Solutions

socrative by MasteryConnect

AP Physics 1 - Test 03 - Vectors and Relative Motion Score:

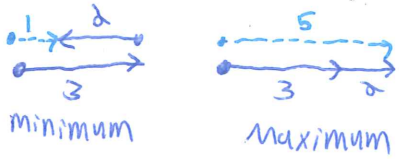
1. When adding two vectors, the magnitude of the resultant vector must always be

(A) zero

(B) between the difference and sum of the two magnitudes

(C) the sum of the two magnitudes of each vector

(D) the hypotenuse of the two vectors



2. Which of the following is a physical quantity that has a magnitude but no direction

(A) Vector

(B) Frame of Reference

(C) Resultant

(D) Scalar

3. Which of the following is an example of a vector quantity?

(A) Temperature

(B) Velocity

(C) Volume

(D) Mass

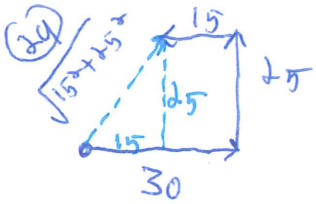
4. An ant on a picnic tables travels 30 cm east, 25 cm north, then 15 cm west. What is the magnitude of the ant's displacement relative to its original position? (Drawing the picture helps)

(A) 29 cm

(B) 70 cm

(C) 57 cm

(D) 52 cm



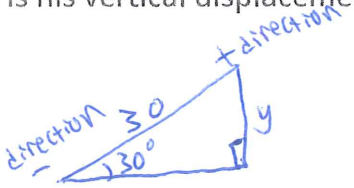
5. Michael runs up a hill that is 30 m long at an elevation of 30° above the horizontal. What is his vertical displacement?

(A) 30 m

(B) 26 m

(C) 15 m

(D) 0 m



$\sin(30) = \frac{y}{30}$

$y = 30\sin(30) = 15$

6. Michael then decides to slide down the hill (with negligible friction). What is the magnitude of his acceleration?

(A) 20 m/s^2

(B) 10 m/s^2

(C) 5 m/s^2

(D) 0 m/s^2

$\Delta x = -30$ m

$a = -g\sin 30 = -5$ m/s^2

$V_i = 0$

7. Assuming Michael started from rest, how long will it take for him to reach the bottom of the hill again?

(A) 10.0 s

(B) 5.00 s

(C) 3.46 s

(D) 2.45 s

$t = ?$

$\Delta x = \cancel{V_i t}^{0} + \frac{1}{2}at^2$

$-30 = \frac{1}{2}(-5)t^2$

$t = \sqrt{\frac{2(-30)}{-5}} = \boxed{3.46 \text{ seconds}}$

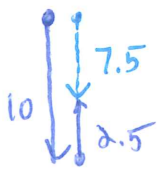
8. For the winter, a duck flies 10.0 m/s south against a gust of wind with a speed of 2.5 m/s. What is the resultant velocity of the duck?

(A) 7.5 south

(B) 7.5 north

(C) 12.5 south

(D) 12.5 north



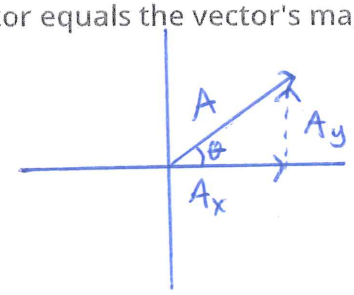
9. In a coordinate system, a vector is oriented at an angle with respect to the *x*-axis. The *x* component of the vector equals the vector's magnitude multiplied by which trigonometric function?

(A) Tangent of angle

(B) Cosine of angle

(C) Cotangent of angle

(D) Sine of angle



A_x is adjacent to θ, so we use $\cos\theta = \frac{A_x}{A}$.

$\Rightarrow A_x = A \cdot \cos\theta$

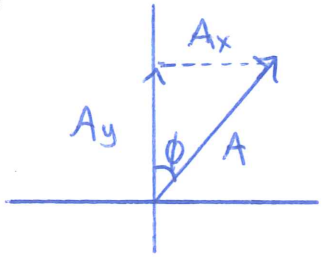
10. In a coordinate system, a vector is oriented at an angle with respect to the *y*-axis. The *y* component of the vector equals the vector's magnitude multiplied by which trigonometric function?

