Two Dimensional Vectors Review

Physics 621

1. Explain the following terms:

<table>
<thead>
<tr>
<th>Resultant</th>
<th>Equilibrium</th>
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<tr>
<td>Components</td>
<td>Equilibrium force</td>
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<tr>
<td>Vector resolution</td>
<td>Rumpelstiltskin</td>
</tr>
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</table>

2. Explain the difference between:

- Resultant vector / Equilibrium vector
- Perpendicular force / Parallel force
- Graphical method / Analytical method

3. Bill and Bob are pushing on a pig. Bill pushes with a force of 400 N and Bob pushes with force of 300 N.
   a) What is the maximum possible resulting force? Explain.
   b) What is the minimum possible resulting force? Explain.
   c) Explain how it would be possible to have a resulting force of 600N.

4. Two unequal forces are exerted on, surprise, a square box.
   a) Could the net force ever be zero? Explain.
   b) What if 3 unequal forces were exerted?
   c) Support your argument for both cases with a diagram.

5. Could you ever have a resultant vector
   a) shorter than one of its components? Explain.
   b) equal to one of its component? Explain.

6. You are piloting a boat that cross as a fast moving river. You want to reach the pier directly across from your starting point. Describe how you would select your heading in terms of the components of your velocity.

7. What is meant about the forces acting on a farm animal of your choice if we stay that the animal is in a state of equilibrium? How can the equilibrant of two or more forces be found? Can an object in equilibrium be moving? Explain.

8. What is the sum of three vectors that form a triangle? Assuming that the vectors are forces, what does this imply about the objects on which the forces act?

9. Two vectors are originally parallel. How does the resultant change as the angle between the forces increases to 180°?

10. The weight of a book sliding down a frictionless incline plane can be broken into vector components: one acting parallel to the plane, and the other acting perpendicular to the plane.
   a) At what angle are these components equal? Draw a FBD.
   b) At what angle is the component parallel to the plane equal to zero? Draw a FBD.
   c) At what angle is the component parallel to the plane equal to the weight? Draw a FBD.

11. Draw a vector diagram to solve this problem.
After walking 14 km due North from his tower, a forest ranger then walks 9.0 km due East.
   a) What is the total distance walked by the ranger? [23 km]
   b) Determine the total displacement from the starting point? [17 km @55°]

12. Draw a vector diagram to solve this problem.
Ian pushes a crate with a force of 197 N at 0°. Jesse exerts a force of 135 N at 25°, while Sarah pushes with 190 N at 285°. What is the resultant force on the crate? [388 N @ -18°]

13. Two forces act on an object, one is 120 N vertically and the other is 65 N horizontally.
   a) What is the magnitude and direction of the resultant force? [140 N @ 62°]
   b) What would be the equilibrant force that would keep the object at rest? [140 N @ 242°]
14. A motorboat travels at 9.9 m/s. It heads straight across a river 120 m wide.
   a) If the water flows downstream at a rate of 4.3 m/s, what is the boat’s resultant velocity? [11 m/s @ -24°]
   b) How long does it take the boat to reach the opposite shore? [12 s]

15. Three people are using ropes to pull on a telephone pole. The first person pulls with 20 N at 60°, the second with 14 N at 125°, the third with 9 N at 200°. What is the magnitude and direction of the resultant force on the pole? [30 N @ 100°]

16. A 900 N box is placed on an inclined plane that forms a 70.0° angle with the horizontal.
   a) Calculate the value of the parallel force. [846 N]
   b) Calculate the value of the perpendicular force. [308 N]

17. Two forces act on an object. A 36 N force acts at 230° and a 75 N force at 40°.
   a) Determine the resultant force. [40 N @ 31°]
   b) Determine the force that would produce equilibrium. [40 N @ 211°]

18. A heavy box is pulled across a wooden floor with a rope. The rope makes an angle of 60° with the floor. A force of 75 N is exerted on the rope. What is the component of the force parallel to the floor? [38 N]

19. A boat heads directly across a river 41 m wide at 3.8 m/s. The current is flowing downstream at 2.2 m/s.
   a) What is the resultant velocity of the boat? [4.4 m/s @ -30°]
   b) How much time does it take the boat to cross the river? [11 s]
   c) How far downstream is the boat when it reaches the other side? [24 m downstream]

20. Draw a vector diagram to solve the following: An explorer walks 13 km due east, then 18 km north, and finally 3.0 km west.
   a) What is the total distance walked? [34 km]
   b) What is the displacement from the starting point? [21 km @ 60°]

21. Three teenagers push a heavy crate across the floor. One pushes with a force of 190 N at the horizontal. The second exerts 170 N at 30° and the last pushes with 200 N at 295°. What is the resultant force on the crate? [430 N @ 350°]

22. An airplane flying toward the horizontal at 300 km/h is being blown toward 90° at 65 km/h. What is the resultant velocity of the plane? [310 km/hr @ 12°]

23. Three people are pulling on a tree. The first person pulls with 15 N at 65°; the second with 15 N at 140°; the third with 10 N at 200°. What is the magnitude and direction of the resultant force? [25 N @ 130°]

24. Two forces act on an object. One force is 8.0 N horizontally. The second force is 10 N vertically.
   a) Find the magnitude and direction of the resultant. [13 N @ 51°]
   b) Find the force that produces equilibrium. [13 N @ 231°]

25. A crate weighing 600 N is resting on a plane inclined at 49° from the horizontal.
   a) Find the components of the weight parallel to the plane. [450 N]
   b) Find the components of the weight perpendicular to the plane. [390 N]