$V_x = 20\cos(60)$

$V = 10$

3. A ball is kicked from the ground level at an angle of 60° to the horizontal. If the initial velocity of the ball is 20 m/s, then the speed (in m/s) of the ball at maximum height is:

a) 0.00　　b) 20.0　　c) 12.5　　d) 17.32　　[✓ e) 10.0]

$V_x = V\cos\theta$

at maximum height $V_y = 0$

✓

Δx

4. A firefighter 40 m a way from a burning building directs a stream of water from a fire hose at an angle of 37° above the horizontal. If the speed of the stream is 30 m/s, at what height (in m) will the water strike the building?

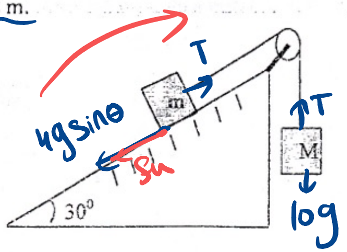
✓

a) 29.0　　b) 16.48　　c) 20.80　　d) 1.00　　e) 18.70

X

5. In the figure shown $M = 10$ kg and $m = 4$ kg. The coefficient of kinetic friction between the inclined surface and mass m is $\mu_k = 0.3$. Given that the system started from rest, find the speed (in m/s) of mass M when it has fallen a distance of 2 m.

a) 2.96　　b) 3.60
[✓ c) 4.42]　　d) 3.96
d) 2.1



$V_f^2 = \cancel{V_i^2} + 2a\Delta x$

$f_k = \mu_k mg\cos\theta$

$T - f_k - 4g\sin\theta = 4a$

$10g - T = 10a$

$10g - \mu_k mg\cos\theta - 4g\sin\theta = 14a$

$g(10 - 4\mu_k\cos\theta - 4\sin\theta) = 14a$

$9.8(10 - 0.3\cos(30)*4 - 4\sin(30)) = 14a$

$a = 4.87$

$V_f = \sqrt{2\times4.87\times2}$

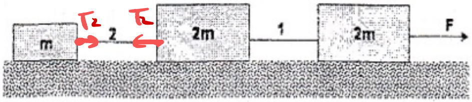
$V_f = 4.4136$


رَبَّنَا وَلَا تُحَمِّلْنَا مَالَا طَاقَةَ لَنَا بِهِ

6. The horizontal surface on which the objects slide is frictionless. If $m = 2.0$ kg, and the magnitude of F is 25 N. The tension in string 2 (in N) is:

a) 2.5 b) 0.0 c) 10.0

d) 15.0 [✓ e) 5.0]



$\boxed{m} \rightarrow T_2$

$T_2 = ma$

$T_2 = 2 * 2.5 = 5$

$a = \frac{F}{5m}$

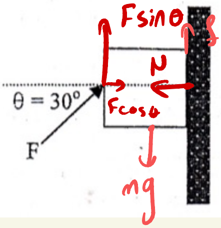
$a = \frac{25}{2 * 5} = 2.5$ m/s²

7. A 3-kg block is pushed against the wall by a force $F = 40$ N that makes a 30° angle with the horizontal. If the force is just enough to hold the block without sliding down, then the coefficient of static friction (μ_s) is equal to:

a) 0.168 b) 0.200

[✓ c) 0.271] d) 0.98

e) 0.262



$f_s = \mu_s(F\cos\theta) \Rightarrow 9.43 = \mu_s(40\cos 30)$

$F\sin\theta = -f_s + mg$

$40\sin(30) = -f_s + 3 * 9.81$

$\mu_s = 0.27$

$f_s = 9.43$

9. A plane flies south at 500 km/h for 2h and then flies west at 500 km/h for 1 h. What is its average speed (in km/h) ?

a) 372.7 [✓ b) 500] c) 0 d) 333.3 e) 166.7

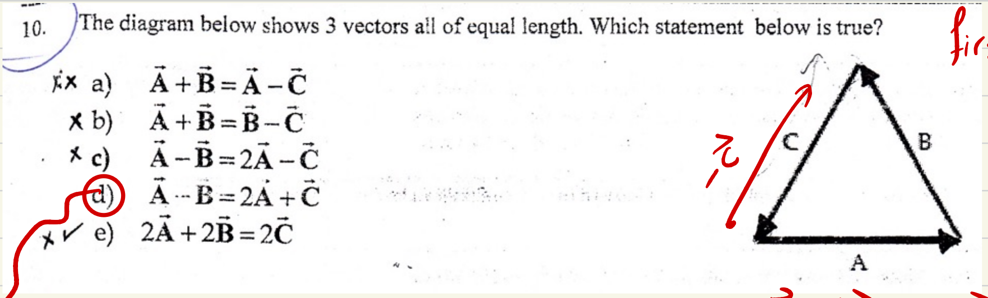
$500 = \frac{d_1}{2}$

$d_1 = 1000$

$500 = \frac{d_2}{1}$

$d_2 = 500$

$S = \frac{d_1 + d_2}{t_1 + t_2} = \frac{1000 + 500}{1 + 2} = 500$



10. The diagram below shows 3 vectors all of equal length. Which statement below is true?

x a) $\vec{A}+\vec{B}=\vec{A}-\vec{C}$

x b) $\vec{A}+\vec{B}=\vec{B}-\vec{C}$

x c) $\vec{A}-\vec{B}=2\vec{A}-\vec{C}$

[✓ d)] $\vec{A}-\vec{B}=2\vec{A}+\vec{C}$

x ✓ e) $2\vec{A}+2\vec{B}=2\vec{C}$

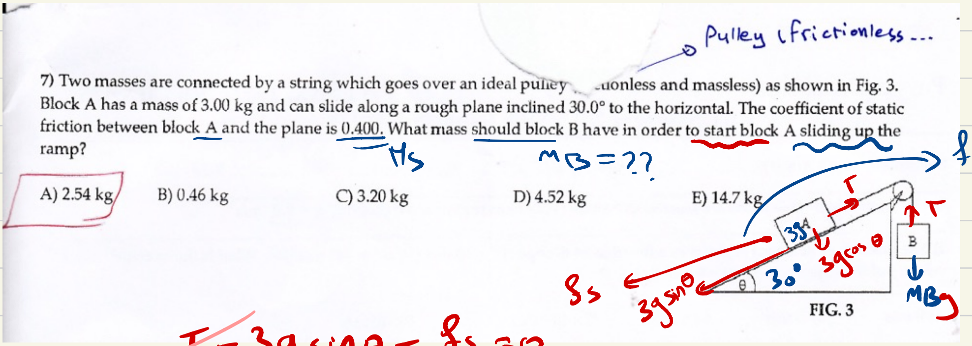
first tail to last head

$$\vec{A}+\vec{B}=-\vec{C}$$

$$\vec{A}-\vec{B}=2\vec{A}+C$$

$$-\vec{B}=\vec{A}+C$$

$$-\vec{C}=\vec{A}+\vec{B}$$ ✓✓



Pulley (frictionless...

7) Two masses are connected by a string which goes over an ideal pulley (frictionless and massless) as shown in Fig. 3. Block A has a mass of 3.00 kg and can slide along a rough plane inclined 30.0° to the horizontal. The coefficient of static friction between block A and the plane is 0.400. What mass should block B have in order to start block A sliding up the ramp?

μ_s $m_B = ??$ flow

[✓ A) 2.54 kg] B) 0.46 kg C) 3.20 kg D) 4.52 kg E) 14.7 kg

FIG. 3

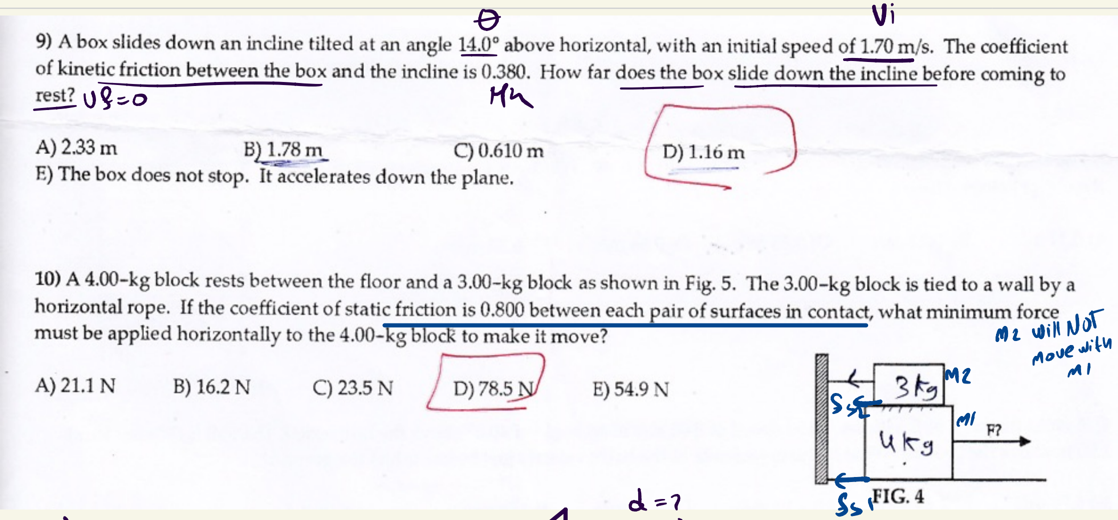
$$\cancel{T}-3g\sin\theta-f_s=0$$

$$f_s=3g\cos\theta\,\mu_s$$

$$M_Bg-\cancel{T}=0$$

$$M_B\cancel{g}-3\cancel{g}\sin\theta-\mu_s\,3\cancel{g}\cos\theta=0$$

$$M_B=3\sin(30)+0.4*3*\cos(30)=2.539\text{ kg}$$



θ V_i

9) A box slides down an incline tilted at an angle 14.0° above horizontal, with an initial speed of 1.70 m/s. The coefficient of kinetic friction between the box and the incline is 0.380. How far does the box slide down the incline before coming to rest? $V_f = 0$ μ_k

A) 2.33 m B) 1.78 m C) 0.610 m [✓ D) 1.16 m]
E) The box does not stop. It accelerates down the plane.

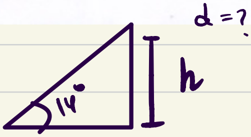
10) A 4.00-kg block rests between the floor and a 3.00-kg block as shown in Fig. 5. The 3.00-kg block is tied to a wall by a horizontal rope. If the coefficient of static friction is 0.800 between each pair of surfaces in contact, what minimum force must be applied horizontally to the 4.00-kg block to make it move?

A) 21.1 N B) 16.2 N C) 23.5 N [✓ D) 78.5 N] E) 54.9 N

m_2 will Not move with m_1

FIG. 4

Q9)



$h = d\sin\theta$

$$\cancel{W_F} + W_f = mgh + \Delta K$$

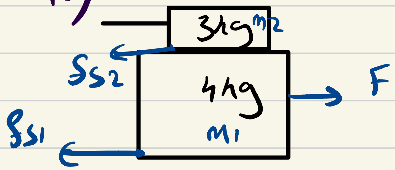
$$-\mu_k \cancel{m} g \cos\theta d = \cancel{m} g h + \tfrac{1}{2}\cancel{m}(0^2 - v_i^2)$$

$$-\mu_k g \cos\theta d - \frac{1}{2}(0 - v_i^2) = -g * d * \sin\theta$$

$$-0.38 \times 9.81 \cos(14) * d - \frac{1}{2}(0 - 1.7^2) = -9.81 * d * \sin(14)$$

$$d = 1.16\,m$$

Q10)



$$F = f_{s1} + f_{s2}$$

$$= \mu_s(m_1 + m_2)g + \mu_s(m_2)g$$

$$= \mu_s g (m_1 + 2m_2)$$

$$= 0.8 \times 9.8(4 + 2(3)) = 78.5\,N$$

1) The position of an object is given as a function of time as $x(t) = (3.00\ \text{m/s})t + (2.00\ \text{m/s}^2)t^2$. What is the average velocity of the object between $t = 0.00$ s and $t = 2.00$ s?

[✓ A)] 7.00 m/s   B) 13.0 m/s   C) 27.0 m/s   D) 11.0 m/s   E) 3.00 m/s

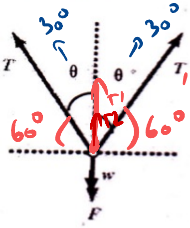
avg velocity

$x_i = 0 \qquad x_f = 3(2) + 2(2)^2 = 14$

$\frac{14}{2} = 7\ m/s$

5) A 5.1-kg box is held at rest by two ropes that form θ = 30° angles with the vertical. An external force *F* acts vertically downward on the box. The force exerted by each of the two ropes is denoted by *T*. A force diagram, showing the four forces that act on the box in equilibrium, is shown below. The magnitude of force *F* is 920 N. The magnitude of force *T* is equal to:

A) 970 N   B) 388 N   [✓ C)] 560 N   D) 486 N   E) 777 N



$F + w = 2T \sin\theta$

$T = \frac{920 + (5.1 \times 9.8)}{2 * \sin(60)} = 560.047N$

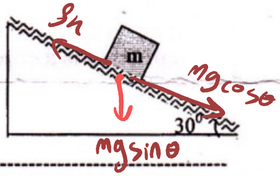
6) A student is sitting on the right hand side in a bus, facing the direction of travel. The bus turns left while the student remains in the same position on the seat. While turning, the student experiences

A) A force to the left and a force to the right   B) A resultant force backward
C) A resultant force to the right   [✓ D)] A resultant force to the left
E) Zero resultant force

force to the left
so student will
remain static

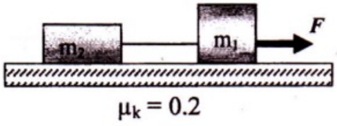
9) A 10-kg block slides down an inclined plane making an angle of 30° with the horizontal at a constant speed. The coefficient of kinetic friction between the block and the surface is

A) 0.50
[✓ D) 0.58]
B) 0.87
E) 1.73
C) 0.42



10) The figure shows two objects connected by a massless string. A force (*F*) of 30.0 N acts on the object with mass m_1 = 5 kg to the right. If the coefficient of kinetic friction between all surfaces is 0.2, and the system accelerates at 2 m/s^2, what is the tension in the string?

