PHYS 105 · Chapter 3: Vectors

Past-Exam Review — questions from PSU past midterm (Major 1) and final exams

Constant: g = 9.81 m/s^2 · The source of each question is shown in [brackets].

Part 1: Multiple-Choice Questions (30)

Indicate the answer choice that best completes the statement or answers the question.

3.1 Vectors and their Components

Q1. *The negative of a vector is represented by an arrow of the _____ length as the original vector, pointing in the _____ direction:* **[Midterm 202]**

A *doubled, opposite*
B *doubled, same*
C *same, opposite*
D *same, same*

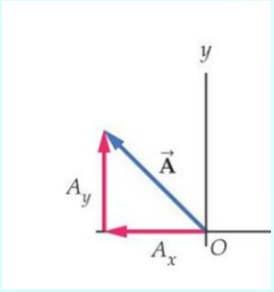
Q2. *A vector in the xy-plane has components of opposite sign. In which quadrant does it lie?* **[Midterm 251]**

A *The fourth quadrant (IV) only*
B *The second quadrant (II) only*
C *The third quadrant (III) only*
D *Either the second (II) or the fourth (IV)*

Q3. *Vector A has components $A_x < 0$ and $A_y < 0$. What is the range of its direction angle?* **[Midterm 202]**

A *180° to 270°*
B *90° to 180°*
C *0° to 90°*
D *270° to 360°*

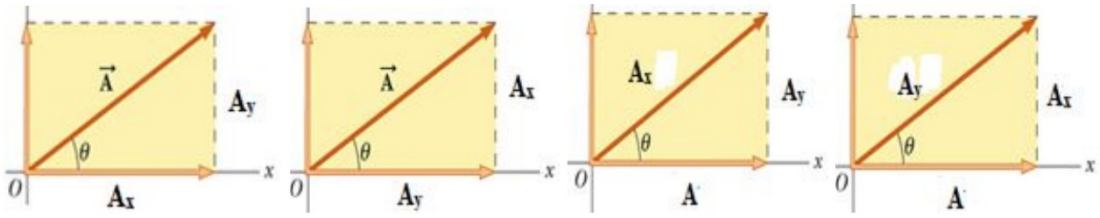
Q4. *What are the signs of the components of the vector shown in the figure?* **[Final 222]**



A $A_x < 0, A_y < 0$
B $A_x > 0, A_y < 0$
C $A_x > 0, A_y > 0$
D $A_x < 0, A_y > 0$

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Q5. *Which of the following pictures correctly shows the components of vector A?* [Midterm 202]



a) b) c) d)

A *Picture (a)*
B *Picture (b)*
C *Picture (c)*
D *Picture (d)*

Q6. *Vector A has a length of 6.1 m and points in the negative x direction. Vector A is:* [Midterm 232]

A $\vec{A} = (0\,m)\,x$
B $\vec{A} = (-6.1\,m)\,x$
C $\vec{A} = (6.1\,m)\,x$
D $\vec{A} = (-6.1\,m)\,\hat{y}$

Q7. *Vector A has a magnitude of 5 m and is directed 30° below the positive x-axis. Which of the following represents the vector?* [Midterm 201]

A $4.3\,\hat{x} - 2.5\,\hat{y}$
B $-4.3\,\hat{x} + 2.5\,\hat{y}$
C $2.5\,\hat{x} - 4.3\,\hat{y}$
D $-2.5\,\hat{x} + 4.3\,\hat{y}$

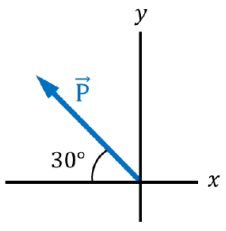
Q8. *A superhero flies down from the top of a tall building at 30° below the horizontal. Find the horizontal and vertical components (A_x, A_y) of his 100 m displacement.* [Final 221]

A $A_x = +86.6$ m, $A_y = +50$ m
B $A_x = +50$ m, $A_y = -86.6$ m
C $A_x = +86.6$ m, $A_y = -50$ m
D $A_x = +58$ m, $A_y = -68$ m

Q9. *A velocity vector of magnitude 20.0 m/s makes an angle of 60° with the negative x-axis (above it). What is the vector?* [Midterm 252]

