Dynamic

Newton's first law

مسألة الوزارة (مترجم للإنجليزي) ←

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Sandwich math

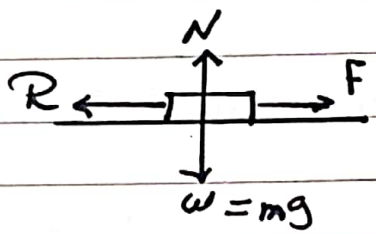
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Newton's First law

«Every body preserves in its state of rest or moving uniformly unless acted upon by an unbalanced external force by external effect.»

Applications

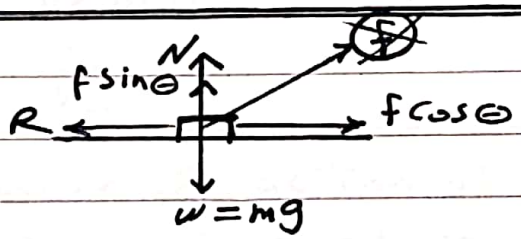
(1)



$f = R \rightarrow (1)$

$N = w \rightarrow (2)$

(2)

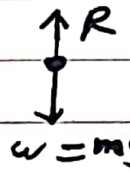


$f\cos\theta = R \rightarrow (1)$

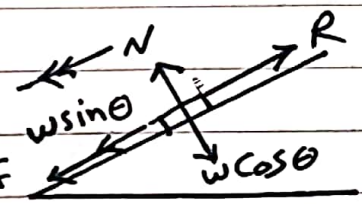
$N + f\sin\theta = w \rightarrow (2)$

(3)

$R = w$

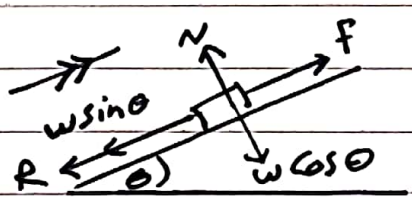


(4)



$F + w\sin\theta = R \rightarrow (1)$

$N = w\cos\theta \rightarrow (2)$



$F = R + w\sin\theta \rightarrow (1)$

$N = w\cos\theta \rightarrow (2)$

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Note That

(1) we use Newton's first law if he say :—

(1) uniform velocity
(2) Max. velocity
(3) Constant velocity
(4) $a = 0$
(5) The body Covered equal distance in equal time.

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(2) If The body moves under The action of resistance porportional with its velocity
we write $\Rightarrow \frac{R_1}{R_2} = \frac{V_1}{V_2}$

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(3) If The body moves under The action of resistance proportional with The square of its velocity
we write $\Rightarrow \frac{R_1}{R_2} = \frac{V_1^2}{V_2^2}$

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Ex(1)

A body moves under the action of $\vec{F_1} = 5\vec{i} + 4\sqrt{3}\vec{j}$, $\vec{F_2} = -3\vec{i} - 2\sqrt{3}\vec{j}$, $\vec{F_3} = a\vec{i} + b\vec{j}$ by uniform velocity find a , b ?

Solution

uniform velocity $\Rightarrow \sum \vec{F} = \vec{0}$

$\vec{F_1} + \vec{F_2} + \vec{F_3} = \vec{0}$

$(5, 4\sqrt{3}) + (-3, -2\sqrt{3}) + (a, b) = (0, 0)$

$5 - 3 + a = 0$ $\qquad$ $4\sqrt{3} + -2\sqrt{3} + b = 0$

$a = -2$ $\qquad$ $b = -2\sqrt{3}$

Ex(2)

The body of mass "m" moves under the action of two forces $\vec{F_1} = 3m\vec{i}$, $\vec{F_2} = 4m\vec{j}$ find additional force which make the body moves with uniform velocity ?

Solution

$\vec{F} + \vec{F_2} + \vec{F_3} = \vec{0}$

$(3m, 0) + (0, 4m) + \vec{F_3} = \vec{0}$

$(3m, 4m) + \vec{F_3} = \vec{0}$

$\vec{F_3} = (0, 0) - (3m, 4m)$

$\vec{F_3} = (-3m, -4m)$

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EX(3)

A car of mass 5 tons moves with uniform velocity on a striaght line road of resistance 18 kg wt per each ton of mass. find the motor car force?

Sol.

$R \leftarrow F \rightarrow F$

$f = R$

$= 18 \text{ kg wt} \times 5 = 90 \text{ kg.wt}$

EX(4)

An engine of mass 10 tons pulls a number of train cars each of 6 tons mass on a stright road by uniform velocity. if the engine force is 1.4 tons.wt and the resistance of the road is 20 kg.wt per each ton of mass. find the Number of Cars.

Sol.