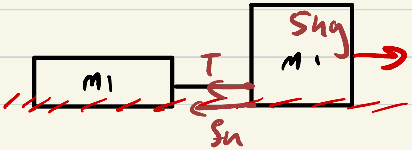
[✓ A) 10.2 N]
B) 30.2 N
C) 29.8 N
D) 49.8 N
E) The problem cannot be solved since m_2 is not known



Q9) $f_k = \mu_k mg\sin\theta \Rightarrow \cancel{mg}\cos\theta = \mu_k \cancel{mg}\sin\theta$

$\mu_k = \tan\theta = 0.577$

Q10)



F=30N

$\mu_k = 0.2$

$a = 2\,m/s^2$

$30 - f_k - T = 5a$

$30 - \mu_k 5g - T = 5a$

$30 - 0.2 * 5 * 9.81 - T = 5(2)$

$T = 10.19N$

Q4) A football player moves 15.0 m north and then 11.0 m south. The **distance** he has traveled and the magnitude of his **displacement**, respectively, are:

a) 26.0 m, 26.0 m [✓ b) 26.0 m, 4.0 m] c) 4.0 m, 4.0 m d) 4.0 m, 26.0 m e) 26 m, 0

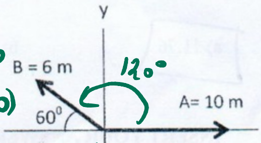
+15 -11

distance
15+11 = 26

displacment
15+ -11 = 4

Q5) The figure shows two vectors $\vec{A}$ and $\vec{B}$. The magnitude of their resultant $|\vec{R}| = |\vec{A} + \vec{B}|$ is:

[✓ a) 8.7] b) 13.2 c) 5.7
d) 0 e) 7.0



$Ax = 10$ $Bx = 6\cos 120$

$Ay = 0$ $By = 6\sin(120)$

$Rx = 7$ $Ry = 5.19$ $\rightsquigarrow$ $\sqrt{7^2 + 5.19^2}$

8.71

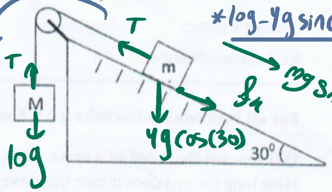
Q7) In the figure shown M = 10.0 kg and m = 4.0 kg. The coefficient of kinetic friction between the inclined surface and mass m is $\mu_k = 0.3$. Given that mass m moves up the inclined plane, determine the acceleration (in m/s²) of the system.

a) 6.3 b) 5.6 c) 3.4
d) 9.8 [✓ e) 4.9]

$T - mg\sin(30) - \mu_k mg\cos 30 = ma$

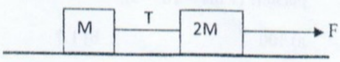
$10g - T = Ma$

$$\frac{*10g - 4g\sin(30) - 0.3(4)g\cos(30)}{10+4} = a$$



$a = 4.87 m/s^2$

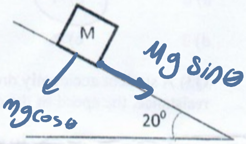
Q8) In the figure shown, the two blocks are connected by a rope. Mass M= 2kg and all surfaces are smooth. If the force F = 40 N, then the value of the tension T (in Newton) in the rope connecting the masses M and 2M is:



a) 6.7 [✓ b) 13.3] c) 3.1 d) 11.4 e) 9.8

Q9) In the figure shown the inclined plane is rough, $\mu_s = 0.4$ and $\mu_k = 0.1$. If M = 2 kg, which of the following statements is correct?

a) The box accelerates down the incline at 3.4 m/s².
b) The box accelerates down the incline at 2.4 m/s².
c) The box accelerates down the incline at 1.6 m/s².
d) The box moves down the incline at constant velocity.
[✓ e) The box remains at rest.]



driving force

$2 * 9.8 * \sin(20) = 6.7 N$

$f_{smax} = 0.4 * 2 * 9.81\cos(20) = 7.37$

driving force < f_s max

obj remain static

Dr. Mohammad Hussein PHY 105 Recitation Session - First Exam - Chapter 6

1) A PHY 105 student is holding a book of mass m. He walks a distance d at a constant speed v. The work the student has done on the book is:

[✓ zero] +mgd – mgd +1/2mv^2 – 1/2mv^2

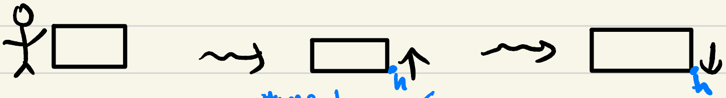
$W_F + \cancel{W_f} = \cancel{\Delta K} + \cancel{\Delta U}$ horizontal

no friction constant speed

$W_F = 0$

2) Imagine you push a box of mass m a distance d across a floor with constant speed. The coefficient of kinetic friction between the box and the floor is μ$_k$. You then pick up the box, raise it to a height h, carry it back to the starting point, and put it back down on the floor. How much work have you done on the box?

μ$_k$mgd zero μ$_k$mgd + 2mgh μ$_k$mgd – 2mgh 2μ$_k$mgd + 2mgh



$-\mu_k mgd$

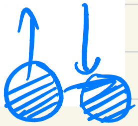
$W_F + W_f = \cancel{\Delta K} + \Delta U$

$\cancel{mg(h-h)}$

$W_F = \mu_k mgd$

3) When a ball rises vertically to a height 3h and returns to its original position, the work done on it by the gravitational force is

[✓ zero] – 6mgh – 3mgh + 3mgh + 6mgh



4) A 20 g particle is moving to the left at a speed of 30 m/s. How much total work (in J) must be done on the particle to make it move to the right at a speed of 30 m/s?

[✓ zero] +9 – 9 +18 – 18

$\Delta U = 0$

5) The engine of a truck of mass 940 kg can deliver an average power of 104800 W. If the truck

$W_F + \cancel{W_f} = \cancel{\Delta K} + \cancel{\Delta U}$ constant speed

$\Delta h = 0$

$W_F = 0$

m P

5) The engine of a truck of mass 940 kg can deliver an average power of 104800 W. If the truck accelerates from rest, the speed (in m/s) after 4.5 s is: (Ignore air resistance)

$v_i = 0$

31.7 11.2 15.1 4.8 36.6

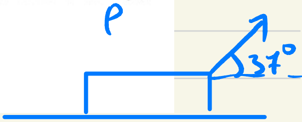
$$P = \frac{W}{t} = \frac{\Delta K}{\Delta t} \rightsquigarrow 104800 = \frac{\frac{1}{2} \times 940 \times v^2}{4.5} \rightarrow v = 31.7\ m/s$$

m v

6) A 100 kg box is pushed at a constant speed of 5.0 m/s across a horizontal floor by an applied force F directed 37° above the horizontal. If the rate at which F does work on the box is 0.66 hp, the applied force F (in N) is: Hint: 1 hp = 746 W

P

123 980 98 164 43



$$0.66 \times 746 = F * 5 * \cos(37)$$

$$\Downarrow$$

$$F = 123.3N$$

$$P = F v \cos\theta$$

m

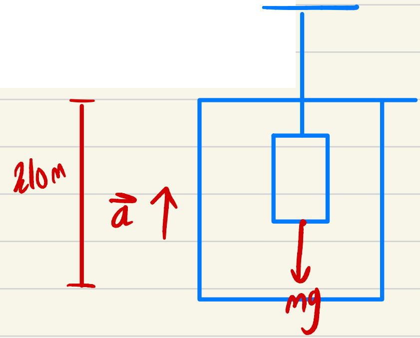
7) A motor lifts a 3000 kg elevator 210 m up during a time interval t at constant speed. If the rate at which the motor does work on the elevator is 362 hp, the time interval t (in s) is: Hint: 1 hp = 746 W

P

23 1.7 5 14.8 19.9

work due to gravity

$$P = \frac{W}{t}$$



$$362 * 746 = \frac{3000 \times 9.81 * 210}{t}$$

$$t = 22.8$$

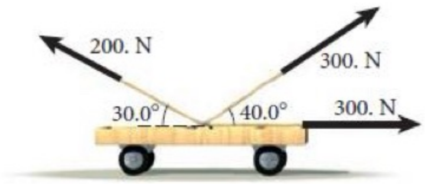
8) A horse drags a heavy cart (200 kg) horizontally on a rough floor at constant speed. The power delivered by the horse is 1.06 hp. The coefficient of kinetic friction between the cart and the floor is 0.115. The speed (in m/s) with which the cart moves across the floor is:

3.5 0.3 11.7 9.0 2.1

$$P = f_k v \cos\theta$$

$$1.06 * 746 = 0.115 \times 200 \times 9.81 \times v \rightsquigarrow v = 3.5\ m/s$$

9) A 125 kg cart initially at rest is pulled by three ropes as shown. When the cart moves 100 m horizontally on a frictionless level, it's final speed (in m/s) is:



$F_1 = 300.$ N at 0°
$F_2 = 300.$ N at 40.0°
$F_3 = 200.$ N at 150.°

24 22 19 27 30

$\cancel{Wf} + WF = \Delta K + \cancel{\Delta U}$

$(300*100)+(300*\cos(40)*100)-(200*\cos(30)\times100) = \frac{1}{2}\times125\times v^2 =$

$\boxed{23.8\ m/s}$

10) A box of mass m at a height h above the floor has a speed v. Its total mechanical energy is E. A second box of mass m at a height 4h above the floor has a speed 2v. The total mechanical energy for the second box is:

4E 2E $(2)^{½}$E E $(2)^{-½}$E

$E=\frac{1}{2}mv^2+mgh$

$E_2 = \frac{1}{2}m(2v)^2 + m\ g4h$

$E_2 = 4(\frac{1}{2}mv^2 + mgh)$

$E_2 = 4\ E$

11) A box of mass m is moving with an initial speed v on a horizontal level, where the coefficient of kinetic friction is μ_k. The box moves a distance d and stops. If the initial speed is doubled, how far will the same box move before it stops?

$v_f = 0$

[✓ 4d] 2d d^2 d $4d^2$

$\cancel{WF} + Wf = \cancel{mgh} + \frac{1}{2}m(0 - v_i^2)$

$+\mu_k \cancel{m} g d = +\frac{1}{2}\cancel{m} v_i^2$

$\mu_k g \overset{④}{d} = \frac{1}{2}(2v_i)^2$

12) As shown, a bead of mass 0.5 kg immersed in a certain liquid is released from rest at point A. At point B, the bead has a speed of 6 m/s. The work done on the bead (in J) by the viscosity (friction force) of the liquid is:

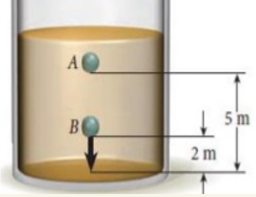
m

$V_i = 0$

V_f

−5.7	+15	+9	−15	−9

α α



$$W_f + \cancel{W_F} = mgh + \Delta K$$

$$W_f = mg(2-5) + \frac{1}{2} m V_f^2$$

$$W_f = 0.5 \times 9.81(2-5) + \frac{1}{2} \times 0.5 \times 6^2 = -5.715$$

13) A 3 kg ball thrown vertically upward has reached a height of 100 m in the presence of air resistance. The air resistance has performed −800 J of work on the ball. Determine the height (in m) the ball would reach if air resistance can be neglected.

127	100	163	196	201

U with friction = 3 x 9.81 x 100 = 2943 J

U without friction = 2943 − (−800) = 3743 J

U without friction = 3743 = mgh = 3 x 9.81 x h

3743 = 3 x 9.81 x h

h = 127.18 m

14) A box of mass 18 kg is dropped from rest from a height of 80 m above the floor. The box falls vertically downward and reaches the floor with a speed of 15 m/s. The work (in 10^3 J) exerted by the air resistance force on the box is:

m

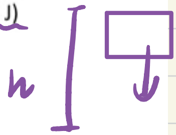
$V_i = 0$

h

V_f

− 12	− 16	+ 12	+ 16	− 14

X X

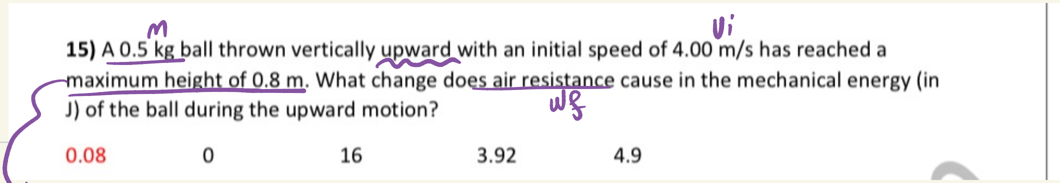


$$\cancel{W_F} + W_f = \Delta K + \Delta U$$

$$W_f = \frac{1}{2} * 18 * (15)^2 + 18 \times 9.81 \times (-80) \rightsquigarrow -12087 \text{ J}$$

↓

−12.087 KJ



15) A 0.5 kg ball thrown vertically upward with an initial speed of 4.00 m/s has reached a maximum height of 0.8 m. What change does air resistance cause in the mechanical energy (in J) of the ball during the upward motion?

