in the same direction that it moves.	Yes	Right
c.  Reason: The spacing between consecutive positions is constant; this indicates a constant speed and no acceleration.	No	--

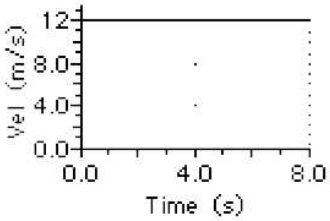
Group 1 Part II

4. The area under the line of a velocity-time graph can be calculated using simple rectangle and triangle equations. The graphs below are examples:

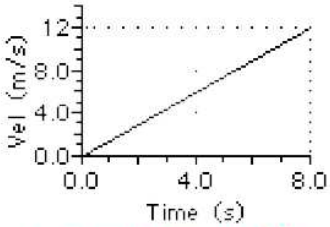
If the area under the line forms a ...

... **rectangle**, then use	... **triangle**, then use	... **trapezoid**, then make it into a rectangle + triangle and add the two areas.
area = base*height	area = 0.5 * base*height	
		
A = (6 m/s)*(6 s) = **36 m**	A = 0.5 * (6 m/s)*(6 s) = **18 m**	$A_{total} = A_{rectangle} + A_{triangle}$ A_{total} = (2m/s)*(6 s) + 0.5 * (4 m/s) * (6 s) = **24 m**

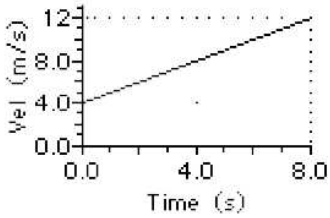
Find the displacement of the objects represented by the following velocity-time graphs.



d = Rectangle Area = b•h
d = (8.0 s) • (12 m/s)
d = 96 m



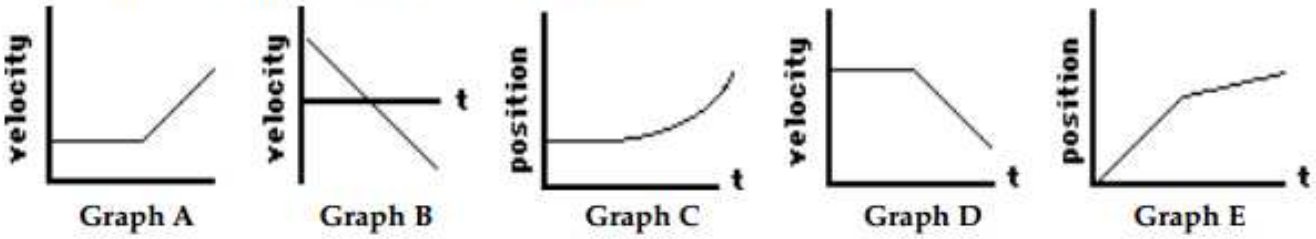
d = Triangle Area = 0.5•b•h
d = 0.5• (8.0 s) • (12 m/s)
d = 48 m



d = Triangle Area + Rect. Area
d = (8.0 s)•(4.0 m/s) +
0.5•(8.0 s)•(8.0 m/s)
d = 64 m

Group 1 Part IV

5. The graphs below depict the motion of several different objects. Note that the graphs include both position vs. time and velocity vs. time graphs.



The motion of these objects could also be described using words. Analyze the graphs and match them with the verbal descriptions given below by filling in the blanks.

d.	The object moves with a constant velocity and then speeds up.	A
e.	The object maintains a rest position for several seconds and then accelerates.	C

Group 2 Part I

1. Motion diagrams for an amusement park ride are shown. The diagrams indicate the positions of the car at regular time intervals. For each of these diagrams, indicate whether the car is accelerating or moving with constant velocity. If accelerating, indicate the direction (right or left) of acceleration. Support your answer with reasoning.

