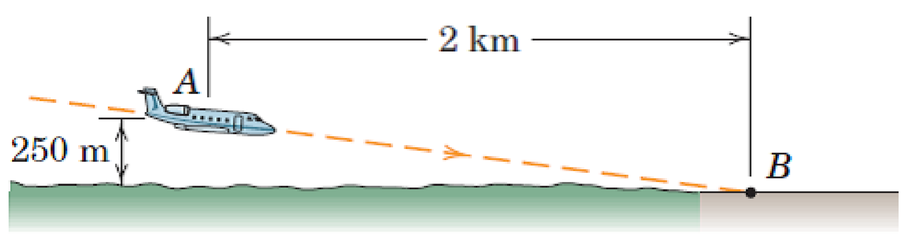
Engineering Mechanics | (8th Edition)

Problem

During its final approach to the runway, the aircraft speed is reduced from 300 km / h at *A* to 200 km / h at *B*. Determine the net external aerodynamic force *R* which acts on the 200-Mg aircraft during this interval, and find the components of this force which are parallel to and normal to the flight path.



Problem 3/33

Step-by-step solution

Step 1 of 5

Given that,

Mass of the aircraft, $m = 200\ \text{Mg}$

Velocity of the aircraft at A, $v_A = 300\ \text{km/hr}$

Velocity of the aircraft at B, $v_B = 200\ \text{km/hr}$

Height of the aircraft from the runway at A, $h = 250\ \text{m}$

Horizontal distance to the runway, $l = 2\ \text{km}$

Net aerodynamic force acts on the aircraft, R

$$\theta = \tan^{-1}\left(\frac{h}{l}\right)$$

$$\theta = \tan^{-1}\left(\frac{250}{2000}\right)$$

$$\theta = 7.125^\circ$$

Comment

Step 2 of 5

Total distance traveled, $s = \sqrt{h^2 + l^2}$

$$s = \sqrt{250^2 + 2000^2}$$

$$s = 2015.56\ \text{m}$$

Using

$$v^2 = u^2 + 2as$$

$$v_B^2 = v_A^2 + 2as$$

$$\left(200 \times \frac{1000}{3600}\right)^2 = \left(300 \times \frac{1000}{3600}\right)^2 + 2a(2015.56)$$

$$a = -0.957\ \text{m/s}^2$$

Comment

Step 3 of 5

Let R_x & R_y are the components of the aerodynamic force which are parallel and normal to the flight path

By dynamic equilibrium equations

$$\Sigma F_x = ma_x$$

$$-R_x + \left(200 \times 10^3 \times 9.81 \times \sin 7.125^\circ\right) = -200 \times 10^3 \times 0.957$$

$$R_x = 434755.6\ \text{N}$$

$$\boxed{R_x = 434.76\ \text{kN}}$$

Comment

Step 4 of 5

$$\Sigma F_y = 0$$

$$-R_y + \left(200 \times 10^3 \times 9.81 \times \cos 7.125^\circ\right) = 0$$

$$R_y = 1946849.26\ \text{N}$$

$$\boxed{R_y = 1946.85\ \text{kN}}$$

Comment

Step 5 of 5

The net external aerodynamic force, $R = \sqrt{R_x^2 + R_y^2}$

$$= \sqrt{(434.76)^2 + (1946.85)^2}$$

$$\boxed{R = 1994.8\ \text{kN}}$$

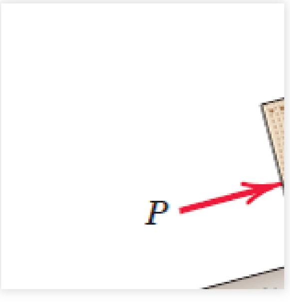
Comment

Was this solution helpful? 6 | 0

Recommended solutions for you in Chapter 3

Chapter 3, Problem 2P

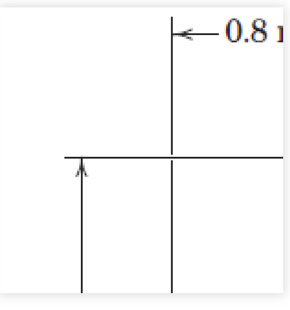
The 50-kg crate is stationary when the force P is applied. Determine the resulting acceleration of the crate if (a) P = 0, (b)...



See solution

Chapter 3, Problem 100P

The 2-kg collar is at rest in position A when the constant force P is applied. Determine the speed of the collar as it...



See solution

Videos related to **Chapter 3**

4:39
TEXTBOOK SOLUTION
Matrix Multiplication
0 1

4:59
TEXTBOOK SOLUTION
Linear Algebra Checklist
0 0

4:32
TEXTBOOK SOLUTION
Free Body Diagrams: connected particles
0 0

Show more

Examples related to **Chapter 3**

Example 1

A 75-kg man stands on a spring scale in an elevator. During the first 3 seconds of motion from rest, the tension T in the hoisting cable is 8300 N . Find the reading R of the scale in newtons during this interval and the upward velocity v of the elevator at the end of the 3 seconds. The total mass of the elevator, man, and scale is 750 kg .

Show more

Example 2

Example 3

Example 4

Example 5