$F = 1.4 \text{ tons wt} \times 10^3 = 1400 \text{ kg.wt}$

let the no. of cars is x

Then $m = (10 + 6x) \times 10^3 \text{ kg}$

$\Rightarrow R = 20 \times (10 + 6x) \text{ kg wt}$

$f = R$ $\quad R \leftarrow F \rightarrow f$

$1400 = 20 \times (10 + 6x) \quad \div 20$

$70 = 10 + 6x \quad \Rightarrow 6x = 60 \quad \div 6$

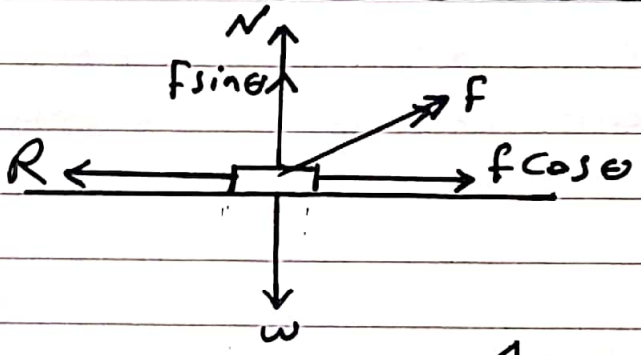
$x = 10$

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Ex (5)

A trian car of mass 1.5 tons is pulled by an inclined force with the horizontal by an angle of its sine is $\frac{3}{5}$ to move on a stright road by uniform velocity. If the resistance of the road equal $\frac{2}{5}$ of the car weight then find the tension force and reaction of road.

Sol.

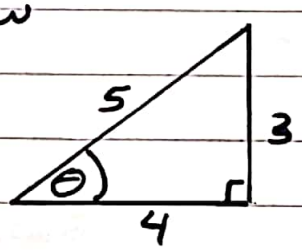


$* m = 1.5 \text{ tons} \times 10^3 \text{ kg}$

$R = \frac{2}{5} w$

$R = \frac{2}{5} \times 1500$

$* R = 600 \text{ kg wt}$



$\Rightarrow f \cos\theta = R$

$f \times \frac{4}{5} = 600$

$\Rightarrow f = 750 \text{ kg.wt}$

$N + f \sin\theta = mg$

$N = mg - f \sin\theta$

$= (1500 \times 9.8 - 750 \times 9.8 \times \frac{3}{5}) \text{ Newton} \div 9.8$

$= 1500 - 450$

$\Rightarrow N = 1050 \text{ kg wt}$

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Ex(6)

A car of weight 2.7 ton.wt moves on a straight horizontal road with a uniform velocity when it reached a ramp inclined to the horizontal at an angle whose sine is $\frac{1}{20}$. The driver stopped the motor of the car so it moved down the ramp with a uniform velocity, if the resistance of the ramp equals $\frac{3}{5}$ of the resistance of the horizontal road. Calculate the driving force of the motor car along the horizontal road.

Sol.

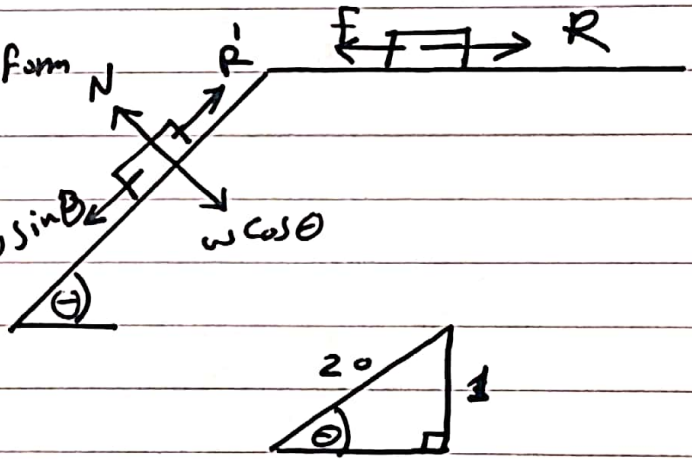
on the inclined plane

∵ The car moves with uniform velocity. Then

$R' = w \sin\theta$

$R' = 2.7 \times 10^3 \times \frac{1}{20}$ kg wt

$\star R' = 135$ kg wt



on horizontal road

∵ The car moves with uniform velocity

∴ $F = R$

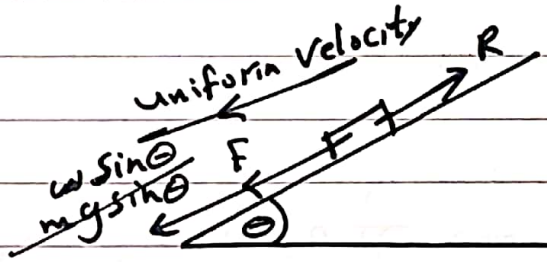
$F = R' \times \frac{5}{3} = 135 \times \frac{5}{3}$

$\star F = 225$ kg wt

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Ex(7)

A car of mass 2 tons is loaded with stones of mass 3 tons and descended along a road inclines to the horizontal at an angle of $\sin = \frac{1}{100}$ with max. velocity. if the engine forces of the car is 90 kg. wt. find the resistance of each ton, if the car emptied the load and rebounded upwards the road with its maximum velocity. find the engine force given that the resistance of each ton of the mass is Const.