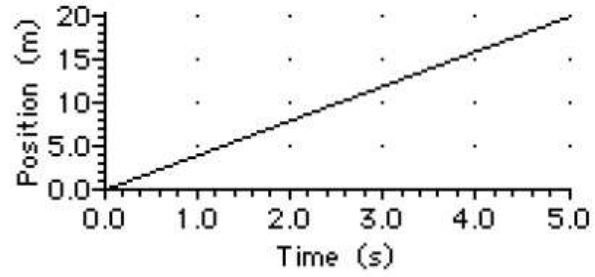
d.  Reason: The spacing between consecutive positions is increasing; this indicates a speeding up motion and thus, an acceleration. An object that is speeding up has an acceleration in the same direction that it moves.	Yes	Right
e.  Reason: The spacing between consecutive positions is decreasing; this indicates a slowing down motion. Slowing down is a form of acceleration. An object that is moving rightward and slowing down has a leftward acceleration.	Yes	Left

2. Suppose that in diagram D (above) the cars were moving leftward (and traveling backwards). What would be the direction of the acceleration? Leftward Explain your answer fully.

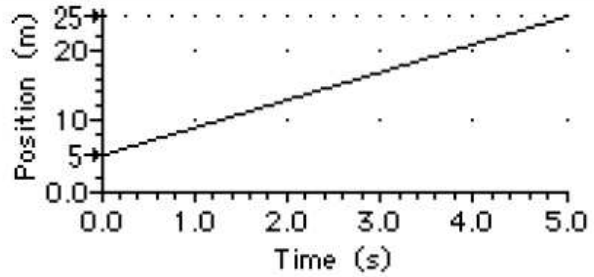
   If this were true, then the cars would be moving leftward and speeding up. The speeding up is due to the fact that the distance between consecutive positions (moving from right to left) is increasing. Moving leftward and speeding up is an example of a leftward acceleration.

Group 2 Part II

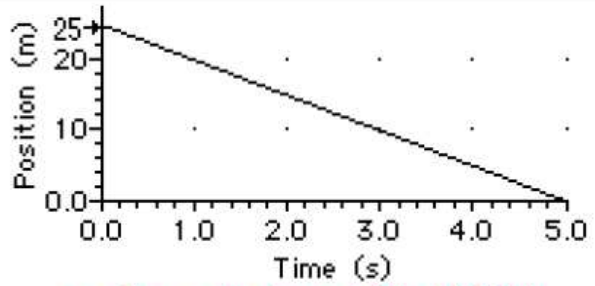
5. Use the position-time graphs below to determine the velocity. **PSYW**



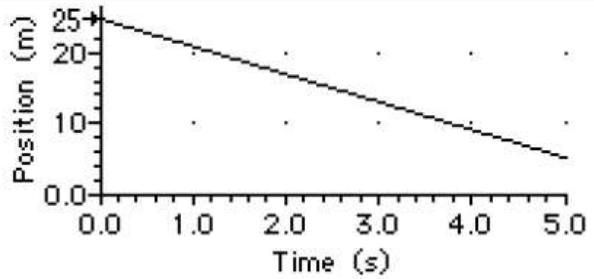
v = slope = rise / run = (20 m) / (5.0 s)
v = 4 m/s



v = slope = rise / run = (20 m) / (5.0 s)
v = 4 m/s



v = slope = rise / run = (-25 m) / (5.0 s)
v = -5 m/s

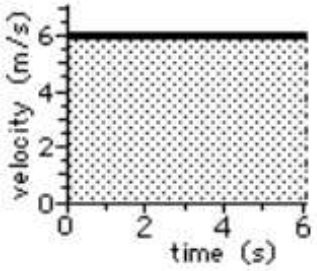


v = slope = rise / run = (-20 m) / (5.0 s)
v = -4 m/s

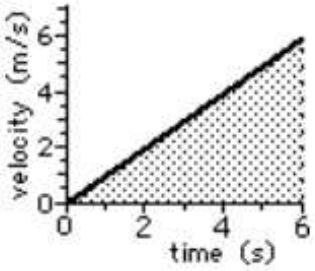
Group 2 Part III

If the area under the line forms a ...

