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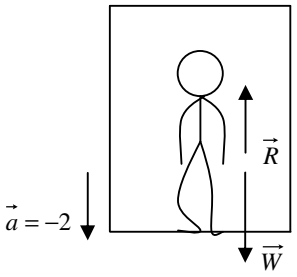
Physics worksheet – Reaction force II

Q1 A 60-kg person is inside an upward moving lift. It slows down at a rate of 2 ms^{-2}. Find the reaction force of the lift floor on the person.

$\vec{F} = m\vec{a}$, $\vec{R} + \vec{W} = m\vec{a}$

$R + (-60 \times 9.8) = 60(-2)$

$R \approx 470$ N

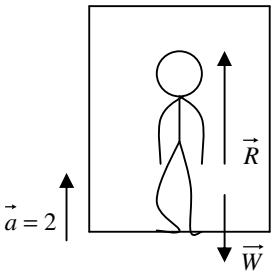


Q2 A 60-kg person is inside a downward moving lift. It slows down at a rate of 2 ms^{-2}. Find the reaction force of the lift floor on the person.

$\vec{F} = m\vec{a}$, $\vec{R} + \vec{W} = m\vec{a}$

$R + (-60 \times 9.8) = 60 \times 2$

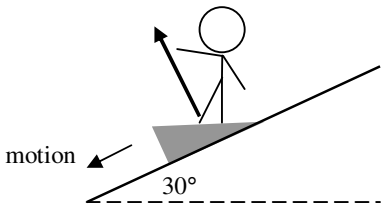
$R \approx 710$ N



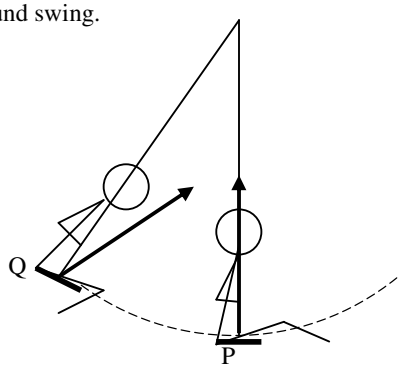
Q3 A 60-kg person on a horizontal platform slides down a frictionless slope inclined at 30° to the horizontal. Draw an accurate arrow to show the direction of the reaction force of the platform on the person. Calculate the magnitude of the reaction force and the angle it makes with the platform.

Reaction force $= mg\cos\theta = 60 \times 9.8 \times \cos 30° \approx 510$ N

Angle with platform = 60°



Q4 Draw an arrow at each of the locations P and Q to indicate the direction of the reaction force on a child riding on a playground swing.



Q5 A 1000-kg car travelling at 10 kmh^{-1} hits a barrier head on and comes to a stop in 0.8 s. Determine the average reaction force of the barrier on the car.

Change 10 kmh^{-1} to $\frac{10}{3.6} \approx 2.78$ ms^{-1}

Average acceleration $= \frac{\Delta v}{\Delta t} = \frac{0 - 2.78}{0.8} \approx -3.47$ ms^{-2}

Average reaction force $= ma \approx 1000 \times (-3.47) \approx -3500$ N

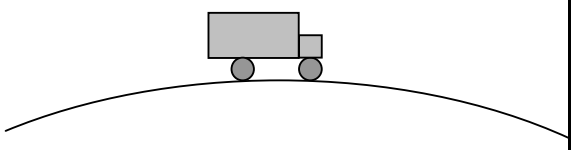
Q6 Calculate the reaction force of the seat on a 60-kg rider in the carriage of a roller coaster travelling upright at 15 ms^{-1} at the bottom of a 25-m-radius loop.

$\vec{F} = m\vec{a}$, $\vec{R} + \vec{W} = m\vec{a}$

$R + (-60 \times 9.8) = 60 \times \frac{15^2}{25}$

$R \approx 1100$ N

Q7 Calculate the reaction force of the seat on a 65-kg driver in a truck travelling at 20 ms^{-1} at the top of a road crest of 100-m radius of curvature.



$\vec{F} = m\vec{a}$, $\vec{R} + \vec{W} = m\vec{a}$

$R + (-65 \times 9.8) = 65 \times \left(-\frac{20^2}{100}\right)$

$R \approx 380$ N

Q8 A 1200-kg car travels at 5 ms^{-1} at a roundabout of 10-m radius. Calculate the magnitude and direction (angle with the vertical) of the reaction force of the horizontal circular road on the car. Ignore air resistance and rolling resistance.

Centripetal force exerted by the road on the car due to friction

$= m\frac{v^2}{r} = 1200 \times \frac{5^2}{10} = 3000$ N

Normal force exerted by the road on the car

$= mg = 1200 \times 9.8 = 11760$ N

Reaction force exerted by the road on the car

$= \sqrt{3000^2 + 11760^2} \approx 12000$ N

Angle with the vertical

$= \tan^{-1}\left(\frac{3000}{11760}\right) \approx 14°$