Vectors and the Parallelogram Rule W.S.

When vectors A and B are at an angle to each other, they add to produce the resultant C by the parallelogram rule. Note that C is the diagonal of a parallelogram where A and B are adjacent sides. Resultant C is shown in the first two diagrams, **a** and **b**.



**Refer to the following information for the next two questions.**

1. Construct the resultant C in diagrams **c** and **d**. Note that in diagram **d** you form a rectangle (a special case of a parallelogram). After you have finished your constructions, state in the blanks which resultant is the longer and which one is shorter.

c.

d.

# Refer to the following information for the next two questions.

1. **Below we see a top view of an airplane being blown off course by wind in various directions. Use the parallelogram rule to show the resulting speed and direction of travel for each case.**



1. In which case does the airplane travel fastest across the ground?

|  |  |  |  |
| --- | --- | --- | --- |
| a | b | c | d |

1. In which case does the airplane travel slowest across the ground?

|  |  |  |  |
| --- | --- | --- | --- |
| a | b | c | d |

# Refer to the following information for the next three questions.

1. **Below, on the right, we see top views of 3 motorboats crossing a river. All have the same speed relative on the water, and all experience the same flow. Construct resultant vectors showing the speed and direction of the boats.**
2. Which boat takes the shortest path to the opposite shore?

|  |  |  |
| --- | --- | --- |
| a | b | c |

1. Which boat reaches the opposite shore first?

|  |  |  |
| --- | --- | --- |
| a | b | c |

1. Which boat provides the fastest ride?

|  |  |  |
| --- | --- | --- |
| a | b | c |

# Refer to the following information for the next four questions:

1. **Circle the vector (A-H) that best represents the resultant of each pair of vectors. Notice in the “choices table” that the resultant vector is in the row above it’s letter!**

|  |  |
| --- | --- |
| http://dev.physicslab.org/img/cf28314c-41a5-4184-a0c4-828711740288.gif | http://dev.physicslab.org/img/8b833dc7-c76d-46d0-bde1-0a5e367fbf21.gif |
| **A** | **B** |



* 1.



* 1. 

|  |  |
| --- | --- |
| http://dev.physicslab.org/img/c3f4f51c-7436-402f-b409-99bd47f1745f.gif | http://dev.physicslab.org/img/1c0b2825-c74e-4468-89eb-7843b7083cae.gif |
| **C** | **D** |
| http://dev.physicslab.org/img/24eb4d81-493c-42bc-9a83-7ef8cbe7318f.gif | http://dev.physicslab.org/img/54e4dbde-c283-4869-ab61-f84233600528.gif |
| **E** | **F** |
| http://dev.physicslab.org/img/bb62fc6c-b6b5-4f10-a7fc-b8eb39eb77cd.gif | http://dev.physicslab.org/img/a206bddc-18f3-4eaa-9884-0d8deebeb6d7.gif |
| **G** | **H** |

* 1. 
	2.
1. Match the vector (A-H) that best represents the resultant of each pair of

vectors. Remember in the "choices table" that the resultant vector is in the row above its letter!

|  |  |
| --- | --- |
| http://dev.physicslab.org/img/fd228fa6-3183-4b34-8fcf-ae7837e36bcc.gif | http://dev.physicslab.org/img/0b3fd654-78c7-4a32-9a72-3550fd7a7642.gif |
| **A** | **B** |
| http://dev.physicslab.org/img/be1d6069-b450-49c0-80ce-61c128df518d.gif | http://dev.physicslab.org/img/22e823ce-dba5-4368-883a-b5ce2d91572f.gif |
| **C** | **D** |



* 1.



* 1.



* 1.



* 1.

|  |  |
| --- | --- |
| http://dev.physicslab.org/img/f2503e5e-01c0-4f81-a8e1-65325d89e054.gif | http://dev.physicslab.org/img/23aa339d-00c9-4a0c-a870-aab24f92a4b8.gif |
| **E** | **F** |
| http://dev.physicslab.org/img/80b70388-81df-4e8a-aff2-ef4837f263a6.gif | http://dev.physicslab.org/img/8bcceb42-f990-4f8b-a3af-cff7d8cd407d.gif |
| **G** | **H** |

1. Match the vector (1-8) that best represents the components of each vector. Notice in the “choices table” that the components are in the row above their number!

|  |  |
| --- | --- |
| Choice 1 | Choice 5 |
| **1** | **5** |
| Choice 2 | Choice 6 |
| **2** | **6** |
| Choice 3 | Choice 7 |
| **3** | **7** |



1.