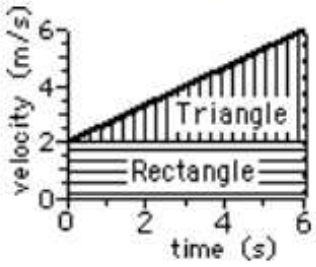
... **rectangle**, then use	... **triangle**, then use	... **trapezoid**, then make it into a rectangle + triangle and add the two areas.
area = base*height	area = 0.5 * base*height	



$A = (6\ m/s)*(6\ s) = \mathbf{36\ m}$



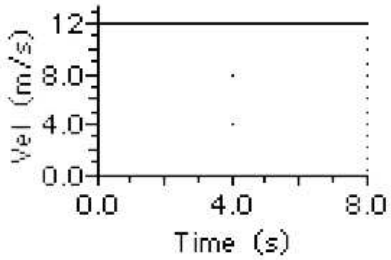
$A = 0.5 * (6\ m/s)*(6\ s) = \mathbf{18\ m}$



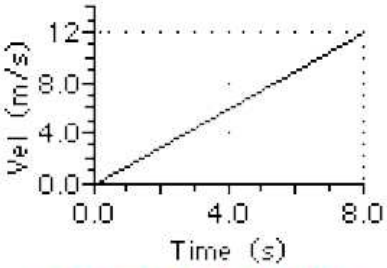
$A_{total} = A_{rectangle} + A_{triangle}$

$A_{total} = (2m/s)*(6\ s) + 0.5 * (4\ m/s) * (6\ s) = \mathbf{24\ m}$

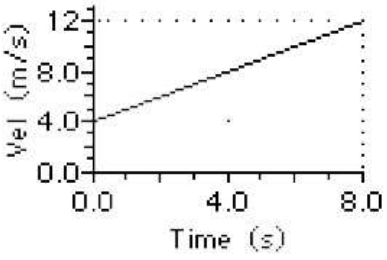
Find the displacement of the objects represented by the following velocity-time graphs.



d = Rectangle Area = b•h
d = (8.0 s) • (12 m/s)
d = 96 m



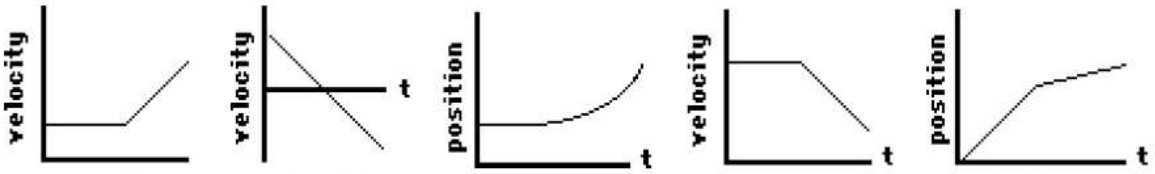
d = Triangle Area = 0.5•b•h
d = 0.5• (8.0 s) • (12 m/s)
d = 48 m



d = Triangle Area + Rect. Area
d = (8.0 s)•(4.0 m/s) +
0.5•(8.0 s)•(8.0 m/s)
d = 64 m

Group 2 Part IV

5. The graphs below depict the motion of several different objects. Note that the graphs include both position vs. time and velocity vs. time graphs.



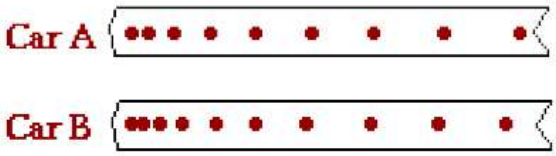
Graph A | Graph B | Graph C | Graph D | Graph E

The motion of these objects could also be described using words. Analyze the graphs and match them with the verbal descriptions given below by filling in the blanks.