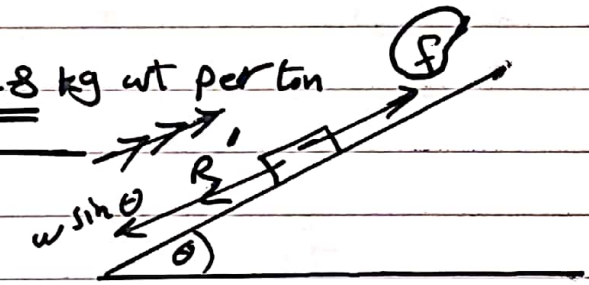
first

$f + w\sin\theta = R$

$R = 90 + 5000 \times \frac{1}{100}$

$= 140$ kg wt

$R\,(\text{rate}) = \frac{140}{5} = \underline{28}$ kg wt per ton



2nd

$F = R' + w\sin\theta$

$= 2000 \times \frac{1}{100} + 28 \times 2 = \underline{76}$ kg wt

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Ex(8)

A small metallic ball of weight 150 gm.wt. in a liquid it is found that it moves equals distances in equal times, Then The magnitude of The resistance of The liquid formation of The ball equal.....

Sol.

uniform velocity

$* R = w = 150 \text{ gm.wt}$



Ex(9)

A parachutist descends vertically with a uniform velocity. If The total weight of The parachutist and the parachute is 95 kg wt. find The magnitude of air resistance for The parachute.

Sol

$R = w$

$* R = 95 \text{ kg.wt}$



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Ex(10)

A chopper aeroplane of weight 8 ton.wt moves vertically againest resistance of 300 kg.wt per ton of mass Calculate the force of engine when it moves with uniform velocity :-

(i) When it ascends vertically upwards

(ii) when it descends vertically downwards

Sol

$W = 8 \text{ ton wt} \times 10^3 \text{ kg wt} = 8000 \text{ kg.wt}$

$R = 300 \text{ kg wt} \times 8 = 2400 \text{ kg wt}$

(i) upwards



$F = W + R$

$= 8000 + 2400$

$F = 10400 \text{ kg.wt}$

(ii) Downwards



$F + R = W$

$F = W - R$

$= 8000 - 2400$

$= 5600 \text{ kg wt}$

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Ex (11)

A car of mass 4 tons moves on a straight horizontal road under the action of a resistance directly proportional to the magnitude of the velocity. if the resistance is 8 kg wt for each ton of the mass of the car when its velocity is 72 km/hr. find the maximum velocity, given that the maximum force generated by the motor is 60 kg. wt.

$$R \propto v \Rightarrow \frac{R_1}{R_2} = \frac{v_1}{v_2}$$

$R_1 = 8 \times 4 = 32$ kg wt

$v_1 = 72$ km/hr

$R_2 =$ f max. velocity

$R_2 = 60$ kg wt

$v_2 = ?$

$$\Rightarrow \frac{R_1}{R_2} = \frac{v_1}{v_2} \Rightarrow \frac{32}{60} = \frac{72}{v_2}$$

$$\bullet\ v_2 = \frac{72 \times 60}{32} = 135 \text{ km/hr}$$

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Ex (12)

A man is tied to a parachute descends vertically downwards. given That The air resistance is directly proportional to The square of The magnitude of The velocity, and is equal to $\frac{1}{4}$ The weight of The man and the parachute when The velocity is 15 km/hr. find The velocity of The desecnt of the man and The parachute when this velocity becomes uniform.

Sol.

$$R \propto v^2 \Rightarrow \frac{R_1}{R_2} = \frac{v_1^2}{v_2^2}$$

$R_1 = \frac{1}{4} w$, $v_1 = 15$ km/hr

$R_2 = w$, $v_2 = ??$



$$\frac{\frac{1}{4}w}{w} = \frac{(15)^2}{v_2^2}$$

$$v_2^2 = \frac{1 \times (15)^2}{\frac{1}{4}} = 900$$

$$\Rightarrow v_2 = \sqrt{900} = 30 \text{ km/hr}$$

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EX (13)

A train of mass 112 tons and the force of its engine is 5600 kg wt. if the resistance to the motion of the train is directly proportional to the square of its velocity, and this resistance is 32 kg wt for each ton of the mass when its velocity was 60 km/hr. Calculate the maximum velocity of the train

Sol

$m = 112 \text{ ton} \times 10^3 \text{ kg}$.

$F = 5600 \text{ kg wt}$

$\Rightarrow R \propto v^2 \Rightarrow \frac{R_1}{R_2} = \frac{v_1^2}{v_2^2}$

$R_1 = 32 \times 112 \text{ kg wt}$, $v_1 = 60 \text{ km/hr}$

$\Rightarrow$ At max. velocity

$R_2 = F = 5600 \text{ kg wt}$

$v_2 = ??$

$\Rightarrow \frac{R_1}{R_2} = \frac{v_1^2}{v_2^2} \Rightarrow \frac{32 \times 112}{5600} = \frac{(60)^2}{v_2^2}$

$v_2^2 = \frac{(60)^2 \times 5600}{32 \times 112} = \dots$

$\star\star\ v_2 = \sqrt{v_2^2} = 75 \text{ km/hr}$

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