1.



1.



|  |  |
| --- | --- |
| Choice 4 | Choice 8 |
| **4** | **8** |

1.
2. Match the vectors (9-16) that best represents the components of each vector. Notice in the “choices table that the components are in the row above their number!

|  |  |
| --- | --- |
| Choice 9 | Choice 13 |
| **9** | **13** |
| Choice 10 | Choice 14 |
| **10** | **14** |
| Choice 11 | Choice 15 |
| **11** | **15** |



* 1.



* 1.



* 1.



* 1.

|  |  |
| --- | --- |
| Choice 12 | Choice 16 |
| **12** | **16** |

# REVIEW NOTES:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **s-t** | **v-t** | **a-t** |
| **instantaneous****position** | y-coordinate of point | - - - | - - - |
| **displacement** | difference in two y- coordinates | area between graph and x-axis | - - - |
| **instantaneous****velocity** | slope of tangent (to the graph) at specified time | y-coordinate of point | - - - |
| **change in velocity** | - - - | difference in two y- coordinates | area between graph and x-axis |
| **instantaneous acceleration** | - - - | slope of graph at specified time | y-coordinate of point |

1. **REVIEW: Refer to the following information for the next nine questions:**

Use the given position-time, velocity-time, and acceleration-time graphs to determine the missing values for position, **P**, and the final velocity, **v**.



1. True or False? The cart in the above graphs is traveling in a positive direction.

|  |  |
| --- | --- |
| True | False |

1. True or False? the cart is experiencing a constant positive acceleration.

|  |  |
| --- | --- |
| True | False |

1. What is the cart's initial speed?
2. What is the cart's initial position?
3. How much did the cart's velocity change from 2 to 14 seconds?
4. What is the cart's final velocity at 14 seconds?
5. How fast was the cart traveling at 8 seconds?
6. How far did the cart travel between 2 and 14 seconds?
7. What is the cart's final position at 14 seconds?

# REVIEW: Refer to the following information for the next seven questions:

Use the given position-time, velocity-time, and acceleration-time graphs to determine the missing values for position, **P**, and the final velocity, **v**.



* 1. True or False? The cart in the above graphs is traveling in a positive direction.

|  |  |
| --- | --- |
| True | False |

* 1. True or False? The cart is experiencing a constant positive acceleration.

|  |  |
| --- | --- |
| True | False |

* 1. What is the cart's acceleration?

d.What is the change in the cart's velocity?

e. True or False? The chart is losing speed.

|  |  |
| --- | --- |
| True | False |

f. What is the total distance that the cart traveled?

What is the value of P?

# REVIEW: Refer to the following information for the next six questions:

Use the given position-time, velocity-time, and acceleration-time graphs to determine the missing values for position, **P**, and the final velocity, **v**.



* 1. True or False? The cart in the above graphs in traveling in a positive direction.

|  |  |
| --- | --- |
| True | False |

* 1. True or False? The cart is experiencing a constant positive acceleration.

|  |  |
| --- | --- |
| True | False |

* 1. What is the cart's displacement?
	2. Write an expression for the displacement using the areas under the v-t graph.
	3. What is the value of the cart's initial velocity, v?
	4. What is the cart's acceleration?

# REVIEW: Refer to the following information for the next three problems:

Use the given position-time, velocity-time, and acceleration-time graphs to determine the missing values for position, **P**, and the acceleration, **a**.



* 1. P =
	2. ∆v =
	3. a =



**12. REVIEW: Refer to the following information for the next three problems.**

Use the given position-time, velocity-time, and acceleration-time graphs to determine the missing values for position, **P**, and the acceleration, **a**.

a.

P =

b. Δv =

c. a =

**13. REVIEW: Refer to the following information for the next three problems.**

Use the given position-time, velocity-time, and acceleration-time graphs to determine the missing values for position, **P**, and the acceleration, **a**.



1. P =
2. Δv =
3. a =

**14. REVIEW: Refer to the following information for the next three problems.**

Use the given position-time, velocity-time, and acceleration-time graphs to determine the missing values for position, **P**, and the acceleration, **a**.



* 1. P =
	2. Δv =
	3. a =