Verbal Description	Graph
a. The object is moving fast with a constant velocity and then moves slow with a constant velocity.	E
b. The object is moving in one direction with a constant rate of acceleration (slowing down), changes directions, and continues in the opposite direction with a constant rate of acceleration (speeding up).	B
c. The object moves with a constant velocity and then slows down.	D

Group 3 Part I

3. Based on the oil drop pattern for Car A and Car B, which of the following statements are true? Circle all that apply. Answer: **B and E**

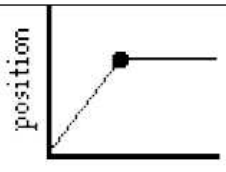


a. Both cars have a constant velocity.
b. Both cars have an accelerated motion.
c. Car A is accelerating; Car B is not.
d. Car B is accelerating; Car A is not.
e. Car A has a greater acceleration than Car B.
f. Car B has a greater acceleration than Car A.

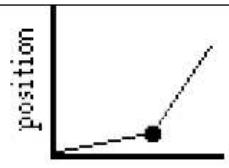
Since the spacing between consecutive positions is increasing, the cars are accelerating. The spacing increases more dramatically for Car A, so it has the greater acceleration.

Group 3 Part II

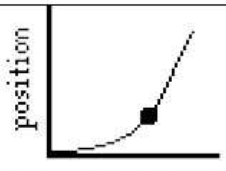
4. Use your understanding of the meaning of slope and shape of position-time graphs to describe the motic depicted by each of the following graphs.



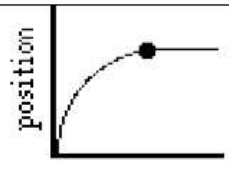
The object moves with a constant velocity in the positive direction; then the object suddenly stops and maintains a rest position.



The object moves slowly with a constant velocity in the positive direction; then the object moves fast with a constant velocity.



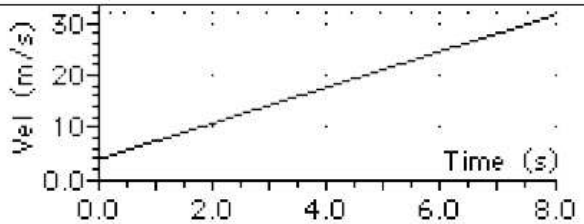
The object moves in the positive direction from slow to fast. Then the object maintains a constant velocity in the positive direction.



The object moves in the positive direction from fast to slow; once the object slows to a stop, it maintains the rest position.

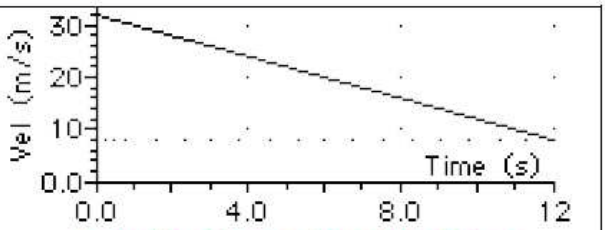
Group 3 Part III

3. Use the velocity-time graphs below to determine the acceleration. **PSYW**



$a = \Delta v / t = (32\ m/s - 4\ m/s) / (8.0\ s)$

a = 3.5 m/s/s

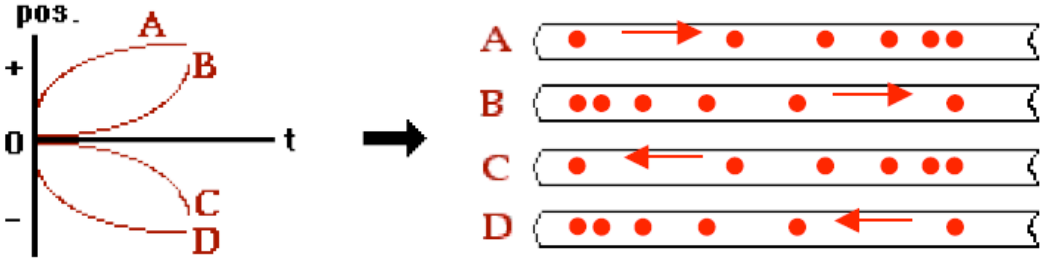


$a = \Delta v / t = (8\ m/s - 32\ m/s) / (12.0\ s)$

a = -2.0 m/s/s

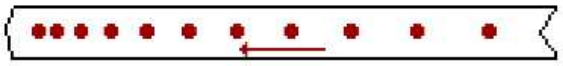
Group 3 Part IV

6. Consider the position-time graphs for objects A, B, C and D. On the *ticker tapes* to the right of the graphs, construct a dot diagram for each object. Since the objects could be moving right or left, put an arrow on each *ticker tape* to indicate the direction of motion.



