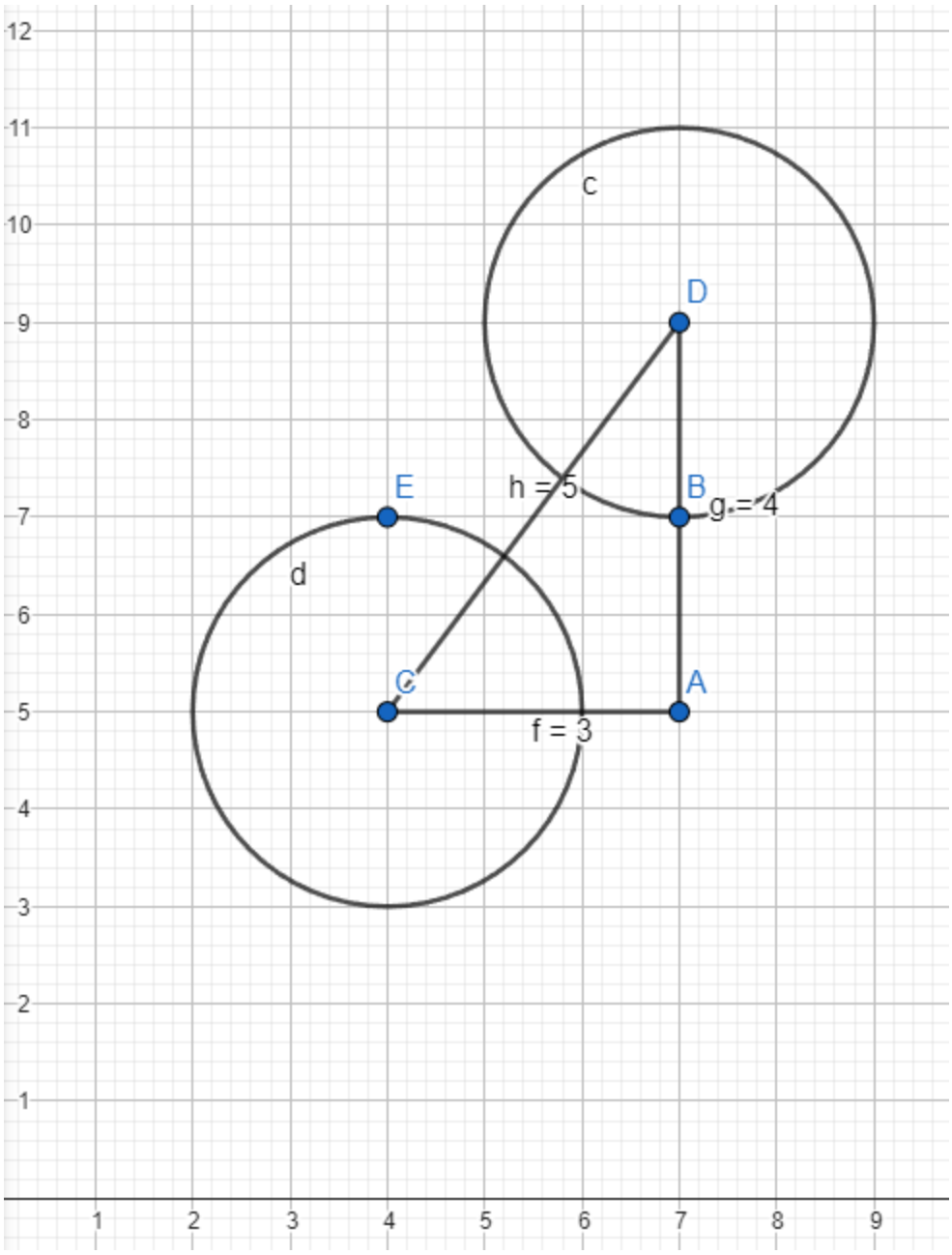
Vector Math Assignment

Vector Math Assignment
Module 1 – A01
Game Development Vector Calculations

1. A game character needs to move from point A to point B on a 2D surface. [2 point]
    a. Pick component values for point A and point B.
        i. Point A will be x = 2, y = 4 (2,4)
        ii. Point B will be x = 8, y = 9 (8,9)
    b. What is the vector $\vec{m}$ representing the required movement?
        i. m = 8,9 - 2,4
        ii. m = 6, 5
2. Imagine two circular objects in a 2D game with their centres located point C = (4, 5) and point D = (7,9). [4 points]
    a. How far apart are points C and D? (Provide a scalar answer.)
        i. c = 4x, 5y d = 7x, 9y
        ii. sides = 3x, 4y
        iii. 3^2 + 4^2 = sqrt(25)
        iv. distance = 5
    b. If both objects have a radius of 2, are the objects touching/overlapping?
        i. No since the distance is 5 and they will have gap of 1 between as they are both 2 in radius