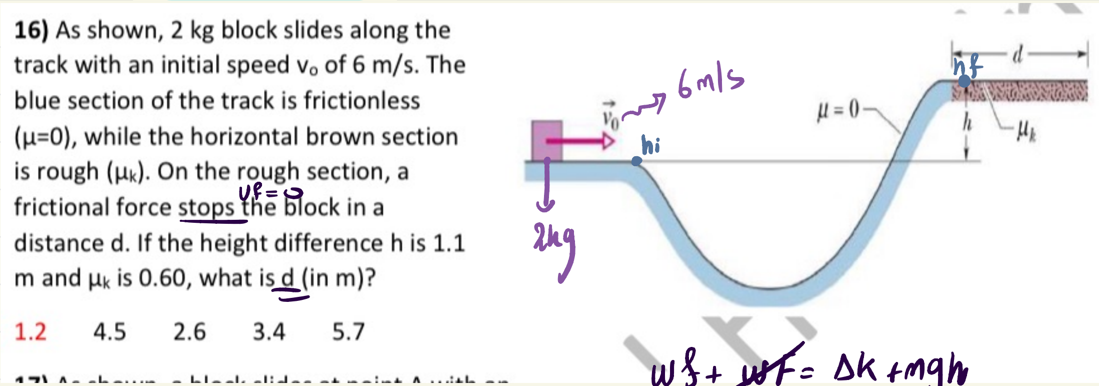
0.08 0 16 3.92 4.9

at maximum height vf=0

$$\cancel{wF} + wf = \Delta K + \Delta U$$

$$wf = \frac{1}{2} * 0.5(0^2 - 4^2) + (0.5 \times 9.8 \times 0.8)$$

$$wf = -0.08$$



16) As shown, 2 kg block slides along the track with an initial speed v₀ of 6 m/s. The blue section of the track is frictionless (μ=0), while the horizontal brown section is rough (μₖ). On the rough section, a frictional force stops the block in a distance d. If the height difference h is 1.1 m and μₖ is 0.60, what is d (in m)?

1.2 4.5 2.6 3.4 5.7

17) As shown, a block slides at point A with an

$$wf + \cancel{wF} = \Delta k + mgh$$

↓

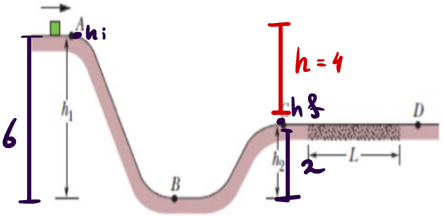
$$-\mu_k mgd = \frac{1}{2}mv^2 + mgh$$

$$-0.6 * \cancel{2} * 9.81\, d = \frac{1}{2} * \cancel{2} * (0 - 6^2) + \cancel{2} * 9.81 * 1.1$$

$$d = 1.22$$

17) As shown, a block slides at point A with an initial speed of 7 $\overset{v_i}{\text{m}}$/s along the track. All the sections of the track are frictionless until the block reaches the section L (of length 12 m), where the coefficient of kinetic friction is 0.7. μ_k If the height differences h₁ and h₂ are 6 m 2 m respectively, how far (in m) through the section of friction does the block travel before it comes to a complete stop? $v_f = 0$

9.3 6.3 10.3 12 5.7



$$W_f \cancel{+W_F} = \Delta K + \Delta U$$

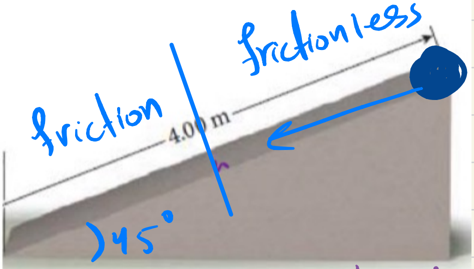
$$-\mu_k \cancel{m} g L = \frac{1}{2}\cancel{m}(0^2 - v^2) - \cancel{m} g y$$

$$-0.7 \times 9.81 \times L = \frac{1}{2}(0^2 - 7^2) - 9.81(4)$$

$$\boxed{L = 9.28\,m}$$

18) A 1 kg ball is located at the top of a 4 m plane inclined at 45° as shown. The ball begins to slide down the inclined plane from $\overset{v_i = 0}{\text{rest}}$. The upper half of the inclined plane is frictionless, while the lower half is rough, with a coefficient of kinetic friction $\mu_k = 0.3$. The speed (in m/s) of the ball at the bottom of the inclined plane is: $v_f = ?$

6.9 5.3 7.5 0.3 1.1



$h = 4\sin(45) = 2.82$

$$\cancel{W_F} + W_f = \Delta K + mgh$$

$$\downarrow$$

$$-\mu_k mg \sin\theta \frac{d}{2} = \frac{1}{2} m v_f^2 - mgh$$

$$-0.3 * 1 * 9.81 \sin(45) * 2 = \frac{1}{2} * 1 * v_f^2 - 1 * 9.81 * 2.82$$

$$\boxed{v_f = 6.856\,m/s}$$

NOTE: For problems involving gravitational force, use $g = 9.80\ \text{m/s}^2$ unless otherwise specified.

Q1) A car travels 40 kilometers at an average speed of 80 km/h and then travels 40 kilometers at an average speed of 40 km/h. The average speed (in km/h) of the car for this 80 km trip is:
A) 40 B) 45 [✓ C) 53] D) 60 E) 80

$$S = \frac{d_1 + d_2}{t_1 + t_2} \rightsquigarrow \frac{80}{\frac{1}{2} + 1} = 53.3$$

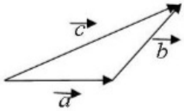
$$\frac{40}{t_1} = 80 \qquad t_1 = \frac{1}{2}$$

$$\frac{40}{t_2} = 40 \qquad t_2 = 1$$

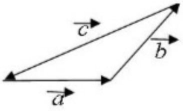
Q2) The vectors $\vec{a}$, $\vec{b}$, and $\vec{c}$ are related by $\vec{c} = \vec{a} - \vec{b}$. Which diagram below illustrates this relationship?

$\vec{c} + \vec{b} = \vec{a}$

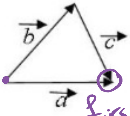
$\vec{b} + \vec{c} = \vec{a}$



I

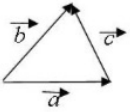


II



[✓ III]

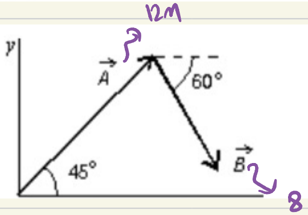
first tail to last head



IV

A) I. B) II. [✓ C) III.] D) IV. E) None of these

Q3) In the diagram, $\vec{A}$ has magnitude 12 m and $\vec{B}$ has magnitude 8 m. The x component (in m) of $\vec{A} + \vec{B}$ is:
A) 1.5 B) 4.5 [✓ C) 12.5] D) 15 E) 20



$A_x = 12\cos 45 = 8.48$

$A_y = 12\sin 45 = 8.48$

$B_x = 8\cos(300) = 4$

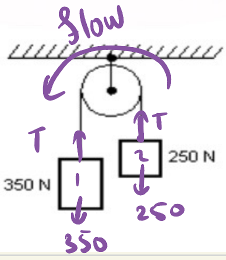
$B_y = 8\sin(300) = -6.928$

$R_x = 12.48$

$R_y = 1.552$

$$R = \sqrt{(12.48)^2 + (1.552)^2} = 12.57$$

Q4) Two blocks weighing 250 N and 350 N respectively, are connected by a string that passes over a massless pulley as shown. The tension (in N) in the string is:
A) 210 [✓ B) 290] C) 410 D) 500 E) 4900



$$T - 250 = \frac{250}{9.81} * 1.635 \rightsquigarrow \boxed{T = 291.6\,N}$$

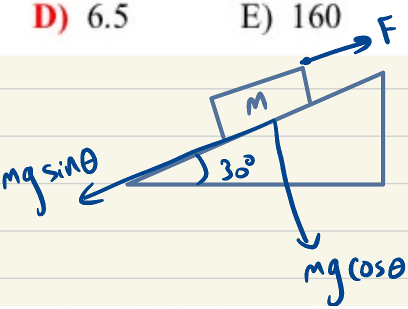
$$T - 250 = \frac{250}{9.8}a \rightsquigarrow 350 - 250 = \frac{a}{9.81}(250 + 350)$$

$$350 - T = \frac{350}{9.8}a$$

$$a = 1.635\ \text{m/s}^2$$

Q5) A 32-N force, parallel to the incline, is required to push a certain block at constant velocity up a frictionless incline that is 30° above the horizontal. The mass (in kg) of the block is:

A) 3.3 B) 3.8 C) 5.7 **D)** 6.5 E) 160



$$F - mg\sin\theta = 0$$

$$32 = m * 9.81 \sin(30)$$

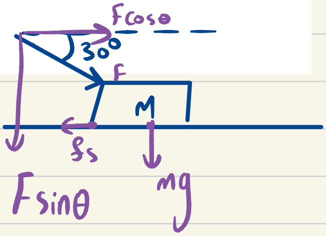
$$m = 6.5239\,kg$$

Q6) A 12-kg block rests on a horizontal surface and a boy pulls on it with a force that is 30° below the horizontal. If the coefficient of static friction is 0.40, the minimum magnitude force (in N) he needs to start the block moving is:

M

μ_s

A) 44 B) 47 C) 54 D) 56 **E)** 71



$$F\cos\theta = f_s$$

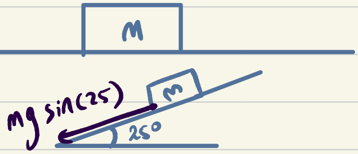
$$F\cos\theta = \mu_s(mg + F\sin\theta)$$

$$F\cos 30 = 0.4(12\times9.8 + F\sin 30)$$

$$F = 70.627\,N$$

Q7) A 5.0-kg block is resting on a horizontal plank. The coefficient of static friction is 0.50 and the coefficient of kinetic friction is 0.40. After one end of the plank is raised so the plank makes an angle of 25° with the horizontal, the force of friction (in N) is:

A) 0 B) 17.8 [✓ C) 20.7] D) 22.2 E) 44.0



driving force → $mg\sin(25)$ → $5\times9.8\times\sin(25) = 20.7$

$f_{s\,max}$ → $\mu_s mg\cos(25)$ → $0.5\times5\times9.8\times\cos(25)$

$= 22.2$

$f_{s\,max}$ > driving force → obj is still static → f_s = driving force = 20.7 N

Q8) A 5.0-kg block is resting on a horizontal plank. The coefficient of static friction is 0.50 and the coefficient of kinetic friction is 0.40. After one end of the plank is raised so the plank makes an angle of 30° with the horizontal, the force of friction (in N) is:

A) 0 **B)** 16.97 C) 21.1 D) 24.5 E) 49.0

$*$ driving force $\rightarrow$ $mg\sin(25) \rightarrow 5\times9.8\times\sin(30) = 24.5N$

$*$ $f_{s\,max} \rightarrow \mu_s mg\cos(25) \rightarrow 0.5\times5\times9.8\times\cos(30) = 21.217$

$*$ driving force $> f_s max$ which means obj is moving

$f_k = \mu_k mg\cos\theta \rightsquigarrow 0.4\times5\times9.8\cos(30) = 16.974$

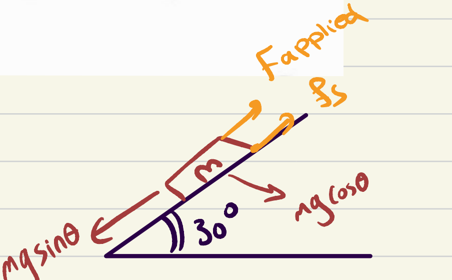
Q9) A 5.0-kg block is on an incline that makes an angle 30° with the horizontal. If the coefficient of static friction is 0.50, the **minimum** force (in N) that can be applied parallel to the plane to hold the block at rest is:

A) 0 **B)** 3.4 C) 21.1 D) 24.5 E) 46

$F_{applied} + f_s = mg\sin\theta$

$F = 5*9.8\sin(30) - 0.5\times9.8\times5\times\cos(30)$

$F = 3.28\ N$



إذا كان الإحتكاك والقوة
نفس الإتجاه رح تكون
القوة قليلة

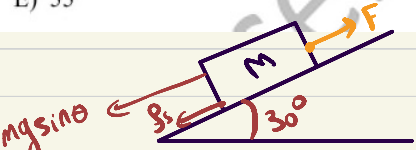
Q10) A 5.0-kg block is on an incline that makes an angle 30° with the horizontal. If the coefficient of static friction is 0.5, the **maximum** force (in N) that can be applied parallel to the plane without moving the block is:

A) 0 B) 3.4 C) 21.1 **D)** 45.6 E) 55

$F = f_s + mg\sin\theta$

$F = 0.5*9.81*5\cos(30) + 5\times9.8\times\sin(30)$

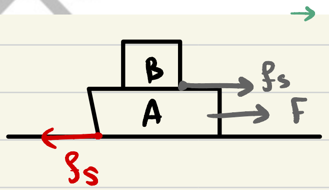
$F = 45.7$



هون القوة لازم تتغلب على الوزن
والإحتكاك عشان هيك بتكون maximum

Q11) Block A, with mass m_A, is initially at rest on a smooth horizontal floor. Block B, with mass m_B, is initially at rest on the horizontal top surface of A. The coefficient of static friction between the two blocks is μ_s. Block A is pulled with a horizontal force. It begins to slide out from under B if the force is greater than:

A) $m_A g$ B) $m_B g$ C) $\mu_s m_A g$ D) $\mu_s m_B g$ E) $\mu_s(m_A + m_B)g$



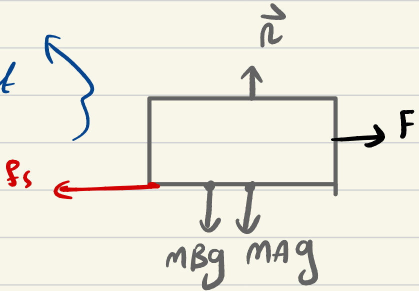
one system moving togather

ما منعهم »
Friction force

ذلك يسقم

$F = \mu_s (m_A + m_B) g$

if F is any greater it will start to slide out



Q12) A 1000-kg airplane moves in straight flight at constant speed. The force of air friction is 1800 N. The net force (in N) on the plane is:

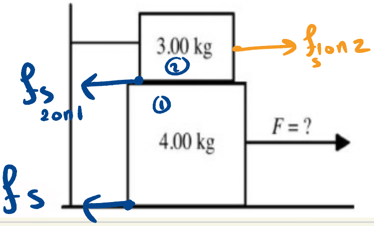
$\boxed{\text{A) } 0}$ B) 11600 C) 1800 D) 9800 E) none of these

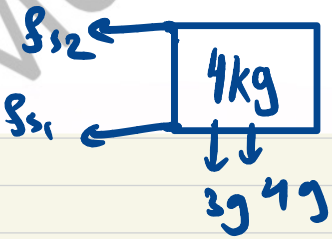
net force at constant speed is zero

$V_f = V_i \rightarrow \Delta V = 0 \rightarrow a = 0 \rightarrow \Sigma F = 0$

Q14) A 4.00-kg block rests between the floor and a 3.00-kg block as shown in the figure. The 3.00-kg block is tied to a wall by a horizontal rope. If the coefficient of static friction is 0.800 between each pair of surfaces in contact, what horizontal force *F* (in N) must be applied to the 4.00-kg block to make it move?

A) 16.2 B) 54.9 C) 21.1 D) 23.5 **E)** 78.4





$$F = f_{s_1} + f_{s_2}$$

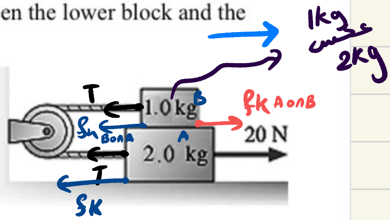
$$= \mu_s (m_1 + m_2) g + \mu_s (m_2) g$$

$$= \mu_s g (m_1 + 2m_2)$$

$$= 0.8 * 9.8 (4 + 3(2)) = 78.4$$

Q15) A rope pulls on the lower block in the figure with a tension force of 20 N. The coefficient of kinetic friction between the lower block and the surface is 0.16. The coefficient of kinetic friction between the lower block and the upper block is also 0.16. The pulley has no appreciable mass or friction. What is the acceleration (in m/s^2) of the 2.0 kg block?

A) 4.1 B) 5.1 C) 8.4 D) 9.2 E) 0.7



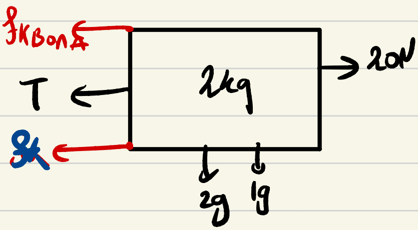
$$T - f_{k\,B on A} = 1a$$

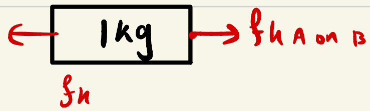
$$20 - f_{k\,A on B} \cancel{T} - f_k = 2a$$

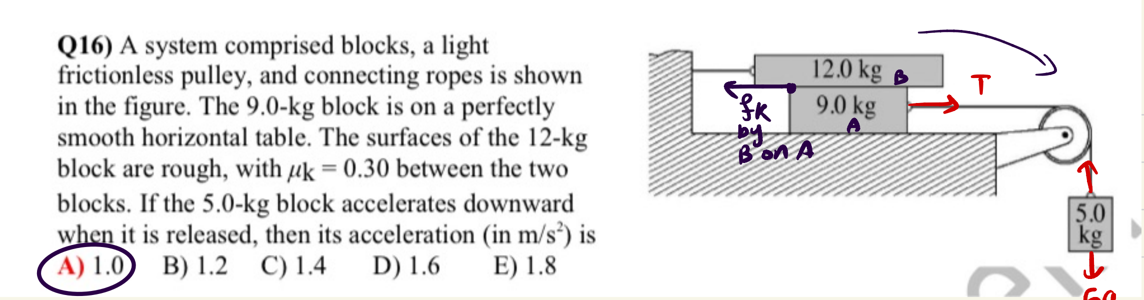
$$20 - 2f_k - f_k = 3a$$

$$20 - 2(1 \times 9.8 \times 0.16) - 0.16(3)(9.81) = 3a$$

$$a = 4.05\ m/s^2$$







Q16) A system comprised blocks, a light frictionless pulley, and connecting ropes is shown in the figure. The 9.0-kg block is on a perfectly smooth horizontal table. The surfaces of the 12-kg block are rough, with $\mu_k = 0.30$ between the two blocks. If the 5.0-kg block accelerates downward when it is released, then its acceleration (in m/s^2) is

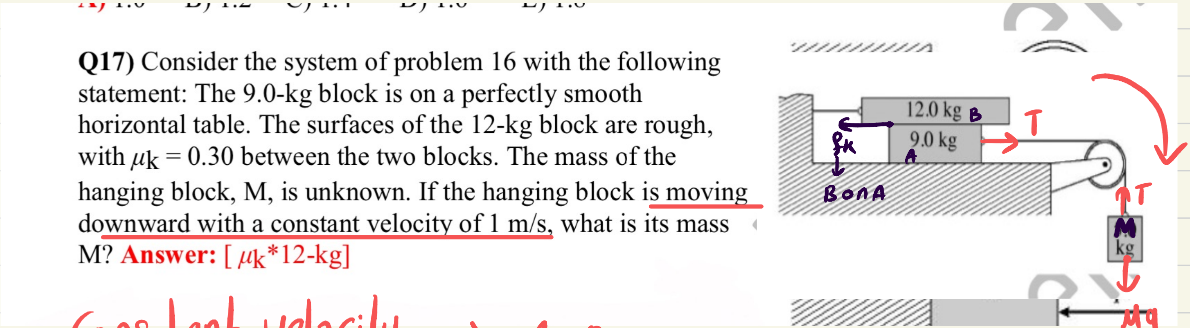
[✓ A) 1.0] B) 1.2 C) 1.4 D) 1.6 E) 1.8

$\cancel{T} - f_k = 9a$

$5g - \cancel{T} = 5a$

$5g - f_k = 14a$ ↗ $5(9.8) - \mu_k m_B g = 14a$

$$a = \frac{5(9.8) - 0.3*12*9.81}{14} = 0.98\ m/s^2$$



Q17) Consider the system of problem 16 with the following statement: The 9.0-kg block is on a perfectly smooth horizontal table. The surfaces of the 12-kg block are rough, with $\mu_k = 0.30$ between the two blocks. The mass of the hanging block, M, is unknown. If the hanging block is moving downward with a constant velocity of 1 m/s, what is its mass M? **Answer:** [μ_k*12-kg]

Constant velocity ⇝ $a=0$

$\mu_k \times 12g = T$ ⇝ $\mu_k \times 12\cancel{g} = M\cancel{g}$

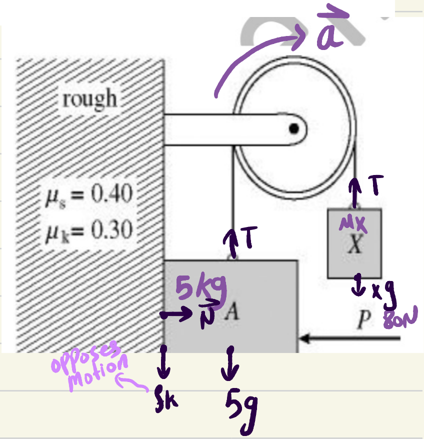
$T = Mg$

$\mu_k * 12 = M$

$0.3 * 12 = 3.6\,kg$

Q18) Block *A* of mass 5.0 kg and block *X* are attached to a rope which passes over a pulley, as shown in the figure. An 80-N force *P* is applied horizontally to block *A*, keeping it in contact with a rough vertical face. The coefficients of static and kinetic friction between the wall and block *A* are $\mu_s = 0.40$ and $\mu_k = 0.30$. The pulley is light and frictionless. The mass of block *X* is adjusted until block *A* moves upward with an acceleration of 1.6 m/s². What is the mass (in kg) of block *X*?

A) 9.9 B) 9.3 C) 8.7 $\vec{a}$ D) 8.1 E) 7.5



$$T - f_k - 5g = 5a$$

$$M_X g - T = M_X a$$

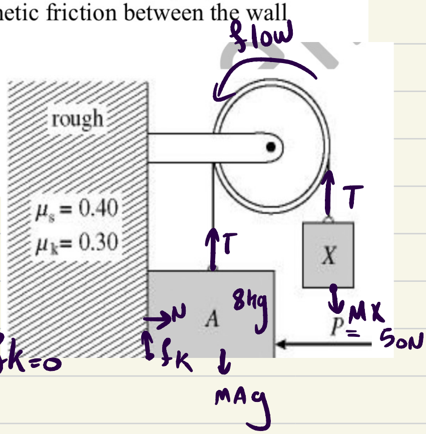
$$M_X g - f_k - 5g = (5 + M_X)a$$

$$M_X(9.81) - 0.3(80) - 5(9.81) = (5 + M_X)(1.6)$$

$$M_X = 9.87 \text{ kg}$$

Q19) Consider the figure of problem 18. Block *A* of mass 8.0 kg and block *X* are attached to a rope that passes over a pulley. A 50-N force *P* is applied horizontally to block *A*, keeping it in contact with a rough vertical face. The coefficients of static and kinetic friction between the wall and block *A* are $\mu_s = 0.40$ and $\mu_k = 0.30$. The pulley is light and frictionless. In the figure, the mass of block *X* is adjusted until block *A* descends at constant velocity of 4.75 cm/s when it is set into motion. What is the mass (in kg) of block *X*?

A) 6.5 B) 7.2 C) 8.0 D) 8.8 E) 9.5



Constant velocity $\vec{a} = 0$

$$M_A g - T - f_k = 0$$

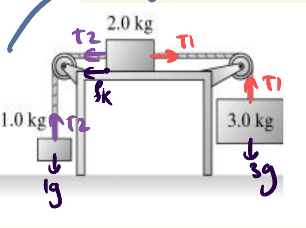
$$T - M_X g = 0 \rightsquigarrow M_A g - M_X g - f_k = 0$$

$$8g - m_X g - 0.3(50) = 0$$

$$M_X = 6.469 \text{ kg}$$

Q20) Three objects are connected as shown in the figure. The strings and frictionless pulleys have negligible masses, and the coefficient of kinetic friction between the 2.0-kg block and the table is 0.25. What is the acceleration (in m/s²) of the 2.0-kg block?

