A fish swimming in a horizontal plane has velocity $\overrightarrow{v_0} = (4.00\vec{\imath} + 1.00\vec{\jmath})\ m/s$ at a point in the ocean where the position relative to a certain rock is $\overrightarrow{r_0} = (16.0\vec{\imath} - 1.80\vec{\jmath})m$. After the fish swims with constant acceleration for 17.0 s, its velocity is $\overrightarrow{v_f} = (23.00\vec{\imath} - 1.00\vec{\jmath})$.
(a) What are the components of the acceleration of the fish?
$a_x =$
Correct: Your answer is correct. m/s^2
$a_y =$
Correct: Your answer is correct.m/s^2
(b) What is the direction of its acceleration with respect to unit vector î?
Correct: Your answer is correct.° counterclockwise from the +x-axis
(c) If the fish maintains constant acceleration, where is it at t = 30.0 s?
$x =$
Correct: Your answer is correct.m
$y =$
Incorrect: Your answer is incorrect. m
In what direction is it moving?
Incorrect: Your answer is incorrect.° counterclockwise from the +x-axis

Solution:

(a) What are the components of the acceleration of the fish?

$$\vec{a} = \frac{\overrightarrow{v_f} - \overrightarrow{v_0}}{T}$$

$$a_x = \frac{v_{xf} - v_{x0}}{T} = \frac{23.00 - 4.00}{17} = \frac{19}{17}\ m/s^2 = 1\frac{2}{17}\ m/s^2 \approx 1.12\, m/s^2$$
$$a_y = \frac{v_{yf} - v_{y0}}{T} = \frac{-1.00 - 1.00}{17} = -\frac{2}{17}\ m/s^2 \approx -0.12\, m/s^2$$

(b) What is the direction of its acceleration with respect to unit vector î?

$$\tan\phi = \frac{a_y}{a_x} = \frac{-\frac{2}{17}}{\frac{19}{17}} = -\frac{2}{19}$$

$$\phi = \tan^{-1}\left(-\frac{2}{19}\right) \approx -88.55^o = 279.45^o$$

(c) If the fish maintains constant acceleration, where is it at t = 30.0 s?

$$\vec{r} = \overrightarrow{r_0} + \overrightarrow{v_0} \cdot t + \frac{\vec{a} \cdot t^2}{2}$$

$$x = x_0 + v_{x0} \cdot t + \frac{a_x \cdot t^2}{2} = 16.0 + 4.00 \cdot 30 + \frac{\frac{19}{17} \cdot 30^2}{2} = 16 + 120 + \frac{19}{17} \cdot 450 = \frac{10862}{17}$$
$$\approx 638.94\, m$$

$$y = y_0 + v_{y0} \cdot t + \frac{a_y \cdot t^2}{2} = -1.80 + 1.00 \cdot 30 + \frac{-\frac{2}{17} \cdot 30^2}{2} = -1.80 + 30 - \frac{2}{17} \cdot 450$$
$$= -\frac{420.6}{17} \approx -24.74\, m$$

$$\tan^{-1}\psi = \frac{\frac{10862}{17}}{-\frac{420.6}{17}} = -\frac{10862}{420.6}$$

$$\psi = \tan^{-1}\left(-\frac{10862}{420.6}\right) \approx -25.82^o = 334.17^o$$

Answer:

(a) What are the components of the acceleration of the fish?

$a_x \approx 1.12\, m/s^2$

$a_y \approx -0.12\, m/s^2$

(b) What is the direction of its acceleration with respect to unit vector î?

$\phi \approx 279.45^o$

(c) If the fish maintains constant acceleration, where is it at t = 30.0 s?

$x \approx 638.94\, m$

$y \approx -24.74\, m$

In what direction is it moving?

$\psi \approx 334.17^o$