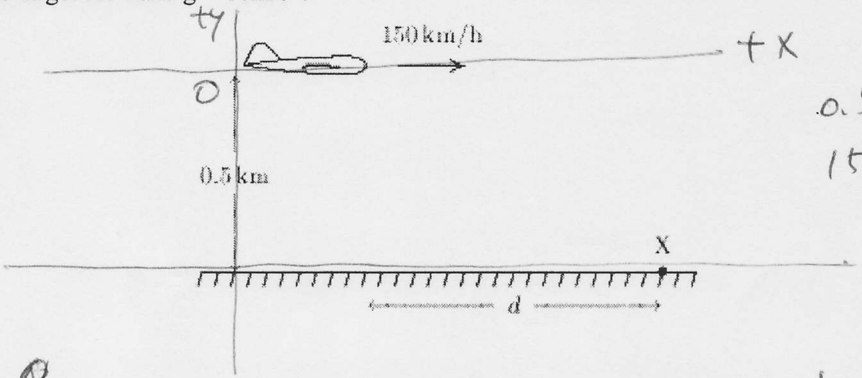
1. The airplane shown is in level flight at an altitude of 0.50 km and a speed of 150 km/h. At what distance d should it release a heavy bomb to hit the target X? Take $g = 10 m/s^2$.



$0.5 km = 500 m$

$150 km/h = \frac{150,000 m}{3600 s} = 41.7 m/s$

A. 150m
B. 295m
C. 420m
D. 2500m
E. 15, 000m

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$\underbrace{y}_{-0.5km} - \underbrace{y_0}_{0} = \underbrace{v_{0y}}_{0} t - \frac{1}{2} g t^2$ $\therefore -500 = -\frac{1}{2} \times 10 \times t^2$ $\therefore t^2 = 100$ $\therefore t = 10$

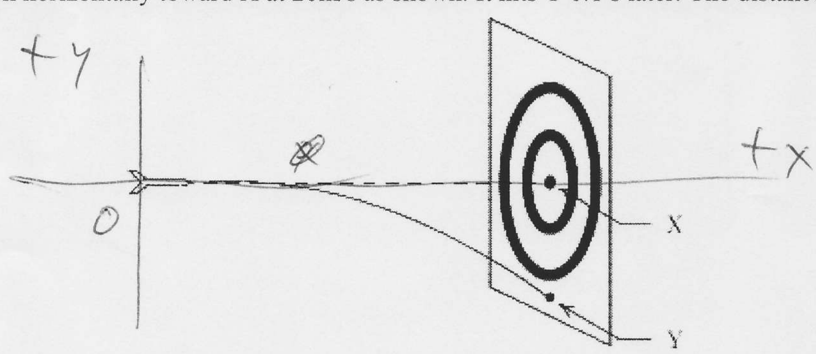
$x - x_0 = v_{0x} t$ $\therefore x = 41.7 \times 10 = 417 m$

2. A large cannon is fired from ground level over level ground at an angle of 30° above the horizontal. The muzzle speed is 980m/s. Neglecting air resistance, the projectile will travel what horizontal distance before striking the ground?

A. 4.3km
B. 8.5km
C. 43km
D. 85km
E. 170km

$R = \frac{v_0^2 \sin 2\theta}{g} = \frac{980^2 \times \sin(2 \times 30^\circ)}{9.8} = 85,000 m$

3. A dart is thrown horizontally toward X at 20m/s as shown. It hits Y 0.1 s later. The distance XY is:



A. 1m
B. 2m
C. 0.5m
D. 0.1m
E. 0.05m

9

$y - \underbrace{y_0}_{0} = \underbrace{v_{0y}}_{0} t - \frac{1}{2} g t^2$ $\therefore y = -\frac{1}{2} \times 9.8 \times 0.1^2 = -0.049 m.$

4. A car travels east at constant velocity. The net force on the car is:

A. east
B. west
C. up
D. down
E. zero

↳ $\vec{a} = 0$

$\vec{F}_{net} = m\vec{a} = 0.$

5. A constant force of 8.0 N is exerted for 4.0 s on a 16-kg object initially at rest. The change in speed of this object will be:

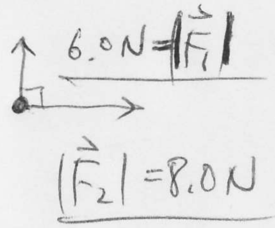
A. 0.5m/s
B. 2m/s
C. 4m/s
D. 8m/s
E. 32m/s

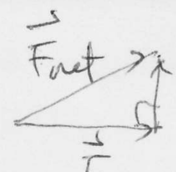
$F = ma \quad \therefore a = \frac{F}{m} = \frac{8}{16} = 0.5.$

$v = v_0 + at = 0 + 0.5 \times 4 = 2\ m/s$

6. Two forces are applied to a 5.0-kg crate; one is 6.0N to the north and the other is 8.0N to the west. The magnitude of the acceleration of the crate is:

A. $0.50 m/s^2$
B. $2.0 m/s^2$
C. $2.8 m/s^2$
D. $10 m/s^2$
E. $50 m/s^2$



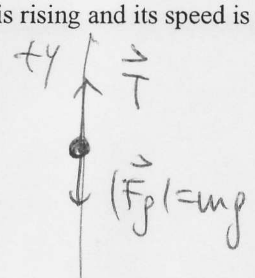


$\therefore |\vec{F}_{net}| = \sqrt{8^2 + 6^2} = 10$

$|\vec{a}| = \frac{|\vec{F}_{net}|}{m} = \frac{10}{5} = 2$

7. A 1000-kg elevator is rising and its speed is increasing at $3 m/s^2$. The tension force of the cable on the elevator is:

A. 6400N
B. 1000N
C. 3000N
D. 9800N
E. 12800N



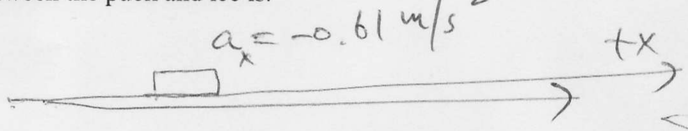
$F_{net,y} = |\vec{T}| - mg = ma_y$

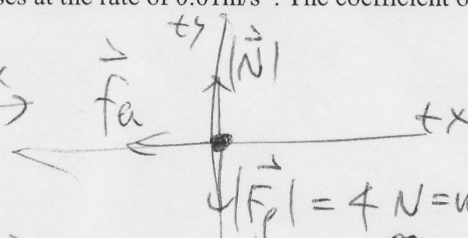
$\therefore |\vec{T}| = mg + ma_y = m(g + a_y)$

$= 1000 \times (9.8 + 3) =$

8. The speed of a 4.0-N hockey puck, sliding across a level ice surface, decreases at the rate of $0.61 m/s^2$. The coefficient of kinetic friction between the puck and ice is:

A. 0.062
B. 0.41
C. 0.62
D. 1.2
E. 9.8





$|\vec{F}_g| = 4\ N = mg \quad \therefore m = \frac{4}{g} = 0.41$

Along y: $F_{net,y} = |\vec{N}| - mg = 0$

$\therefore |\vec{N}| = 4N$

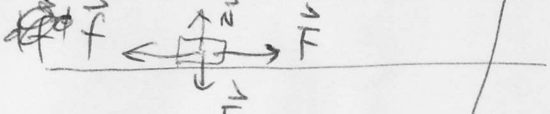
Along x: $F_{net,x} = -|\vec{f}_k| = ma_x$

$-\mu_k |\vec{N}| = ma_x$

$\mu_k = \frac{-ma_x}{|\vec{N}|} = \frac{0.41 \times 0.61}{4} = 0.063$

9. A 40-N crate rests on a rough horizontal floor. A 12-N horizontal force is then applied to it. If the coefficients of friction are $\mu s = 0.5$ and $\mu k = 0.4$, the magnitude of the frictional force on the crate is:

A. 8N
B. 12N
C. 16N
D. 20N
E. 40N



$\vec{F}$

Along y: $|\vec{F}_g| = |\vec{N}| = 40N$

$|f_s^{max}| = \mu_s |\vec{N}| = 0.5 \times 40 = 20\ N.$

$12N < 20N$

$\therefore$ The object is not moving

$\therefore \vec{f}_s$ and $\vec{F}$ balance each other

$\therefore |\vec{f}_s| = |\vec{F}| = 12N$

10. A car is traveling at 15m/s on a horizontal road. The brakes are applied and the car skids to a stop in 4.0s. The coefficient of kinetic friction between the tires and road is:

A. 0.38
B. 0.69
C. 0.77
D. 0.92
E. 1.11

$15 m/s = v_0$ $\quad v = 0$ $\quad t = 0$ $\quad t = 4s$

$a = \frac{v - v_0}{t - t_0} = \frac{0 - 15}{4 - 0} = -3.75 m/s$

$F_{net,x} = -|\vec{f}_k| = m a_x, \therefore -\mu_k |\vec{N}| = m a_x$, $|\vec{N}| = mg$

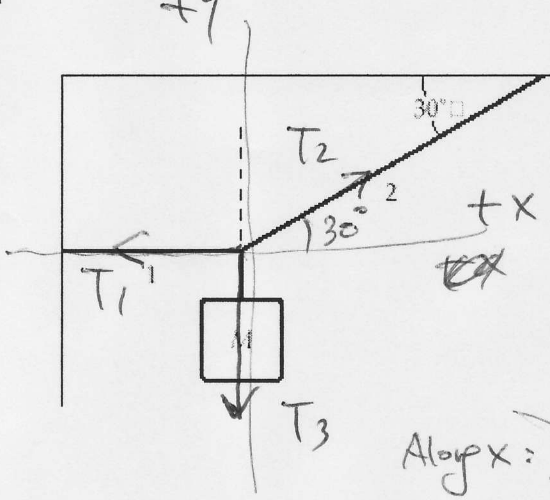
$\therefore -\mu_k m g = m a_x$

$\mu_k = \frac{a_x}{-g} = \frac{-3.75}{-9.8} = 0.38$

11. If M = 2.0 kg, what is the tension in string 1?

A. 1.2 N
B. 11 N
C. 34 N
D. 3.5 N
E. 40 N

Ans = C



$|\vec{T}_3| = Mg = 2 \times 9.8$

Along y: $F_{net,y} = +|\vec{T}_2| \sin 30° - |\vec{T}_3| = 0$

$\therefore |\vec{T}_2| = \frac{|\vec{T}_3|}{\sin 30°} = \frac{2 \times 9.8}{\sin 30°} = 39.2$

Along x:

$F_{net,x} = -|\vec{T}_1| + |\vec{T}_2| \cos 30° = 0$

$\therefore |\vec{T}_1| = |\vec{T}_2| \cos 30° = 39.2 \times \cos 30° = 33.9$

12. If the only forces acting on a 2.0-kg mass are $\mathbf{F}_1 = (3\mathbf{i} - 8\mathbf{j})$ N and $\mathbf{F}_2 = (5\mathbf{i} + 3\mathbf{j})$ N, what is the magnitude of the acceleration of the particle?

A. 1.5 m/s^2
B. 6.5 m/s^2
C. 4.7 m/s^2
D. 9.4 m/s^2
E. 7.2 m/s^2

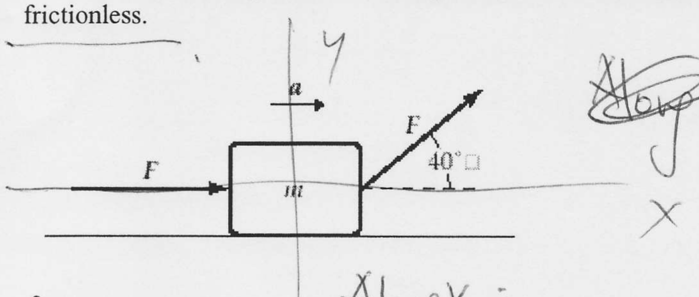
$\vec{F}_{net} = \vec{F}_1 + \vec{F}_2 = 3\hat{i} - 8\hat{j} + 5\hat{i} + 3\hat{j}$