3. A projectile is fired with an initial velocity vector v . Gravity adds a vector g = (0, −9.8) each second. For simplicity, please assume that the projectile remains in the air for at least two seconds. You should also ignore the effect of drag (air resistance) on the projectile. [6 points]

   a. Pick positive component values for the initial velocity vector v . Each component should be between 10 and 20.

i. (15, 20)

b. After two seconds, what is the total effect of gravity on the projectile?

i. 19.6m/s

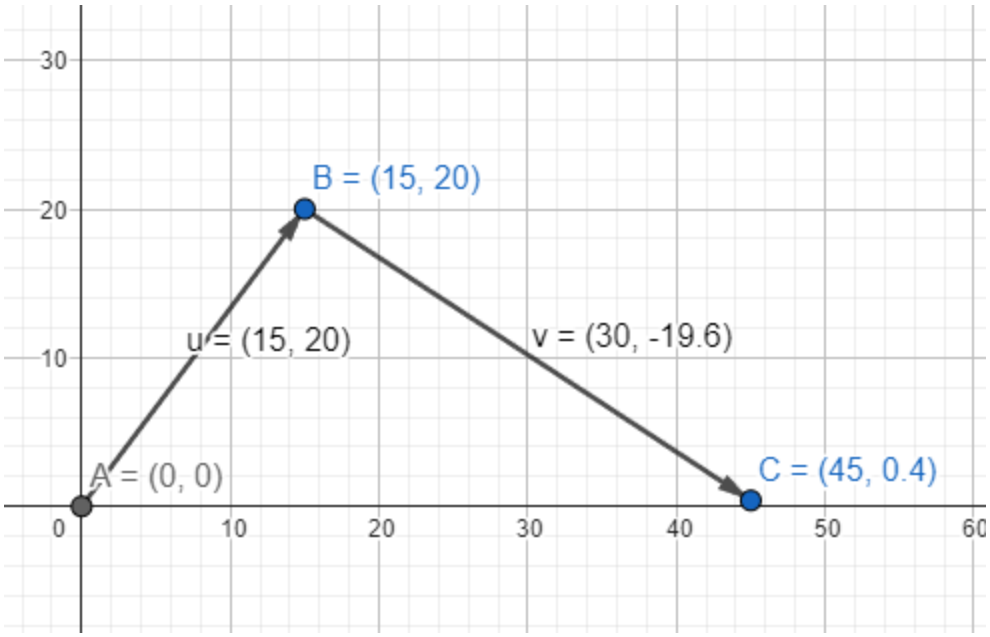
c. After two seconds, what is the projectile's velocity?

i. (15, 0.4)

d. After two seconds, what is the magnitude of the projectile's velocity?

i. 15^2 + 0.4^2 = sqrt(225.16)

ii. 15m/s



4. An enemy NPC is stationed at the point E = (6, 8) in a stealth game. The lights are out. This enemy can hear the player character moving if the player is 5 units or closer to the enemy. [4 points]

a. List two points where the player would be caught moving by the enemy due to being too close.