A) 2.5 B) 1.7 C) 3.2 D) 4.0 E) 8.2



$$3g - \cancel{T_1} = 3a$$

$$\cancel{T_1} - \cancel{T_2} - f_k = 2a$$

$$\cancel{T_2} - g = a$$

$$3g - f_k - g = 6a$$

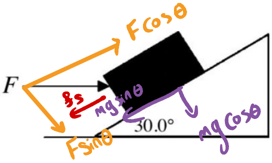
$$2g - \mu_k(2g) = 6a$$

$$2g(1 - \mu_k) = 6a \rightarrow \frac{2 \times 9.81(1 - 0.25)}{6} = a$$

$$\boxed{a = 2.45\ m/s^2}$$

Q21) A 4.00-kg block rests on a 30.0° incline as shown in the figure. The coefficients of static friction and kinetic friction between the block and the incline are 0.700 (μ_s) and 0.500 (μ_k) respectively. The magnitude of the force F (in N) that must act on the block to start it moving up the incline is: A) 34.0 B) 51.1 C) 54.7 D) 84.0 E) 76.4

→ Still static



$$F\cos\theta = mg\sin\theta + f_s$$

$$F\cos\theta = mg\sin\theta + \mu_s(mg\cos\theta + F\sin\theta)$$

$$F\cos(30) = 4(9.81)\sin(30) + 0.7(4 \times 9.8\cos(30) + F\sin(30))$$

$$F = 84.07\ N$$

1. The time T required for one complete oscillation of a mass m on a spring of force constant k is $T = 2\pi\sqrt{\frac{m}{k}}$. Find the dimensions k must have for this equation to be dimensionally correct. Use [M] to represent the dimension of mass, [T] for time, and [L] for length. $\frac{[M]}{[T]^2}$

Insight: This is a dimensional analysis question. The $4\pi^2$ does not contribute any dimensions.

$$(T)^2 = \left(2\pi\sqrt{\frac{M}{K}}\right)^2$$

$$T^2 = (2\pi)^2\frac{m}{k}$$

$$T^2 k = 2\pi^2 m$$

$$k = \frac{2\pi^2 m}{T^2} \rightarrow \frac{M}{T^2}$$

2. Acceleration is related to velocity and time by the following expression: $a = v^p t^q$. Find the powers p and q that make this equation dimensionally consistent. p = 1 and q = -1

Insight: Sometimes you can determine whether you've made a mistake in your calculations simply by checking to ensure the dimensions work out correctly on both sides of your equations.

$$a = v^p t^q$$

$a \rightarrow m/s^2$

$v \rightarrow v^1 \rightarrow \frac{m}{s}$

$t \rightarrow t^{-1} \rightarrow \frac{1}{s}$

$$\frac{m}{s} * \frac{1}{s} = \frac{m}{s^2}$$

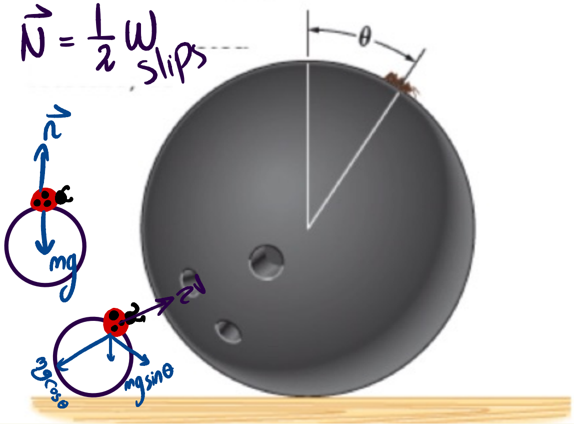
thus $p = 1$ $q = -1$

4. An ant walks away from the top of a smooth bowling ball, as depicted at right. If the ant starts to slip when the normal force on its feet equals one-half its weight, at what angle θ does slipping begin?

60°

Insight: The normal force itself will not be zero until θ = 90°, at which point nothing will stop the ant's fall unless it has sticky feet!

$\vec{N} = \frac{1}{2}W$ slips



$$\vec{n} = \frac{1}{2}mg$$

$$\cancel{mg}\cos\theta = \frac{1}{2}\cancel{mg} \rightsquigarrow \cos^{-1}\left(\frac{1}{2}\right) = 60°$$

6. A food particle from your breakfast takes a circuitous path through your digestive system. Suppose its motion over a period of time can be represented by the four displacement vectors depicted in the figure below. Let the vectors have magnitudes *A* = 8.0 cm, *B* = 16 cm, *C* = 23 cm, and *D* = 5.6 cm. If the average speed of the particle is 0.010 mm/s, what is its average velocity (in mm/s) over the time interval of the four displacements? Give its direction relative to the direction of vector **A**.

0.0034 mm/s at 214.35° counterclockwise from **A**.

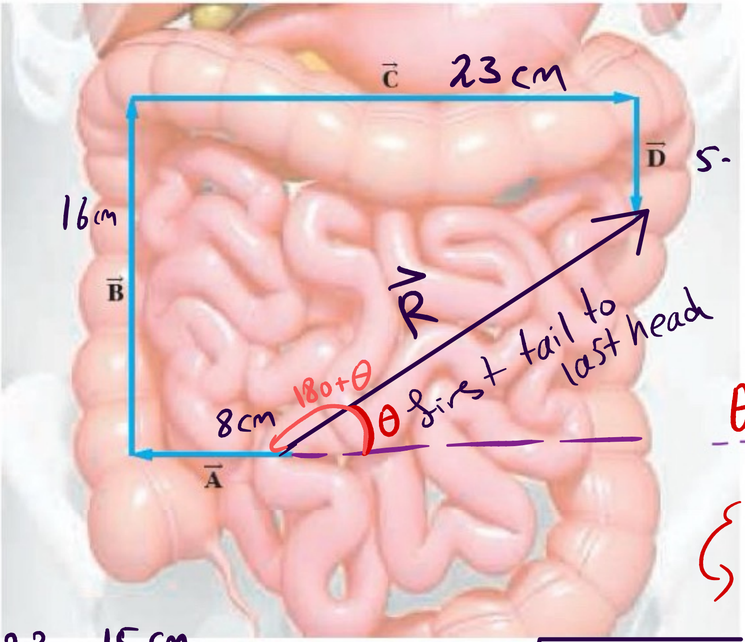
$\times 10^{-2}$

$$0.010 \times 10^{-3} = \frac{(8+16+23+5.6)\hat{i}}{t}$$

$t = 52900 m/s$

Free tip: First, find the total displacement of the food particle. Give its direction counterclockwise from **A**. To find the average velocity of the food particle, use the average speed value to find the total time elapsed, and then use the displacement and the time to calculate the average velocity.

Insight: Food particles (called chyme) travel faster in the human small intestine, requiring at least 1.7 hours to traverse the 6.1-m length at an average speed of about 1.0 mm/s.



$$\theta = \tan^{-1}\left(\frac{10.4}{15}\right)$$

$\theta = 34.73°$

$180 + 34.73 = 214.73°$

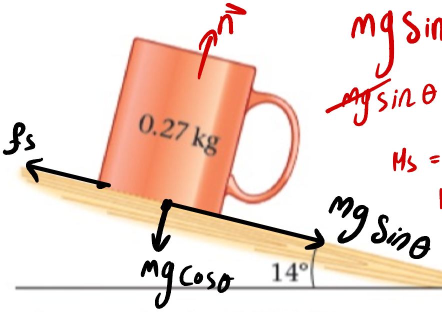
$R_x = -8 + 23 = 15$ cm

$R_y = 16 + -5.6 = 10.4$ cm

$$|\vec{R}| = \sqrt{15^2 + 10.4^2} = 18.25 \text{cm}$$

$$V = \frac{18.25 \times 10^{-2}}{52900} = 3.44 \times 10^{-4} \text{m/s} \rightarrow 3.44 \times 10^{-3} \text{mm/s}$$

7. A mug rests on an inclined surface, as shown. What is the minimum coefficient of static friction required to keep the mug from sliding? 0.25



$mg\sin\theta = f_s$

$\cancel{m}g\sin\theta = \mu_s(\cancel{m}g\cos\theta)$

$\mu_s = \tan\theta$

$\mu_s = \tan(14)$

$\mu_s = 0.249$

8. The human brain consumes about 22 W of power under normal conditions, though more power may be required **during exams, hmm!** مقدار :)

P

(a) For what amount of time can one Snickers bar (see the note below) power the normally functioning brain? (b) At what rate must you lift a 3.6-kg container of milk (one gallon) if the power output of your arm is to be 22 W? (c) How much time does it take to lift the milk container through a distance of 1.0 m at this rate?

t

Note: each Snickers bar contains 280 Cal of energy, and each Cal is equivalent to 4186 J.

(a) 14.8 hours. (b) 0.62 m/s. (c) 1.6 s.

Insight: The human brain converts chemical energy into electrical energy and finally into heat energy. The power required for doing mechanical work is typically larger than that consumed by the brain. In practice it probably takes you a little less than a second to lift the milk 1.0 m, so you expend about 40 W or twice the power lifting the milk than your brain consumes.

a) $P = \frac{W}{t} \rightsquigarrow 22 = \frac{4186 \times 280}{t}, \quad t = 53276.36s$

$\downarrow$

14.79 hours

b) $P = Fv \Rightarrow 22 = 3.6 \times 9.8 \times v$

$v = 0.623 \, m/s$

c) $\Delta x - vt \rightarrow 1 = 0.623 \, t \rightsquigarrow t = 1.605s$

9. (a) To accelerate a certain car from rest to the speed v requires the work W_1, as shown in the sketch. The work needed to accelerate the car from v to $2v$ is W_2. Which of the following statements is correct: $W_2 = W_1$, $W_2 = 2W_1$, $\boxed{W_2 = 3W_1}$, $W_2 = 4W_1$?

(b) Which of the following is the best explanation for your prediction?

I. The increase in speed is the same, so the work is also the same.

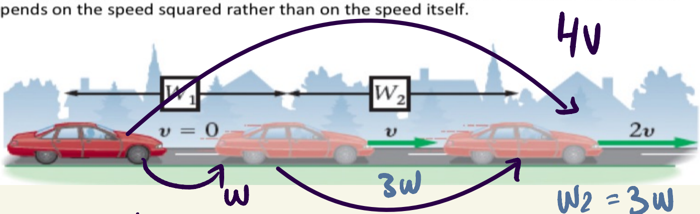
II. To double the speed requires double the work.

III. Kinetic energy depends on v^2, and hence it takes four times as much work to increase the speed to $2v$.

IV. Four times as much work is required to go from 0 to $2v$ as to go from 0 to v. Therefore, the work required to increase the speed from v to $2v$ is three times the original work.

(a) The required work is $W_2 = 3W_1$. (b) The best explanation is IV.

Insight: A common misconception is to reason that because we increase the speed by the same amount in each case, the work required is the same. It is not, and the reason is that work depends on the speed squared rather than on the speed itself.



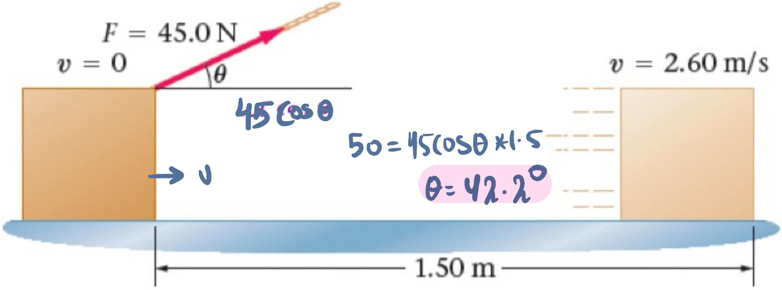
$W_2 = 3W$

$4W = \frac{1}{2} m (2v)^2$

4v

~~$u=0$~~ ~~$w_f=0$~~

10. A block rests on a horizontal frictionless surface. A string is attached to the block, and is pulled with a force of 45.0 N at an angle θ above the horizontal, as shown in the figure below. After the block is pulled through a distance of 1.50 m, its speed is 2.60 m/s, and 50.0 J of work has been done on it. (a) What is the angle θ? 42.2°. (b) What is the mass of the block? 14.8 kg.



$45\cos\theta$

$\rightarrow v$

$50 = 45\cos\theta \times 1.5$

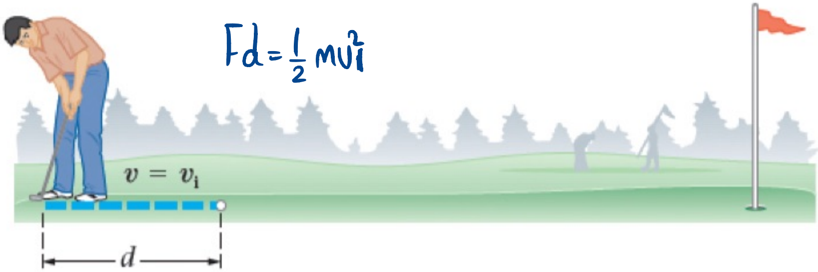
$\theta = 42.2^\circ$

$W_F = \frac{1}{2}mv^2$

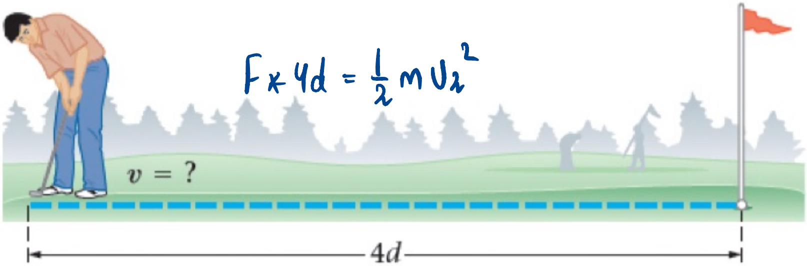
$50 = \frac{1}{2} \times m \times 2.6^2$

$m = 14.79$ kg

11. A golfer badly misjudges a putt, sending the ball only one-quarter of the distance to the hole. The original putt gave the ball an initial speed of v_i. If the force of resistance due to the grass is constant, would an initial speed of (a) $2v_i$, (b) $3v_i$, or (c) $4v_i$ be needed to get the ball to the hole from its original position? $2v_i$



$Fd = \frac{1}{2}mv_i^2$



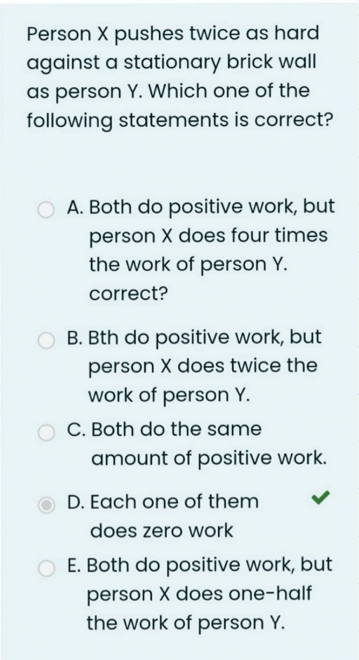
$F \times 4d = \frac{1}{2}mv_2^2$

$$\frac{\cancel{F}d}{\cancel{F}4\cancel{d}} = \frac{\cancel{\frac{1}{2}}\cancel{m}v_1^2}{\cancel{\frac{1}{2}}\cancel{m}v_2^2}$$

$\sqrt{4v_1^2} = \sqrt{v_2^2}$

$\boxed{2v_1 = v_2}$

Dr. J Quiz



Person X pushes twice as hard against a stationary brick wall as person Y. Which one of the following statements is correct?