Group 4 Part I

4. An object is moving from right to left. It's motion is represented by the oil drop diagram below. This object has a _____ velocity and a _____ acceleration.

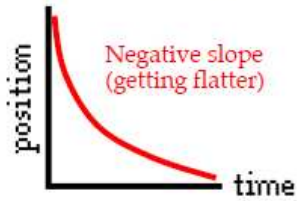


a. rightward, rightward
b. rightward, leftward
c. leftward, rightward
d. leftward, leftward
e. rightward, zero
f. leftward, zero

The velocity of an object is always in the direction that it moves; in this case, to the left. If an object is slowing down (as is the case here), then its acceleration is opposite the direction of motion.

Group 4 Part II

3. For each type of accelerated motion, construct the appropriate shape of a position-time graph.

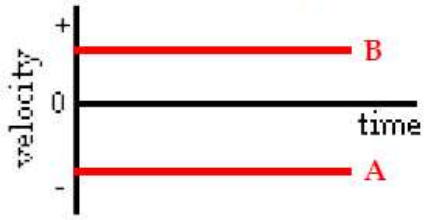
Moving with a + velocity and a + acceleration	Moving with a + velocity and a - acceleration
	
Moving with a - velocity and a + acceleration	**Moving with a - velocity and a - acceleration**
	

Group 4 Part III

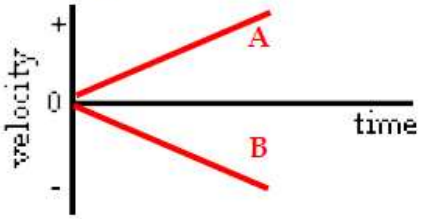
Interpreting Velocity-Graphs

2. On the graphs below, draw two lines/curves to represent the given verbal descriptions; label the lines/curves as A or B.

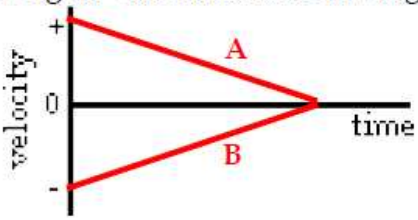
A Moving at constant speed in - direction
B Moving at constant speed in + direction



A Moving in + direction and speeding up
B Moving in - direction and speeding up



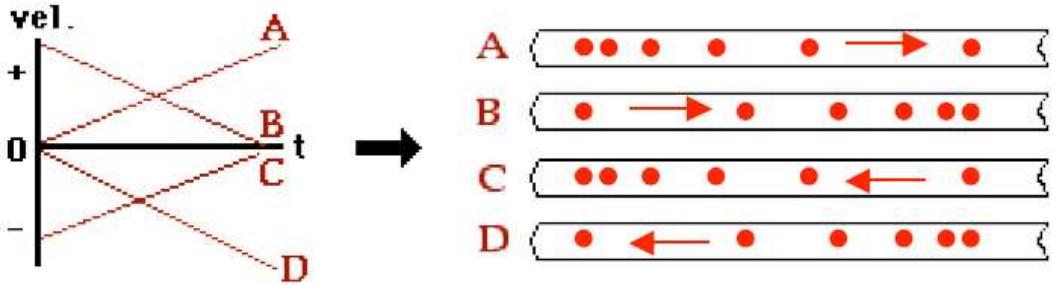
A Moving in + direction and slowing down
B Moving in - direction and slowing down



A Moving with + velocity and - accel'n
B Moving with + velocity and + accel'n

Group 4 Part IV

7. Consider the velocity-time graphs for objects A, B, C and D. On the *ticker tapes* to the right of the graphs, construct a dot diagram for each object. Since the objects could be moving right or left, put an arrow on each *ticker tape* to indicate the direction of motion.