(A) Tangent of angle

(B) Cosine of angle

(C) Cotangent of angle

(D) Sine of angle



A_y is adjacent to ϕ, so we use $\cos\phi = \frac{A_y}{A}$

$\Rightarrow A_y = A \cdot \cos\phi$

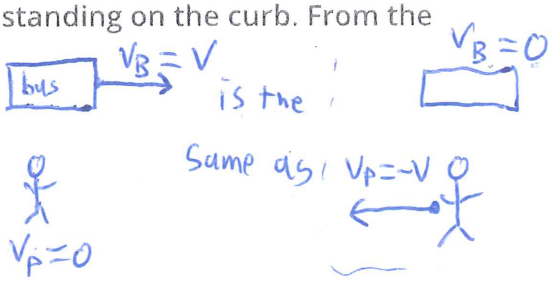
11. A passenger on a bus moving east sees a man standing on the curb. From the passengers perspective, the man appears to

(A) Move west at a speed that is equal to the bus's speed.

(B) Move west at a speed that is less than the bus's speed.

(C) Stand still.

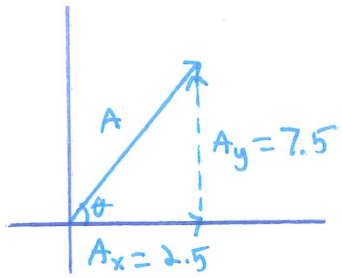
(D) Move east at a speed that is equal to the bus's speed.



is the same as

12. A vector is given by its components, $A_x = 2.5$ and $A_y = 7.5$. What angle does vector A make with the positive x-axis.

- (A) 72°
- (B) 18°
- (C) 25°
- (D) 50°
- (E) 75°



$\theta = \tan^{-1}\left(\frac{\text{Opposite}}{\text{Adjacent}}\right) = \tan^{-1}\left(\frac{7.5}{2.5}\right)$

$\theta = 72°$

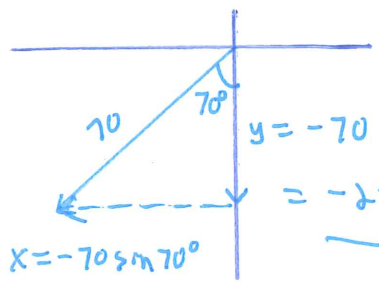
13. Which pair of vectors could produce a resultant that has a magnitude of 35?

- (A) 15 and 15 — 0 – 30 range
- (B) 20 and 20 — 0 – 40 range
- (C) 30 and 70 — 40 – 100 range
- (D) 20 and 60 — 40 – 80 range
- (E) 20 and 70 — 50 – 90 range

From Question 1, the minimum is the difference between the vector magnitudes and the maximum is the sum of the two magnitudes.

14. A boat travels at 70 km/hr at 70° West of South. What are the Western and Southern components?

- (A) West: 65.8 km/hr, South: 23.9 km/hr
- (B) West: 23.9 km/hr, South: 65.8 km/hr
- (C) West: 70 km/hr, South: 70 km/hr
- (D) West: 192.3 km/hr, South: 0 km/hr



$y = -70 \cos 70$

$= -23.9$

$x = -70 \sin 70°$

$= -65.8$

15. If Vector A - B is positive, then A must be positive and B must be negative

- (A) True
- (B) False

example $A = 3$, $B = -3$ $\quad A - B = 3 - (-3) = 6$

Still positive

but if $A = 3$, $B = 2$: $A - B = 3 - 2 = 1$

16. If Vector A + B is positive, then A and B must both be positive

- (A) True
- (B) False

example: $A = 3$, $B = -2$ $\quad A + B = 3 + (-2) = 1$

17. A vector which points in the Southwest direction is considered a negative vector.

- (A) True
- (B) False

Direction of diagonal vectors are considered as angles rather than "−" or "+"

18. A car travels up a ramp at an angle of 30° with a speed of 10 m/s before the engine dies. The car travels up the ramp and then back down. How long will it take the car to return to the spot in which the engine died?

$v_i = 10$

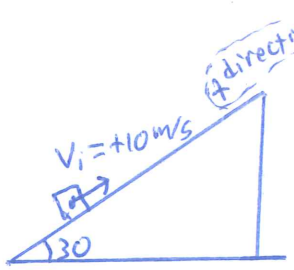
$\Delta x = 0$

(A) 1 second

(B) 2 seconds

(C) 4 seconds

(D) 8 seconds



"a" goes down the ramp, which is "−" direction.