○ A. Both do positive work, but person X does four times the work of person Y. correct?

○ B. Bth do positive work, but person X does twice the work of person Y.

○ C. Both do the same amount of positive work.

● D. Each one of them does zero work ✓

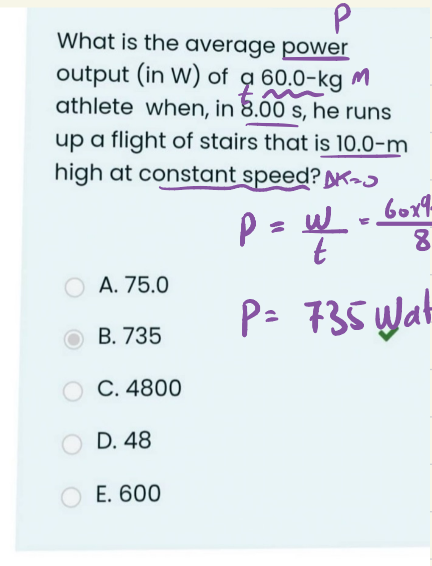
○ E. Both do positive work, but person X does one-half the work of person Y.

$W = F\underset{\text{zero}}{d}$

zero

$WF + \cancel{wf} = \Delta K + \overset{\text{or}}{\cancel{mgy}}$

$\boxed{WF = 0}$



What is the average power output (in W) of a 60.0-kg athlete when, in 8.00 s, he runs up a flight of stairs that is 10.0-m high at constant speed?

P

m

t

ΔK=0

○ A. 75.0

● B. 735

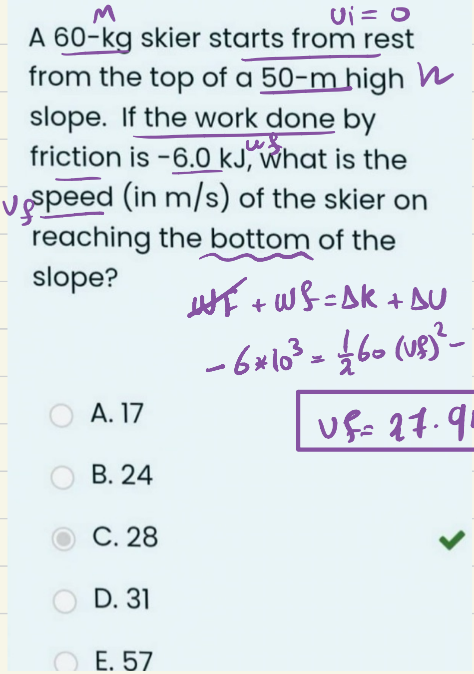
○ C. 4800

○ D. 48

○ E. 600

$P = \frac{w}{t} = \frac{60 \times 9.8 \times 10}{8}$

$P = 735$ Watt ✓



A 60-kg skier starts from rest from the top of a 50-m high slope. If the work done by friction is -6.0 kJ, what is the speed (in m/s) of the skier on reaching the bottom of the slope?

m

$v_i = 0$

h

wf

v_f

○ A. 17

○ B. 24

● C. 28 ✓

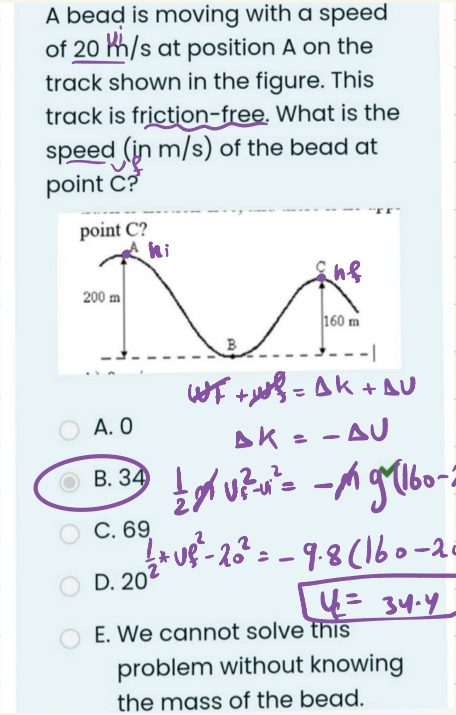
○ D. 31

○ E. 57

$\cancel{WF} + Wf = \Delta K + \Delta U$

$-6 * 10^3 = \frac{1}{2} 60 (v_f)^2 - 60 * 9.81 * 50$

$\boxed{v_f = 27.94 \text{ m/s}}$



A bead is moving with a speed of 20 m/s at position A on the track shown in the figure. This track is friction-free. What is the speed (in m/s) of the bead at point C?

v_i

v_f

○ A. 0

● B. 34 ✓

○ C. 69

○ D. 20

○ E. We cannot solve this problem without knowing the mass of the bead.

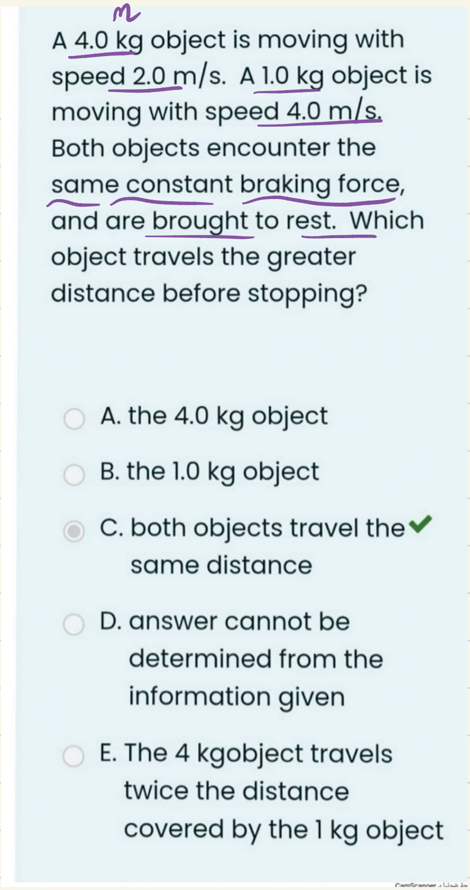
$\cancel{WF} + \cancel{wf} = \Delta k + \Delta U$

$\Delta K = -\Delta U$

$\frac{1}{2} \cancel{m} (v_f^2 - v_i^2) = -\cancel{m} g (160 - 200)$

$\frac{1}{2} * v_f^2 - 20^2 = -9.8 (160 - 200)$

$\boxed{v_f = 34.4}$



m

A 4.0 kg object is moving with speed 2.0 m/s. A 1.0 kg object is moving with speed 4.0 m/s. Both objects encounter the same constant braking force, and are brought to rest. Which object travels the greater distance before stopping?

○ A. the 4.0 kg object

○ B. the 1.0 kg object

● C. both objects travel the same distance ✓

○ D. answer cannot be determined from the information given

○ E. The 4 kgobject travels twice the distance covered by the 1 kg object

A) $\cancel{W_F} + W_f = \Delta K + \cancel{\Delta U}$

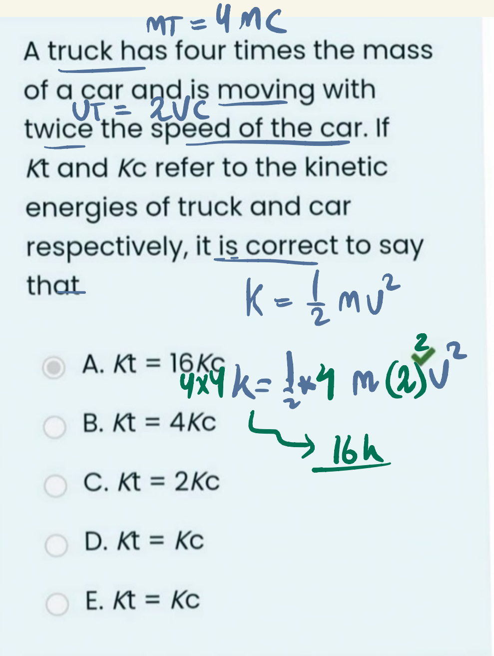
$- f_{kA}\, d = -\frac{1}{2} m_A v_A^2$

B) $- f_{kB}\, d = -\frac{1}{2} m_B v_B^2$

$$\frac{\cancel{-f_k}\ d_A}{\cancel{-f_k}\ d_B} = \frac{\cancel{+}\cancel{\frac{1}{2}}\, m_A\ v_A^2}{\cancel{+}\cancel{\frac{1}{2}}\, m_B\ v_B^2}$$

$$\frac{d_A}{d_B} = \frac{4\,(2)^2}{1 * 4^2}$$

$$\frac{d_A}{d_B} = 1 \rightsquigarrow \boxed{d_A = d_B}$$



$M_T = 4 M_C$

A truck has four times the mass of a car and is moving with twice the speed of the car. If Kt and Kc refer to the kinetic energies of truck and car respectively, it is correct to say that

$v_T = 2 v_C$

$K = \frac{1}{2} m v^2$

● A. Kt = 16Kc

○ B. Kt = 4Kc

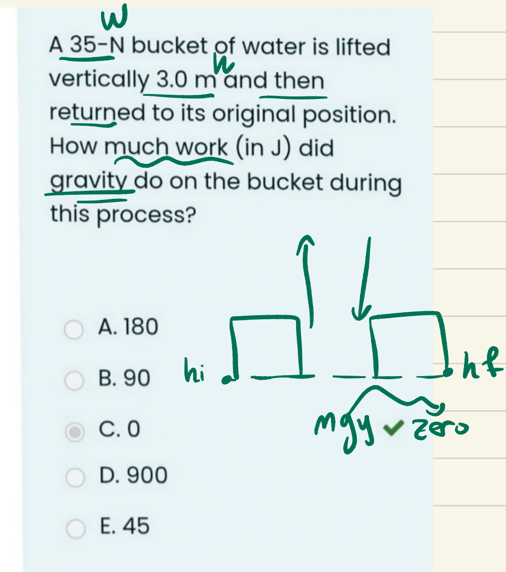
○ C. Kt = 2Kc

○ D. Kt = Kc

○ E. Kt = Kc

$4 \times 4\, k = \frac{1}{2} * 4\ m\,(2)^2 v^2$ ✓

→ 16k



w

A 35-N bucket of water is lifted vertically 3.0 m and then returned to its original position. How much work (in J) did gravity do on the bucket during this process?