Group 5 Part I

5. Renatta Oyle's car has an oil leak and leaves a trace of oil drops on the streets as she drives through Glenview. A study of Glenview's streets reveals the following traces. Match the trace with the verbal descriptions given below. For each match, verify your reasoning.

Fast; rapidly decelerating At rest Accelerating

Diagram A:

Constant, moderate speed Begins a gradual acceleration

Diagram B:

Constant speed; suddenly stops. At rest Moves very slowly at constant speed

Diagram C:

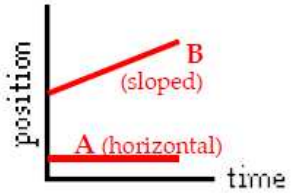
	Verbal Description	Diagram
i.	Renatta was driving with a slow constant speed, decelerated to rest, remained at rest for 30 s, and then drove very slowly at a constant speed. Reasoning: See notes above each diagram.	C
ii.	Renatta rapidly decelerated from a high speed to a rest position, and then slowly accelerated to a moderate speed. Reasoning: See notes above each diagram.	A

Group 5 Part II

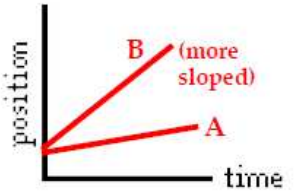
Interpreting Position-Graphs

2. On the graphs below, draw two lines / curves to represent the given verbal descriptions; label the lines / curves as A or B.

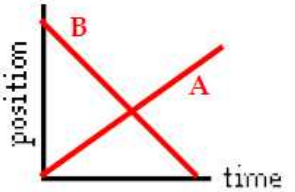
A Remaining at rest
B Moving



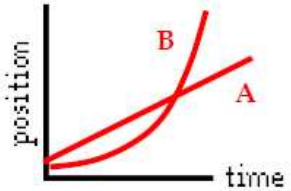
A Moving slow
B Moving fast



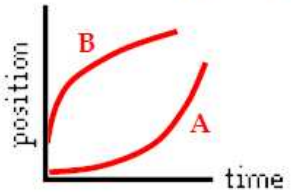
A Moving in + direction
B Moving in - direction



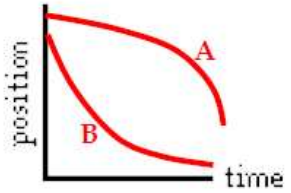
A Moving at constant speed
B Accelerating



A Move in + dirn; speed up
B Move in + dirn; slow dn



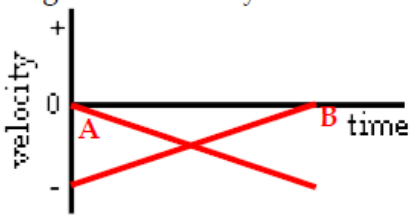
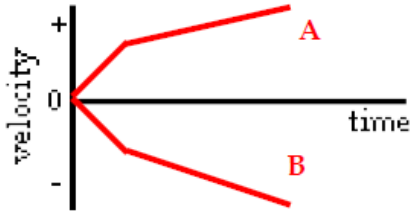
A Move in - dirn; speed up
B Move in - dirn; slow dn



Group 5 Part III

Interpreting Velocity-Graphs

2. On the graphs below, draw two lines/curves to represent the given verbal descriptions; label the lines/curves as A or B.