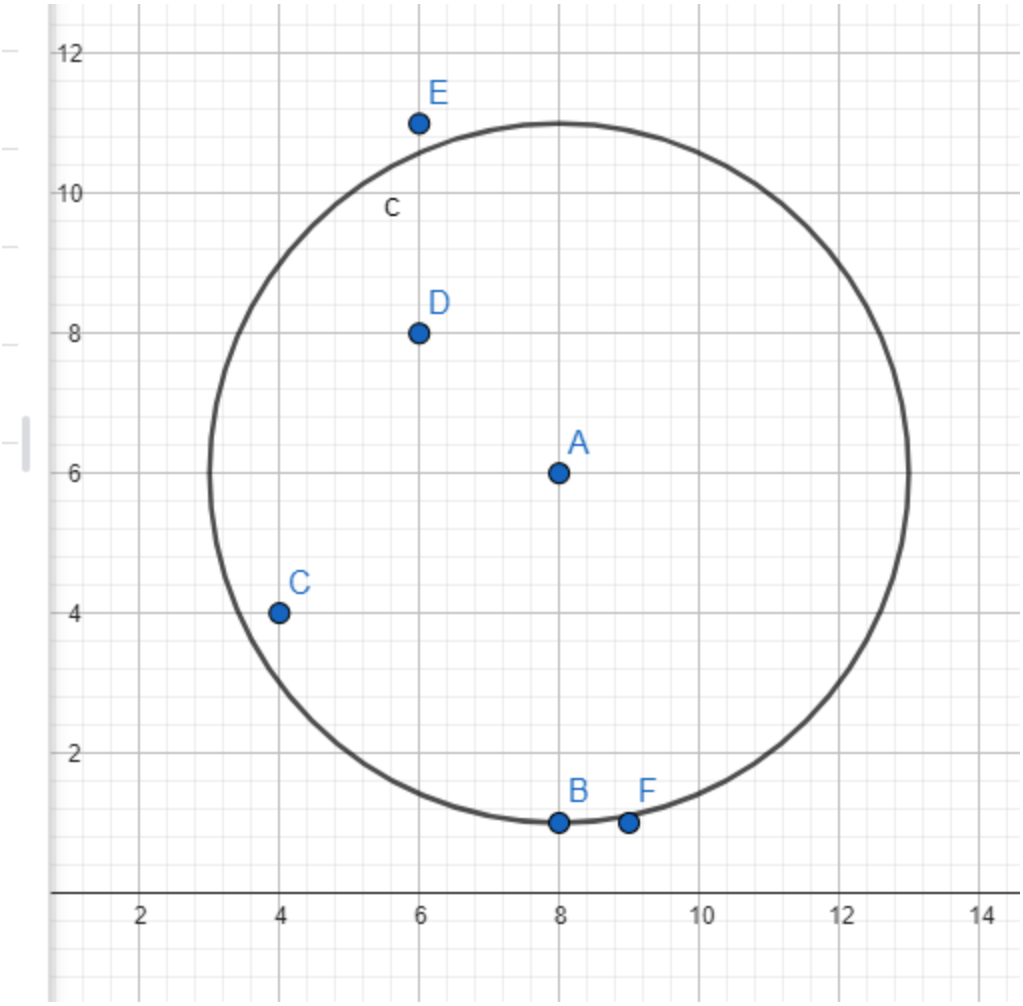
i. (4, 4)

ii. (6, 8)

b. List two points near to the enemy but far enough away that the enemy wouldn't hear the character moving.

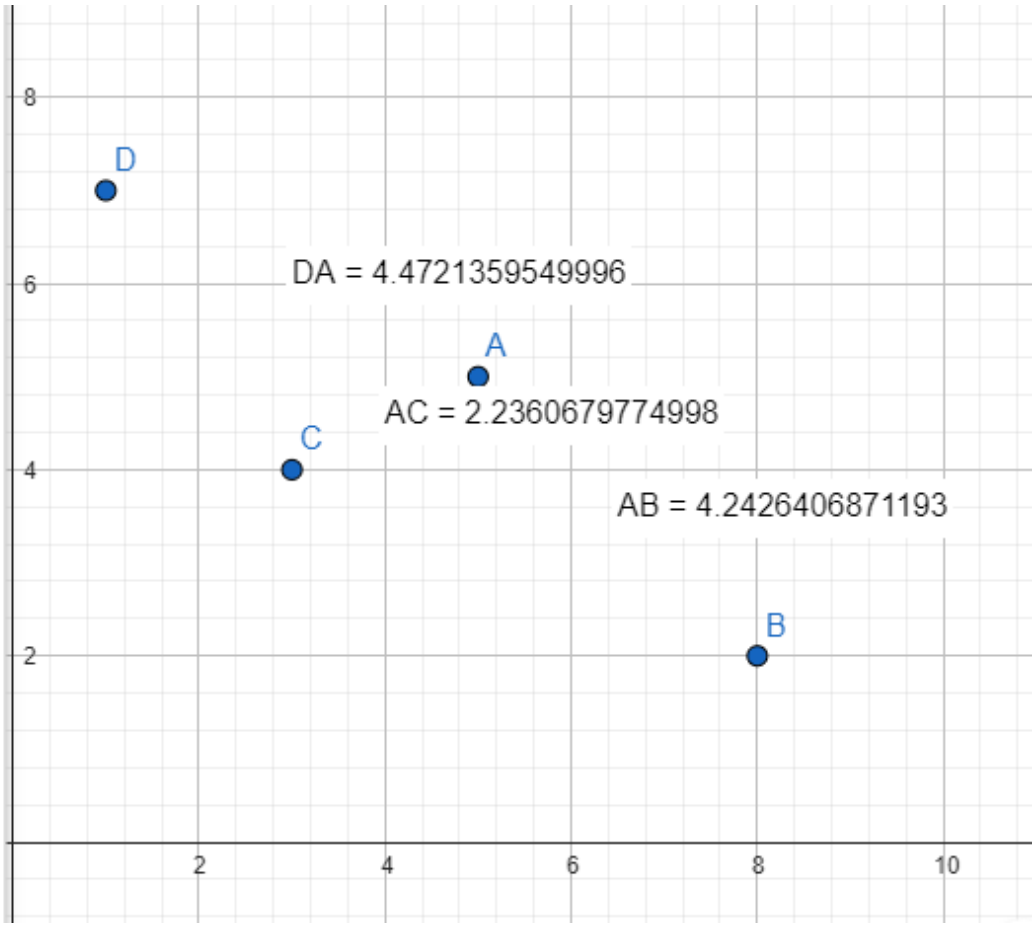
i. (6, 11)

