11 Physics Revision

Motion

Vector Manipulation

1. A cyclist enters a roundabout at 32 km/h 070° and exits the roundabout at 27 km/h 160°. Find the cyclist's change in velocity.
2. A pool ball travelling at 3.92 m s^{-1} strikes the edge of the table and bounces straight up in the air at 3.46 m s^{-1}. Determine the ball's change in velocity.
3. A bullet travelling at 472 m s^{-1} ricochets off tank armour at 341 m s^{-1}. Determine the bullet's change in velocity if the angle of incidence and angle of reflection were both 45°.
4. A boat needs to directly cross to the East side of a river, perpendicular to the current. If the current flows at 2.8 m s^{-1} S, and the barge's engines can push it at 6.4 m s^{-1}, what direction must it steer in?

Complex Problems

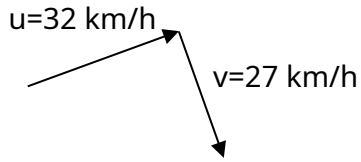
1. A cyclist enters a roundabout at 27 km/h 250° and exits the roundabout at 19 km/h 160°. Find the force exerted on the cyclist if the cornering took 12 s and combined mass of the cyclist and bicycle is 107 kg.
2. A 166 g pool ball travelling at 3.84 m s^{-1} strikes the edge of the table and bounces straight up in the air at 3.12 m s^{-1}. Find the force exerted on the ball if it was contacting the table edge for 0.14 s.
3. A 26 g bullet travelling at 390 m s^{-1} ricochets off tank armour at 270 m s^{-1}. Determine the force the bullet exerted on the tank if the angle of incidence and angle of reflection were both 45° and the collision took 0.07 s.
4. A boat needs to directly cross to the East side of a 120 m river, perpendicular to the current. If the current flows at 3.1 m s^{-1} S, and the barge's engines can push it at 7.9 m s^{-1}, how long will it take to cross?

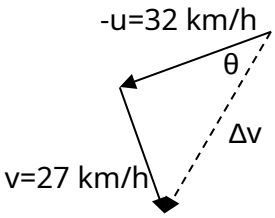
11 Physics Revision Solutions

Motion Solutions

Vector Manipulation Solutions

1.





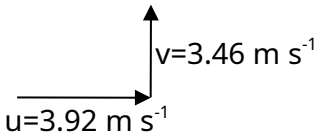
$$\Delta v = \sqrt{27^2 + 32^2} = 41.9\, km/h$$

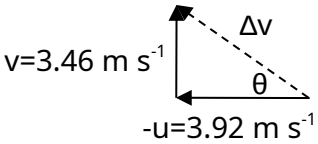
$$\theta = \tan^{-1}\left(\frac{27}{32}\right) = 40.16°$$

$$TB = 70 + 180 - 40.16 = 210°$$

$$\Delta v = 41.9\, km/h\, 210°$$

2.



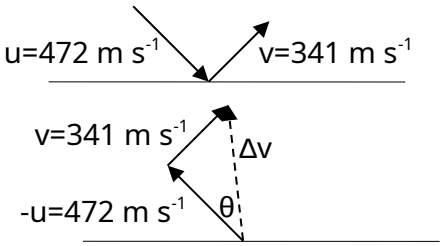


$$\Delta v = \sqrt{3.46^2 + 3.92^2} = 5.23\, m\, s^{-1}$$

$$\theta = \tan^{-1}\left(\frac{3.46}{3.92}\right) = 41.43°$$

$$\Delta v = 5.23\, m\, s^{-1}\, back\ ¿\ the\ edge, 41.4°\, up\ ¿\ horizontal$$

3.



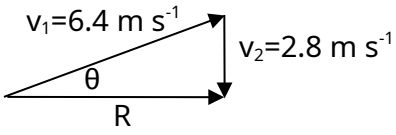
$$\Delta v = \sqrt{472^2 + 341^2} = 582\, m\, s^{-1}$$

$$\theta = \tan^{-1}\left(\frac{341}{472}\right) = 35.85°$$

$$45 + 35.85 = 80.8°$$

$$\Delta v = 582\, m\, s^{-1}\, 80.8°\ ¿\ the\ surface$$

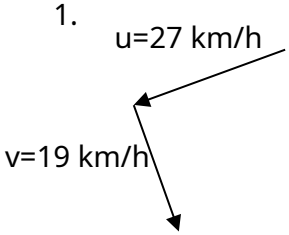
4.

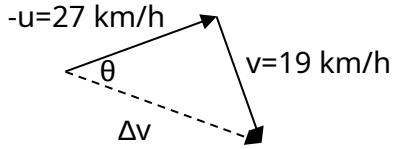


$$\theta = \sin^{-1}\left(\frac{2.8}{6.4}\right) = 25.9° = 026°$$

Complex Problem Solutions

1.





$$\Delta v = \sqrt{27^2 + 19^2} = 33.0\, km/h$$

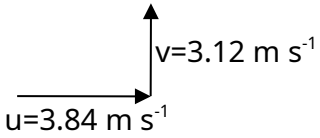
$$\theta = \tan^{-1}\left(\frac{19}{27}\right) = 35.13°$$

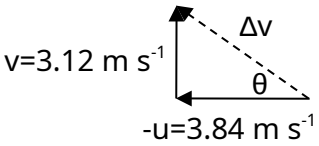
$$TB = 250 - 180 + 35.13 = 105°$$

$$a = \frac{\Delta v}{t} = \frac{(33.0 \div 3.6)}{12} = 0.764\, m\, s^{-2}\, 105°$$

$$F = ma = 107 \times 0.764 = 81.8\, N\, 105°$$

2.





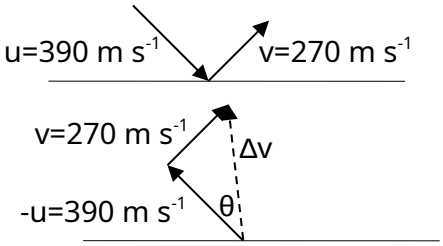
$$\Delta v = \sqrt{3.12^2 + 3.84^2} = 4.95\, m\, s^{-1}$$

$$\theta = \tan^{-1}\left(\frac{3.12}{3.84}\right) = 39.09°$$

$$a = \frac{\Delta v}{t} = \frac{4.95}{0.14} = 35.34\, m\, s^{-2}\, 39.1°$$

$$F = ma = 0.166 \times 35.34 = 5.87\, N\, back\, ¿\, the\, edge, 39.1°\, up\, ¿\, horizontal$$

3.



$$\Delta v = \sqrt{390^2 + 270^2} = 474\, m\, s^{-1}$$

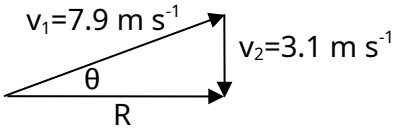
$$\theta = \tan^{-1}\left(\frac{270}{390}\right) = 34.7°$$

$$45 + 34.7 = 79.7°$$

$$a = \frac{\Delta v}{t} = \frac{474}{0.07} = 6780\, m\, s^{-2}\, 79.7°$$

$$F = ma = 0.026 \times 6780 = 176\, N\, 79.7°\, ¿\, the\, surface$$

4.



$$R = \sqrt{(7.9^2 - 3.1^2)} = 7.27\, m\, s^{-1}$$

$$t = \frac{s}{v} = \frac{120}{7.27} = 16.5\, s$$