A Moving with - velocity and - accel'n B Moving with - velocity and + accel'n	A Moving in + dir'n, first fast, then slow B Moving in - dir'n, first fast, then slow
	

Group 5 Part IV

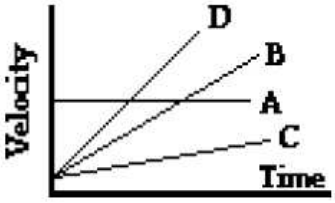
3. The slope of the line on a velocity vs. time graph reveals information about an object's acceleration. Furthermore, the area under the line is equal to the object's displacement. Apply this understanding to answer the following questions.

   a. A horizontal line means constant velocity (a = 0 m/s/s).

   b. A straight diagonal line means accelerating object.

   c. A gradually sloped line means small acceleration.

   d. A steeply sloped line means large acceleration.



4. The motion of several objects is depicted by a velocity vs. time graph. Answer the following questions. Each question may have less than one, one, or more than one answer.

   ___---___ a. Which object(s) is(are) at rest?

   ___BCD___ b. Which object(s) is(are) accelerating?

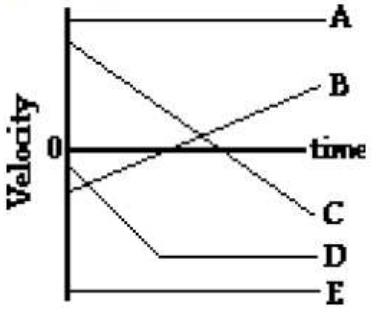
   ___---___ c. Which object(s) is(are) not moving?

   ___BC___ d. Which object(s) change(s) its direction?

   ___B___ e. Which accelerating object has the smallest acceler'n?

   ___C___ f. Which object has the greatest acceleration?

   ___D (sort of BC)___ g. Which object(s) is(are) moving in the same direction as object E?



Group 6 Part I

5. Renatta Oyle's car has an oil leak and leaves a trace of oil drops on the streets as she drives through Glenview. A study of Glenview's streets reveals the following traces. Match the trace with the verbal descriptions given below. For each match, verify your reasoning.

Diagram A:

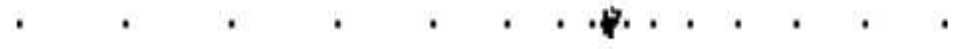


Diagram B:

Diagram C:

iii. Renatta was driving at a moderate speed and slowly accelerated. Reasoning: See notes above each diagram.	B

Group 6 Part II

Review:

1. Categorize the following motions as being either examples of + or - acceleration.
   a. Moving in the + direction and speeding up (getting faster) — positive
   b. Moving in the + direction and slowing down (getting slower) — negative
   c. Moving in the - direction and speeding up (getting faster) — negative
   d. Moving in the - direction and slowing down (getting slower) — positive

Group 6 Part III

1. The slope of the line on a position vs. time graph reveals information about an object's velocity. The magnitude (numerical value) of the slope is equal to the object's speed and the direction of the slope (upward/+ or downward/-) is the same as the direction of the velocity vector. Apply this understanding to answer the following questions.

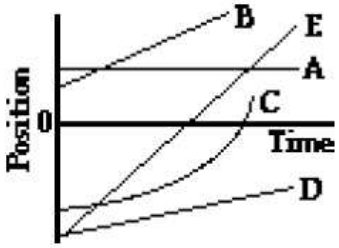
   a. A horizontal line means **the velocity is 0 m/s (object is at rest)**.

   b. A straight diagonal line means **the velocity is constant**.

   c. A curved line means **the velocity is changing (acceleration)**.

   d. A gradually sloped line means **the velocity is small (slow)**.

   e. A steeply sloped line means **the velocity is large (fast)**.



2. The motion of several objects is depicted on the position vs. time graph. Answer the following questions. Each question may have less than one, one, or more than one answer.

   ___AE___ a. Which object(s) is(are) at rest?

   ___D___ b. Which object(s) is(are) accelerating?

   ___---___ c. Which object(s) is(are) not moving?

   ___---___ d. Which object(s) change(s) its direction?

   ___B___ e. Which object is traveling fastest?

   ___D (on average)___ f. Which moving object is traveling slowest?

   ___D___ g. Which object(s) is(are) moving in the same direction as object B?