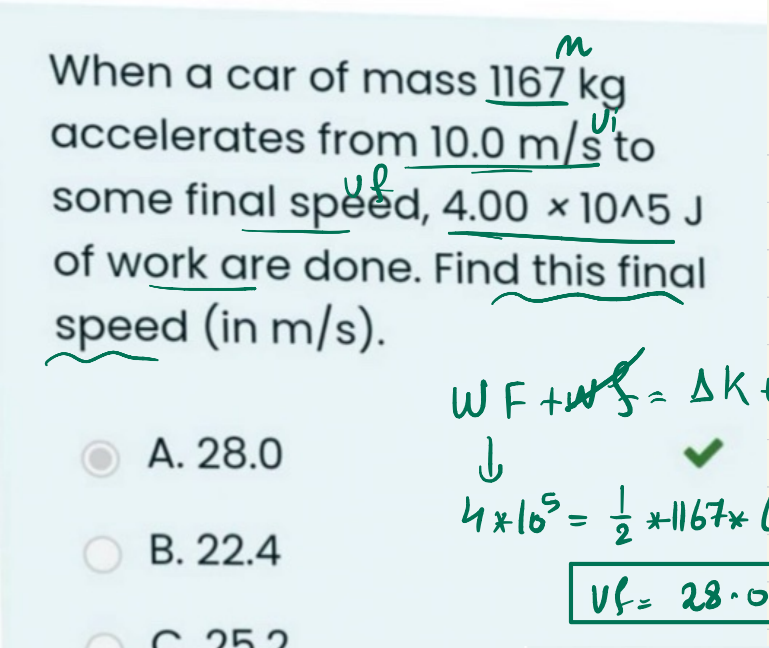
○ A. 180

○ B. 90

● C. 0

○ D. 900

○ E. 45



When a car of mass 1167 kg accelerates from 10.0 m/s to some final speed, 4.00 × 10^5 J of work are done. Find this final speed (in m/s).

m

vi

vf

● A. 28.0 ✓

○ B. 22.4

○ C. 25.2

○ D. 30.8

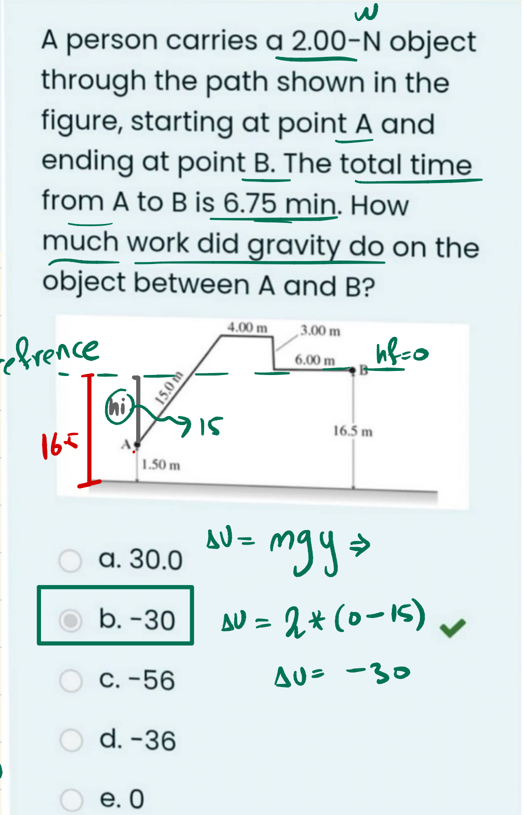
○ E. 16.7

$W_F + \cancel{W_f} = \Delta K + \cancel{\Delta U}$

↓

$4*10^5 = \frac{1}{2} * 1167 * (v_f^2 - 10^2)$

$\boxed{v_f = 28.027 \text{ m/s}}$



A person carries a 2.00-N object through the path shown in the figure, starting at point A and ending at point B. The total time from A to B is 6.75 min. How much work did gravity do on the object between A and B?

w

refrence

hf=0

hi

15

16.5

○ a. 30.0

● b. -30

○ c. -56

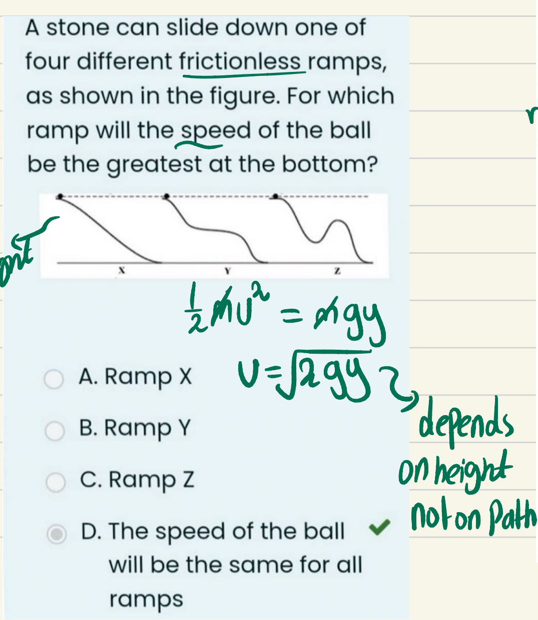
○ d. -36

○ e. 0

$\Delta U = mgy \Rightarrow$

$\Delta U = 2*(0-15)$ ✓

$\Delta U = -30$



A stone can slide down one of four different frictionless ramps, as shown in the figure. For which ramp will the speed of the ball be the greatest at the bottom?

same height

$\frac{1}{2}\cancel{m}v^2 = \cancel{m}gy$

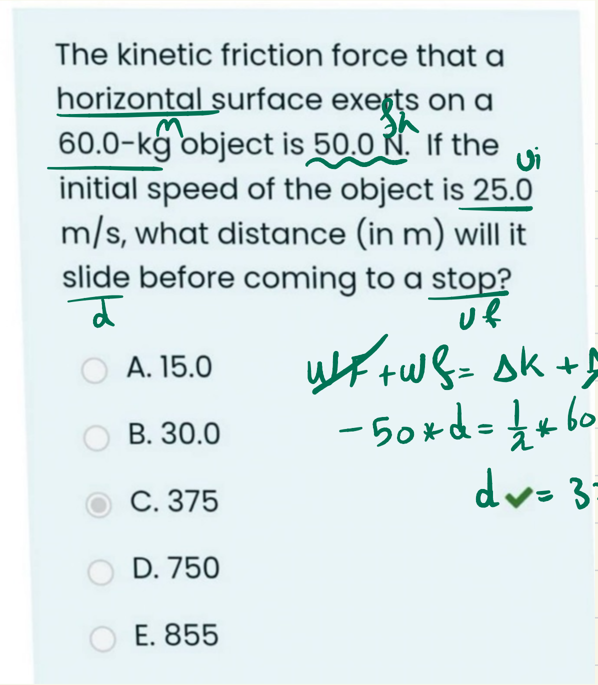
$v = \sqrt{2gy} \rightarrow$ depends on height not on Path

○ A. Ramp X

○ B. Ramp Y

○ C. Ramp Z

● D. The speed of the ball will be the same for all ramps ✓



The kinetic friction force that a horizontal surface exerts on a 60.0-kg object is 50.0 N. If the initial speed of the object is 25.0 m/s, what distance (in m) will it slide before coming to a stop?

m fk vi d vf

○ A. 15.0

○ B. 30.0

● C. 375

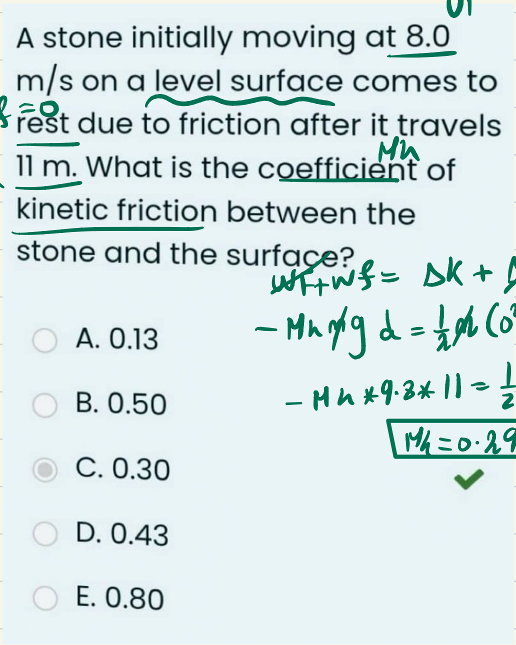
○ D. 750

○ E. 855

$$\cancel{W_F} + W_f = \Delta K + \cancel{\Delta U}$$

$$-50 * d = \frac{1}{2} * 60(0^2 - 25^2)$$

d ✓ = 375 m



A stone initially moving at 8.0 m/s on a level surface comes to rest due to friction after it travels 11 m. What is the coefficient of kinetic friction between the stone and the surface?

vi Vf = 0 d Mk

○ A. 0.13

○ B. 0.50

● C. 0.30 ✓

○ D. 0.43

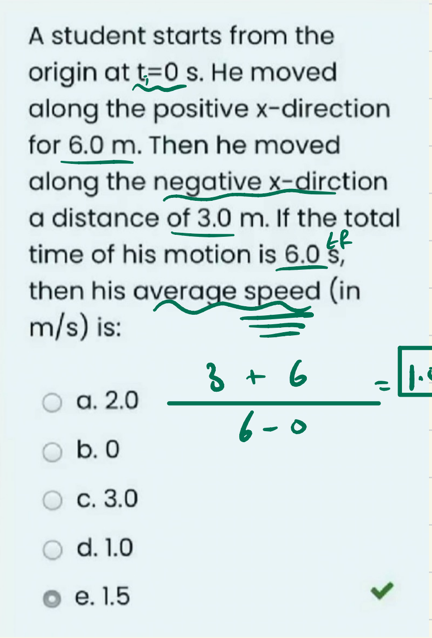
○ E. 0.80

$$\cancel{W_F} + W_f = \Delta K + \cancel{\Delta U}$$

$$-M_k \cancel{m} g\, d = \frac{1}{2}\cancel{m}(0^2 - v_i^2)$$

$$-M_k * 9.8 * 11 = \frac{1}{2}(0^2 - 8^2)$$

$$\boxed{M_k = 0.296}$$



A student starts from the origin at t=0 s. He moved along the positive x-direction for 6.0 m. Then he moved along the negative x-dirction a distance of 3.0 m. If the total time of his motion is 6.0 s, then his average speed (in m/s) is:

ti tf

○ a. 2.0

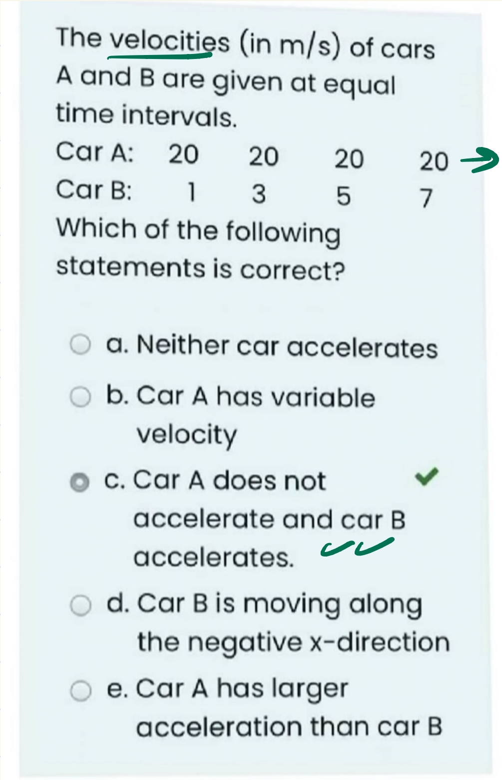
○ b. 0

○ c. 3.0

○ d. 1.0

● e. 1.5 ✓

$$\frac{3 + 6}{6 - 0} = \boxed{1.5 m/s}$$



The velocities (in m/s) of cars A and B are given at equal time intervals.

Car A:	20	20	20	20
Car B:	1	3	5	7

→ Constant speed

$a=0$

Which of the following statements is correct?

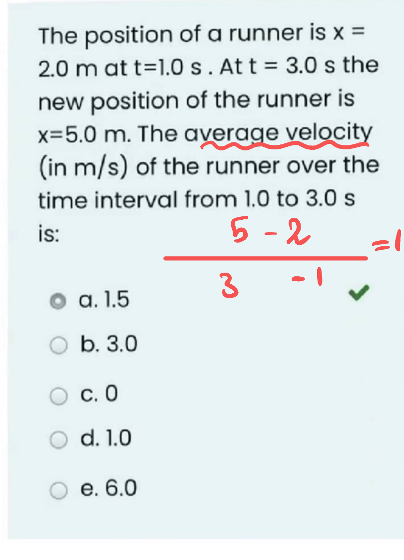
○ a. Neither car accelerates

○ b. Car A has variable velocity

● c. Car A does not accelerate and car B accelerates. ✓ ✓✓

○ d. Car B is moving along the negative x-direction

○ e. Car A has larger acceleration than car B



The position of a runner is x = 2.0 m at t=1.0 s . At t = 3.0 s the new position of the runner is x=5.0 m. The average velocity (in m/s) of the runner over the time interval from 1.0 to 3.0 s is:

$$\frac{5-2}{3-1} = 1.5$$

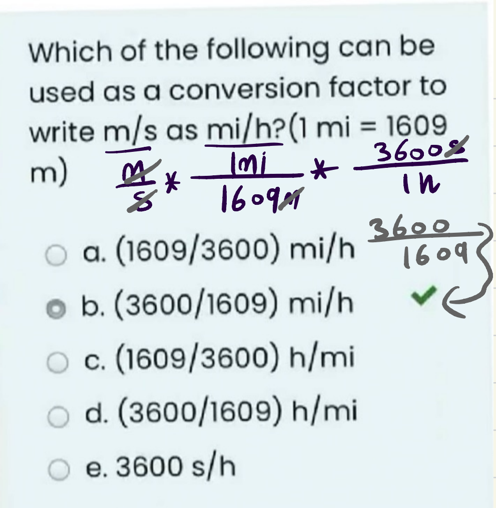
● a. 1.5 ✓

○ b. 3.0

○ c. 0

○ d. 1.0

○ e. 6.0



Which of the following can be used as a conversion factor to write m/s as mi/h?(1 mi = 1609 m)

$$\frac{\cancel{m}}{\cancel{s}} * \frac{1mi}{1609\cancel{m}} * \frac{3600\cancel{s}}{1h}$$

$$\frac{3600}{1609}$$

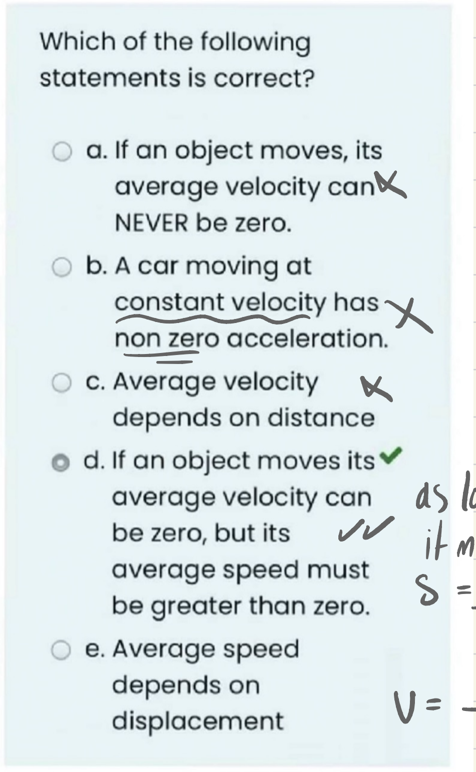
○ a. (1609/3600) mi/h

● b. (3600/1609) mi/h ✓

○ c. (1609/3600) h/mi

○ d. (3600/1609) h/mi

○ e. 3600 s/h



Which of the following statements is correct?