$a = -g\sin 30 = -5$ m/s²

$v_i = 10$ m/s

$\Delta x = 0$

$t = ?$

$\Delta x = v_i t + \frac{1}{2}at^2$

$0 = v_i t + \frac{1}{2}at^2$

$0 = t(v_i + \frac{1}{2}at)$

$0 = v_i + \frac{1}{2}at$

$t = \frac{-2v_i}{a}$

$= \frac{-2(10)}{-5}$

$t = 4$

19. A car enters an icy intersection traveling 16 m/s due north. After a collision with a truck, the car slides away moving 12 m/s east. In which general direction will the change in velocity and acceleration face?

(A) Nowhere

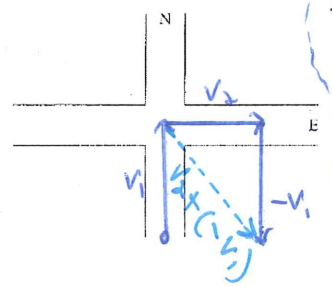
(B) East

(C) South

(D) South and East

$\vec{a} = \frac{\Delta \vec{v}}{t} = \frac{\vec{v}_2 - \vec{v}_1}{t}$

a must be in the same direction as $\vec{v}_2 - \vec{v}_1$, so find direction of $\vec{v}_2 + (-\vec{v}_1)$



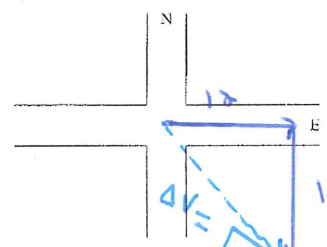
20. A car enters an icy intersection traveling 16 m/s due north. After a collision with a truck, the car slides away moving 12 m/s east. What is the value of the change in velocity (not just magnitude)?

(A) 4 m/s

(B) 10 m/s

(C) 20 m/s

(D) 28 m/s



$\Delta v = \sqrt{12^2 + 16^2} = 20$ m/s

21. A car enters an icy intersection traveling 16 m/s due north. After a collision with a truck, the car slides away moving 12 m/s east. If the collision lasted for 0.05 seconds, what would be the magnitude of the average acceleration during the collision?

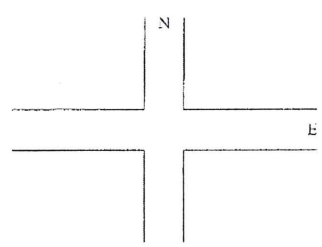
(A) 1 m/s²

(B) 10 m/s²

(C) 200 m/s²

(D) 400 m/s²

$a = \frac{\Delta v}{t} = \frac{20}{0.05} = 400$ m/s²



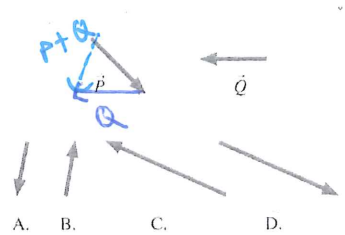
22. Given the vectors P and Q, what is P + Q?

(A) A

(B) B

(C) C

(D) D



23. Given the vectors P and Q, what is P - Q?

(A) A

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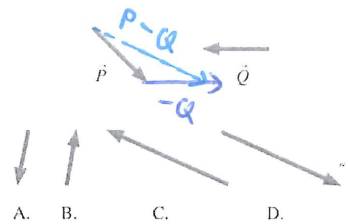
(C) C

(D) D



24. Given the vectors P and Q, what is Q + P?

(A) A

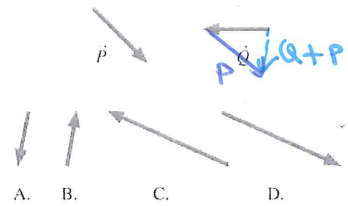
(B) B

(C) C

(D) D

Addition is Commutative so

P+Q = Q+P



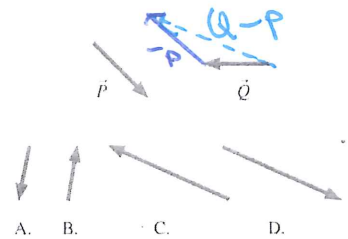
25. Given the vectors P and Q, what is Q - P?

(A) A

(B) B

(C) C

(D) D



26. A particle undergoes acceleration *a* while moving from point 1 to point 2. Which of the choices shows the velocity vector v_2 as the object moves away from point 2?

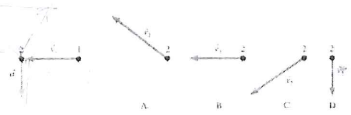
(A) A

(B) B

(C) C

(D) D

The acceleration did not affect x-directional motion, however it added a downward velocity. so the velocity needs to be down and left



27. The diagram shows three points of a motion diagram. The particle changes direction with no change of speed. What is the acceleration at point 2?