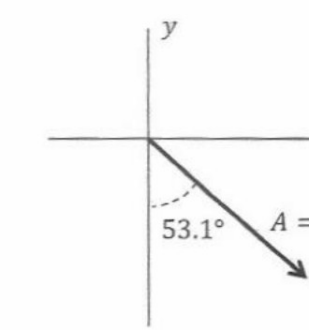
A $(-10.0\,m/s)\,\hat{x} + (17.3\,m/s)\,\hat{y}$
B $(17.3\,m/s)\,\hat{x} + (-10.0\,m/s)\,\hat{y}$
C $(-15.0\,m/s)\,\hat{x} + (15.0\,m/s)\,\hat{y}$
D $(0\,m/s)\,\hat{x} + (20.0\,m/s)\,\hat{y}$

Q10. *The vector P in the figure has a magnitude of 50. Which of the following is equal to P?* [Midterm 241]



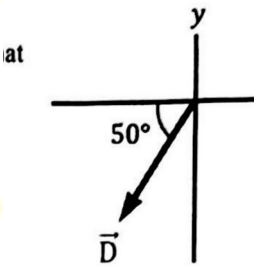
A $43.3\,\hat{x} + 25\,\hat{y}$
B $-43.3\,\hat{x} + 25\,\hat{y}$
C $-25\,\hat{x} + 43.3\,\hat{y}$
D $25\,\hat{x} - 43.3\,\hat{y}$

Q11. *Which of the following describes the vector shown in the figure?* **[Midterm 233]**



A $4.8\,\hat{x} - 6.4\,\hat{y}$
B $6.4\,\hat{x} - 4.8\,\hat{y}$
C $-4.8\,\hat{x} + 6.4\,\hat{y}$
D $-6.4\,\hat{x} + 4.8\,\hat{y}$

Q12. *Which of the following represents vector D in the figure, given that its magnitude is 15 m?* **[Midterm 243]**



A $(11.5\,m)\,\hat{x} - (9.6\,m)\,\hat{y}$
B $(-11.5\,m)\,\hat{x} - (9.6\,m)\,\hat{y}$
C $(-9.6\,m)\,\hat{x} + (11.5\,m)\,\hat{y}$
D $(-9.6\,m)\,\hat{x} - (11.5\,m)\,\hat{y}$

Q13. *What is the direction angle of the vector $r = -3\hat{x} + 4\hat{y}$?* **[Final 182]**

A *53.1°*
B *143.1°*
C *306.9°*
D *126.9°*

Q14. *What is the direction angle of the vector $A = -3\hat{x} - 6\hat{y}$?* **[Midterm 233]**

A *116.6°*
B *206.6°*
C *296.6°*
D *243.4°*

Q15. *What is the direction angle of the vector $A = 10\hat{x} - 4\hat{y}$?* **[Midterm 243]**

A *338.2°*
B *248.2°*
C *291.8°*
D *158.2°*

Q16. *A student's velocity is $v = (4.0\ m/s)\hat{x} + (-2.0\ m/s)\hat{y}$. Determine the magnitude and direction of the velocity.* **[Final 242]**

A *2.5 m/s, −27°*
B *3.0 m/s, 63°*
C *4.5 m/s, −27°*
D *5.3 m/s, 27°*

Q17. *Find the speed and direction of motion of a rainbow trout whose velocity is v = (3.7 m/s)x̂ + (−1.3 m/s)ŷ.* **[Final 232]**

A *15.38 m/s, θ = −70.6°*
C *2.24 m/s, θ = −6°*
B *3.92 m/s, θ = −19.36°*
D *2.4 m/s, θ = 1°*

3.2 Unit Vectors and Adding Vectors by Components

Q18. *A dimensionless vector with a magnitude of one that points in the positive y direction is:* **[Midterm 202]**

A *x̂*
C *ẑ*
B *ŷ*
D *None of the above*

Q19. *Starting from the origin, you travel 5 m in the negative x direction and 8 m in the positive y direction. What is the magnitude of your displacement?* **[Midterm 233]**

A *3 m*
C *13 m*
B *6.2 m*
D *9.4 m*

Q20. *Two position vectors are $r_1 = (3\hat{x} + 4\hat{y})$ m and $r_2 = (6\hat{x} + 8\hat{y})$ m. What is the magnitude of the displacement $\Delta r = r_2 - r_1$?* **[Midterm 251]**

A *15 m*
C *2 m*
B *10 m*
D *5 m*

Q21. *An object moves from the point $r_i = (-5\text{ m})\hat{x} + (14\text{ m})\hat{y}$ to the point $r_f = (25\text{ m})\hat{x} + (-4\text{ m})\hat{y}$. Its displacement Δr is:* **[Final 231]**