$= 8\hat{i} - 5\hat{j}$

$|\vec{F}_{net}| = \sqrt{8^2 + 5^2} = 9.43$

$|\vec{a}| = \frac{|\vec{F}_{net}|}{m} = \frac{9.43}{2} = 4.72 m/s^2$

13. If $F = 4.0$ N and $m = 2.0$ kg, what is the magnitude a of the acceleration for the block shown below? The surface is frictionless.



A. 5.3 m/s^2
B. 4.4 m/s^2
C. 3.5 m/s^2
D. 7.0 m/s^2
E. 8.4 m/s^2

$F = 4$
$m = 2$

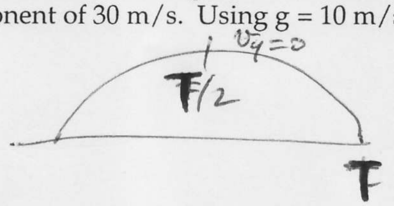
Along X:

$F_{net,x} = F + F\cos 40^\circ = m a_x$

$\therefore F(1+\cos 40^\circ) = m a_x$

$a_x = \frac{F}{m}(1+\cos 40^\circ)$

14. A projectile is fired over level ground with an initial velocity that has a vertical component of 20 m/s and a horizontal component of 30 m/s. Using g = 10 m/s, the distance from launching to landing points is below?



A. 40 m
B. 60 m
C. 80 m
D. 120 m
E. 180 m

~~$v_0 = \sqrt{20^2 + 30^2} = 36.1$~~

$v_y = v_{y0} - g t$

$0 = 20 - g \times \frac{T}{2}$

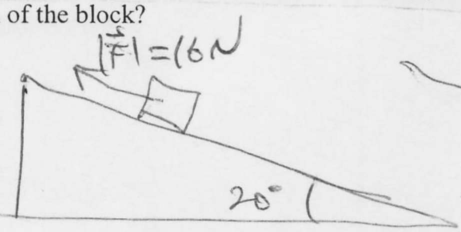
$\therefore T = \frac{20 \times 2}{10} = 4$

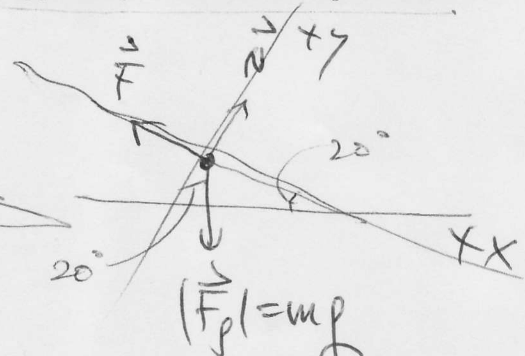
$x = x_0 + v_{0x} t$

$R = 0 + 30 \times 4 = 120.$

15. A 3.0-kg block slides on a frictionless 20° inclined plane. A force of 16 N acting parallel to the incline and up the incline is applied to the block. What is the acceleration of the block?

A. 2.0 m/s^2 down the incline
B. 5.3 m/s^2 up the incline
C. 2.0 m/s^2 up the incline
D. 3.9 m/s^2 down the incline
E. 3.9 m/s^2 up the incline





Along y: $F_{net,y} = |\vec{N}| - mg\cos 20^\circ = 0$

$|\vec{N}| = mg\cos 20^\circ$

Along x: $F_{net,x} = -|\vec{F}| + mg\sin 20^\circ = m a_x$

$a_x = -\frac{|\vec{F}|}{m} + g\sin 20^\circ = -\frac{16}{3} + 9.8 \times \sin 20^\circ$

$= -1.98$ m/s^2