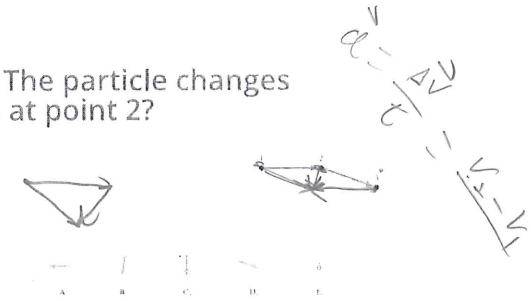
(A) A

(B) B

(C) C

(D) D

(E) E



28. What are the x- and y-components of this vector?

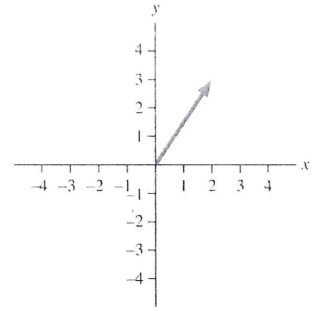
(A) 3, 2

(B) 2, 3

(C) -3, 2

(D) 2, -3

(E) -3, -2



29. What are the x- and y-components of vector C?

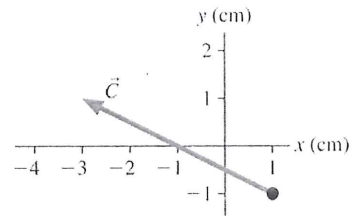
(A) 1, -3

(B) -3, 1

(C) 1, -1

(D) -4, 2

(E) 2, -4



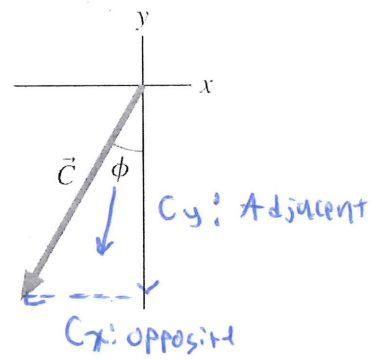
30. The angle Φ that specifies the direction of vector C is

(A) $\tan^{-1}(C_x/C_y)$

(B) $\tan^{-1}(C_y/C_x)$

$\theta = \tan^{-1}\left(\frac{\text{opposite}}{\text{Adjacent}}\right)$

$= \tan^{-1}\left(\frac{C_x}{C_y}\right)$



31. A ball rolls up the ramp, then back down. Which is the correct acceleration graph?

(A) A

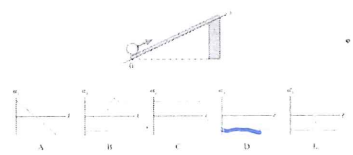
(B) B

(C) C

(D) D

(E) E

Still a constant negative acceleration of g sin θ



32. Bill wants to swim directly across a river. However, the river has a current. What will he need to do in order to assure that he will end directly across his starting point?

(A) Aim himself directly across the river

(B) Aim himself partly across the river and partly with the current

(C) Aim himself partly across the river and partly against the current

(D) Aim himself directly with the current

(E) Aim himself directly against the current

33. Billy and Sally are Trick or Treating and see a house across a river. Unfortunately, the house only has 1 piece of candy left, so they must race to the house. They swim across a river with a width of 500 m and a current of 3 m/s east. Both Bill and Sally can swim at a rate of 4 m/s and run at a rate of 6 m/s. Billy Aims himself directly across the river, while sally aims herself partly against the current to assure that she will get to the house in a more direct path.

- What is the magnitude of Billy's velocity relative to the Earth?

(A) 2.65 m/s

(B) 4.00 m/s

(C) 5.00 m/s

(D) 6.00 m/s

34. Billy and Sally are Trick or Treating and see a house across a river. Unfortunately, the house only has 1 piece of candy left, so they must race to the house. They swim across a river with a width of 500 m and a current of 3 m/s east. Both Bill and Sally can swim at a rate of 4 m/s and run at a rate of 6 m/s. Billy Aims himself directly across the river, while sally aims herself partly against the current to assure that she will get to the house in a more direct path.

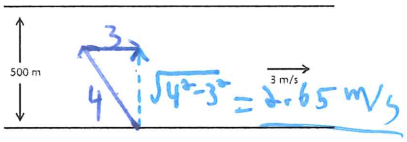
- What is the magnitude of Sally's velocity relative to the Earth?