ii. (9, 1)

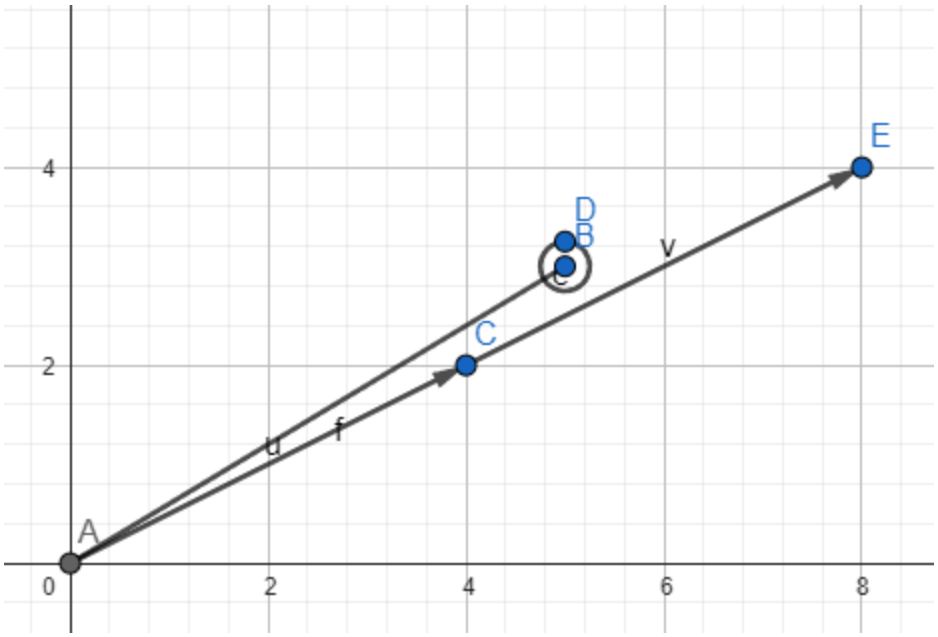


5. Health packs placed in a level at points H1 = (3, 4), H2 = (7, 1), and H3 = (2, 8).
   A player is currently at position P = (5, 5).
   Which health pack is the closest to the player? [2 points]

   a. H1



6. A character needs to follow a path represented by a vector from the origin to the point P = (5, 3). When the character arrives at the origin, they are moving with a velocity represented by the vector v = (4, 2). Their velocity remains constant. [4 points]
   a. Provide an argument that uses dot product to show that the character's trajectory is roughly aligned with the path.
      i. As depicted below Vector AB (the path's trajectory) is very similar to the player's (Vector AC) trajectory.
   b. There is a pick-up at the end of the path (point P). Pickups are obtained if the character comes with 0.25 units of their position. Given the above details, will our character get close enough to the end of the path to get the pick-up?
      i. No as shown below we will not be within the 0.25 unit range.



7. **Marking Rubric**

   A total of 22 points are available for this assignment.

   For each question (or sub-question):

   • 1 point will be assigned for the correct answer.

   • If the answer is correct, an additional point will be assigned for showing the work required to calculate the answer,
   accompanied by a diagram visually demonstrating the work. (Like what was done for challenge C01.)

   • Partial marks may be assigned for incorrect answers based on the quality of the shown work.