A $(-20\,m)\hat{x} + (10\,m)\hat{y}$
C $(-1\,m)\hat{x} + (21\,m)\hat{y}$
B $(30\,m)\hat{x} + (-18\,m)\hat{y}$
D $(-9\,m)\hat{x} + (39\,m)\hat{y}$

Q22. *Given $A = -2\hat{x} + \hat{y}$ and $B = -3\hat{x} + 3\hat{y}$, what is the direction angle of A − B?* **[Midterm 201]**

A *206.6°*
C *116.6°*
B *26.6°*
D *296.6°*

3.3 Multiplying Vectors

Q23. *Two vectors are given as $A = 5\hat{x} + 12\hat{y}$ and $B = -4\hat{x} + 3\hat{y}$. What is the magnitude of $C = 3A - 2B$?* **[Final 211]**

A *30.8*
C *47.8*
B *53*
D *37.8*

Q24. *Multiplying a vector by −6 results in:* **[Midterm 242]**

A *A magnitude 6 times larger and a reversed direction*
B *A magnitude 6 times smaller and a reversed direction*
C *A magnitude 6 times larger and the same direction*
D *A direction angle 6 times larger*

Q25. *If you multiply the vector $A = -3\hat{x} + 4\hat{y}$ by −4, what will be its x-component?* **[Midterm 241]**

A *12*
B *−3*
C *−4*
D *0*

Q26. *What is the magnitude of the vector $C = -2B$, where $B = 3\hat{x} - 4\hat{y}$?* **[Midterm 243]**

A *10*
B *7*
C *14*
D *5*

Q27. *$A(B + C)$ is equal to:* **[Midterm 202]**

A *$AB + AC$*
B *$BA + AC$*
C *$BA + CA$*
D *All of the above*

Q28. *Vector A has a magnitude of 8.00 m and vector B has a magnitude of 7.00 m. If $AB = 14.0$, what is the angle between them?* **[Midterm 252]**

A *56.0°*
B *75.5°*
C *14.0°*
D *15.0°*

Q29. *When the vector G is multiplied by the vector H to give $G \times H$, the result is:* **[Midterm 232]**

A *a scalar quantity*
B *a vector quantity*
C *always equal to zero*
D *always equal to one*

Q30. *Which of the following is correct about the result of the cross product of two vectors?* **[Midterm 202]**

A *It is a scalar, directed perpendicular to both vectors*
B *It is a vector, directed perpendicular to both vectors*
C *It is a scalar quantity with no direction*
D *None of the above*

Part 2: Problems (3)

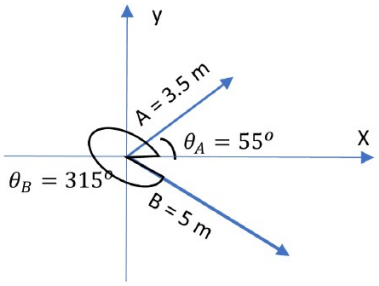
Solve the following problems and show your work in detail.

Problem 1. *A jogger runs at a constant speed of 3.25 m/s in a direction 30° above the x-axis for 3 minutes.* [Midterm 202]

a) *Find the vertical displacement of the jogger.*

b) *Find the horizontal displacement of the jogger.*

Problem 2. *Refer to vectors A and B in the figure (A = 3.5 m at $\theta_A = 55°$, B = 5 m at $\theta_B = 315°$).* [Midterm 202]

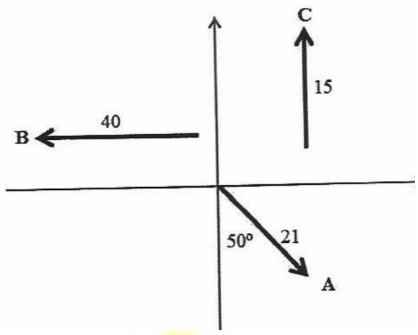


a) *Find the x and y components of A and B.*

b) *Find the magnitude and direction of C = A − B.*

c) *Is A − B = B − A in magnitude and direction? Explain.*

Problem 3. *If D = A + 2B − C, where A, B and C are the three vectors in the graph (A = 21 at 50° from the −y axis, B = 40 along −x, C = 15 along +y), use the algebraic (component) method to find the magnitude and direction of D.* **[Midterm 211]**



a) *Write each vector in components.*

b) *Find the magnitude and direction of D.*

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