(A) 2.65 m/s

(B) 4.00 m/s

(C) 5.00 m/s

(D) 6.00 m/s



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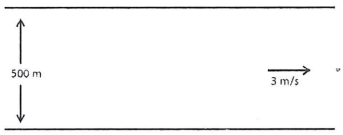
- Who will reach the other side of the river first (NOT the same as asking "Who reaches the house first?")?

(A) Billy

(B) Sally

Billy has a velocity of 4 m/s directly across the river while Sally has a velocity of 2.65 m/s directly across the river



36. Billy and Sally are Trick or Treating and see a house across a river. Unfortunately, the house only has 1 piece of candy left, so they must race to the house. They swim across a river with a width of 500 m and a current of 3 m/s east. Both Bill and Sally can swim at a rate of 4 m/s and run at a rate of 6 m/s. Billy Aims himself directly across the river, while sally aims herself partly against the current to assure that she will get to the house in a more direct path.

- How long will it take Billy to reach the other side of the river?

(A) 189 seconds

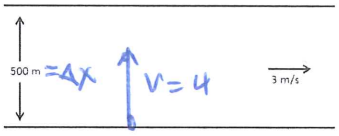
(B) 125 seconds

(C) 100 seconds

(D) 83.3 seconds

$V = \frac{\Delta x}{t}$

$t = \frac{\Delta x}{V} = \frac{500}{4} = 125$



37. Billy and Sally are Trick or Treating and see a house across a river. Unfortunately, the house only has 1 piece of candy left, so they must race to the house. They swim across a river with a width of 500 m and a current of 3 m/s east. Both Bill and Sally can swim at a rate of 4 m/s and run at a rate of 6 m/s. Billy Aims himself directly across the river, while sally aims herself partly against the current to assure that she will get to the house in a more direct path.
How long will it take Sally to reach the other side of the river?

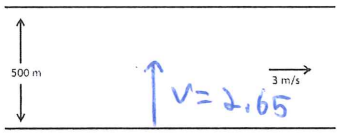
(A) 189 seconds

(B) 125 seconds

(C) 100 seconds

(D) 83.3 seconds

$t = \frac{\Delta x}{V} = \frac{500}{2.65} = 189$



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Billy will be slightly off course of the house by the time he gets to the other side of the river. How far away from the house will he be?

(A) 945 m

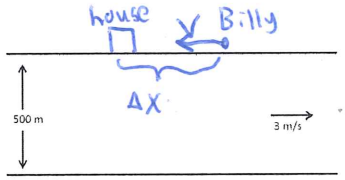
(B) 625 m

(C) 567 m

(D) 375 m

The river is what displaced Billy, so use the velocity of the river! Billy's time

$V = \frac{\Delta x}{t} \Rightarrow \Delta x = V \cdot t = (3)(125) = 375\ m$



39. Billy and Sally are Trick or Treating and see a house across a river. Unfortunately, the house only has 1 piece of candy left, so they must race to the house. They swim across a river with a width of 500 m and a current of 3 m/s east. Both Bill and Sally can swim at a rate of 4 m/s and run at a rate of 6 m/s. Billy Aims himself directly across the river, while sally aims herself partly against the current to assure that she will get to the house in a more direct path.
How long will it take Billy to run to the house after crossing the river?

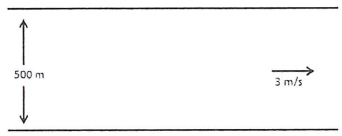
(A) 157.5 seconds

(B) 104.2 seconds

(C) 94.5 seconds

(D) 62.5 sconds

$V = \frac{\Delta x}{t}$



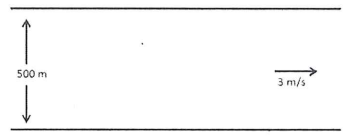
$t = \frac{\Delta x}{V} = \frac{375}{6} = 62.5$

40. Billy and Sally are Trick or Treating and see a house across a river. Unfortunately, the house only has 1 piece of candy left, so they must race to the house. They swim across a river with a width of 500 m and a current of 3 m/s east. Both Bill and Sally can swim at a rate of 4 m/s and run at a rate of 6 m/s. Billy Aims himself directly across the river, while sally aims herself partly against the current to assure that she will get to the house in a more direct path.

• Who will make it to the house first for the piece of candy?

(A) Billy

(B) Sally



Billy's total time = time to swim + time to run

= 125 + 62.5 = 187.5 seconds

Sally's time = time to swim

= 189 seconds

Billy gets there first and reaps his reward.

Sally is a sucker...