○ a. If an object moves, its average velocity can NEVER be zero. ✗

○ b. A car moving at constant velocity has non zero acceleration. ✗

○ c. Average velocity depends on distance ✗

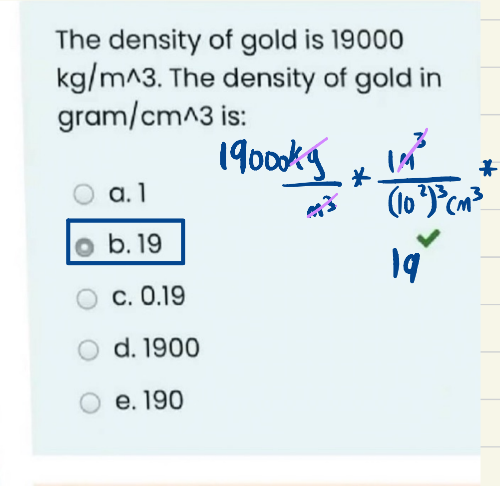
● d. If an object moves its average velocity can be zero, but its average speed must be greater than zero. ✓ ✓✓

○ e. Average speed depends on displacement

as long as it moves

$S = \frac{d}{t}$ ← this cannot be zero

$V = \frac{x}{t}$ ← this can be zero



The density of gold is 19000 kg/m^3. The density of gold in gram/cm^3 is:

○ a. 1

● b. 19

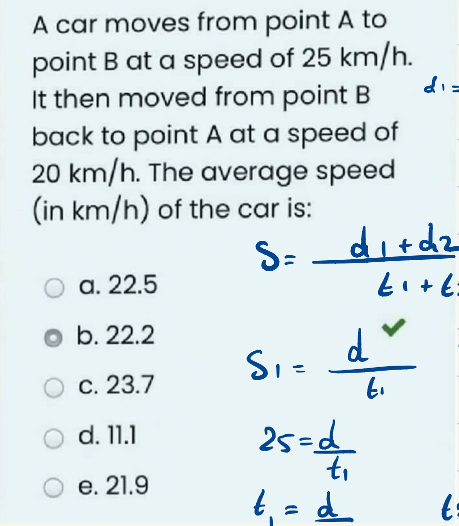
○ c. 0.19

○ d. 1900

○ e. 190

$$\frac{19000\cancel{kg}}{\cancel{m^3}} * \frac{1\cancel{m^3}}{(10^2)^3 cm^3} * \frac{1000g}{1\cancel{kg}}$$

19 ✓



A car moves from point A to point B at a speed of 25 km/h. It then moved from point B back to point A at a speed of 20 km/h. The average speed (in km/h) of the car is:

○ a. 22.5

● b. 22.2 ✓

○ c. 23.7

○ d. 11.1

○ e. 21.9

$d_1 = d_2$

$$S = \frac{d_1 + d_2}{t_1 + t_2}$$

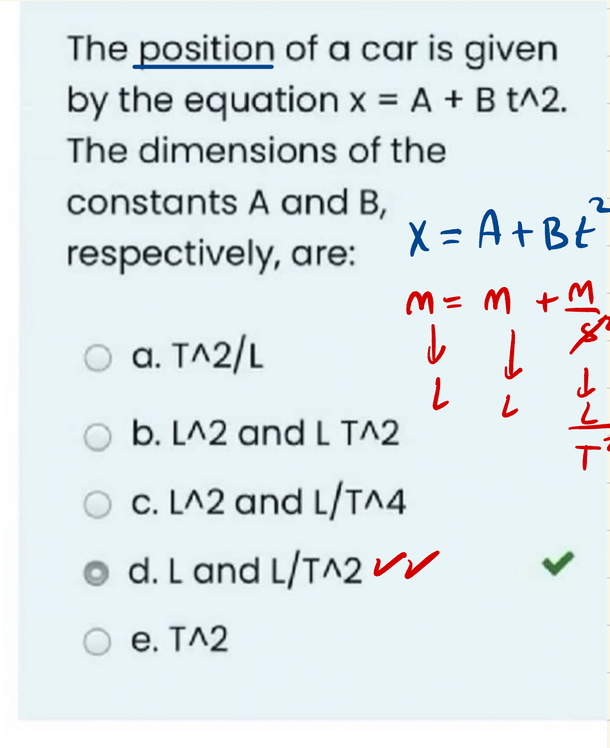
$$S_1 = \frac{d}{t_1} \qquad S_2 = \frac{d}{t_2}$$

$$25 = \frac{d}{t_1} \qquad 20 = \frac{d}{t_2}$$

$$t_1 = \frac{d}{25} \qquad t_2 = \frac{d}{20}$$

$$S = \frac{2\cancel{d}}{\frac{\cancel{d}}{25} + \frac{\cancel{d}}{20}}$$

$$S = \frac{2}{\frac{1}{25} + \frac{1}{20}} = 22.22$$



The position of a car is given by the equation x = A + B t^2. The dimensions of the constants A and B, respectively, are:

○ a. T^2/L

○ b. L^2 and L T^2

○ c. L^2 and L/T^4

● d. L and L/T^2 ✓✓ ✓

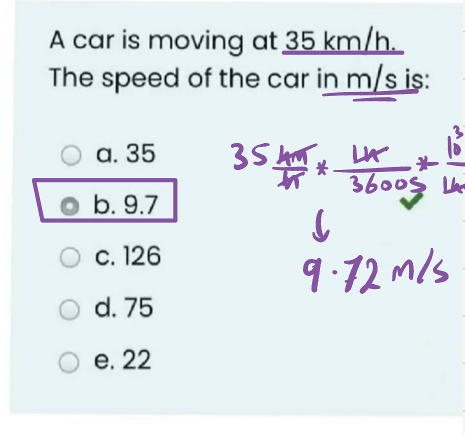
○ e. T^2

$$X = A + Bt^2$$

$$m = m + \frac{m}{\cancel{s^2}}\cancel{s^2}$$

$$\downarrow \quad \downarrow \quad \downarrow$$

$$L \quad L \quad \frac{L}{T^2}$$



A car is moving at 35 km/h. The speed of the car in m/s is:

○ a. 35

● b. 9.7

○ c. 126

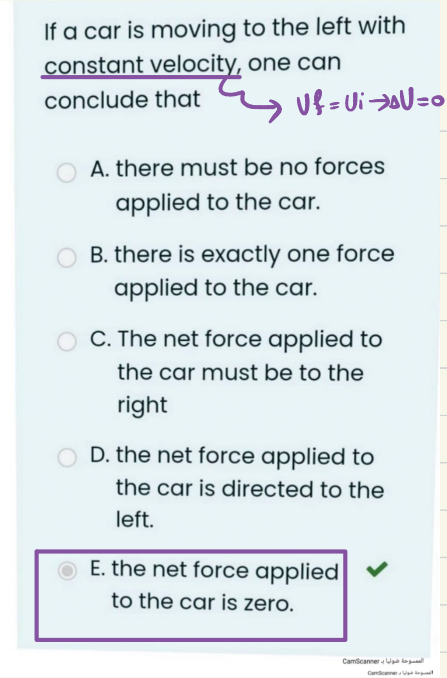
○ d. 75

○ e. 22

$$35\frac{\cancel{km}}{\cancel{h}} * \frac{1\cancel{h}}{3600s} * \frac{10^3 m}{1\cancel{km}}$$ ✓

↓

9.72 m/s



If a car is moving to the left with constant velocity, one can conclude that

$V_f = V_i \rightarrow \Delta V = 0 \rightarrow a = 0 \rightarrow \Sigma F = 0$

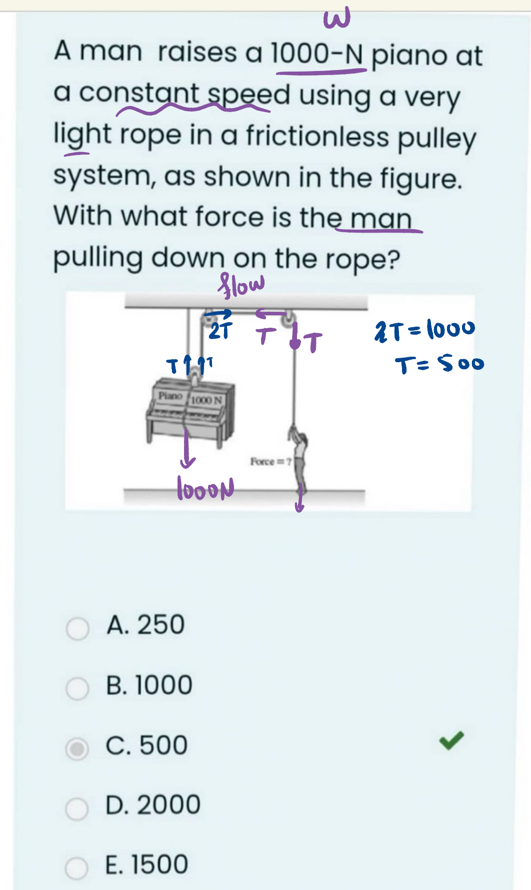
○ A. there must be no forces applied to the car.

○ B. there is exactly one force applied to the car.

○ C. The net force applied to the car must be to the right

○ D. the net force applied to the car is directed to the left.

● E. the net force applied to the car is zero. ✓



A man raises a 1000-N piano at a constant speed using a very light rope in a frictionless pulley system, as shown in the figure. With what force is the man pulling down on the rope?

$2T = 1000$
$T = 500$

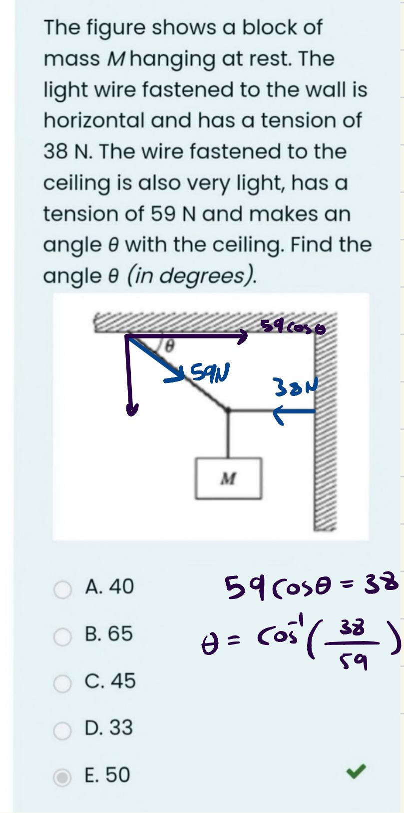
○ A. 250

○ B. 1000

● C. 500 ✓

○ D. 2000

○ E. 1500



The figure shows a block of mass *M* hanging at rest. The light wire fastened to the wall is horizontal and has a tension of 38 N. The wire fastened to the ceiling is also very light, has a tension of 59 N and makes an angle θ with the ceiling. Find the angle θ *(in degrees)*.

○ A. 40

○ B. 65

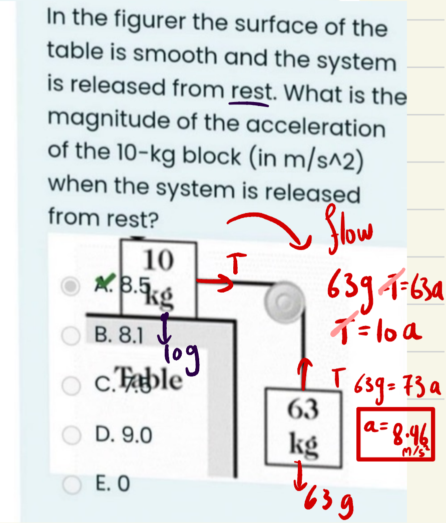
○ C. 45

○ D. 33

● E. 50 ✓

$59\cos\theta = 38$

$\theta = \cos^{-1}\left(\frac{38}{59}\right) = \boxed{49.9^\circ}$



In the figurer the surface of the table is smooth and the system is released from rest. What is the magnitude of the acceleration of the 10-kg block (in m/s^2) when the system is released from rest?

● A. 8.5 ✓

○ B. 8.1

○ C. 7.6

○ D. 9.0

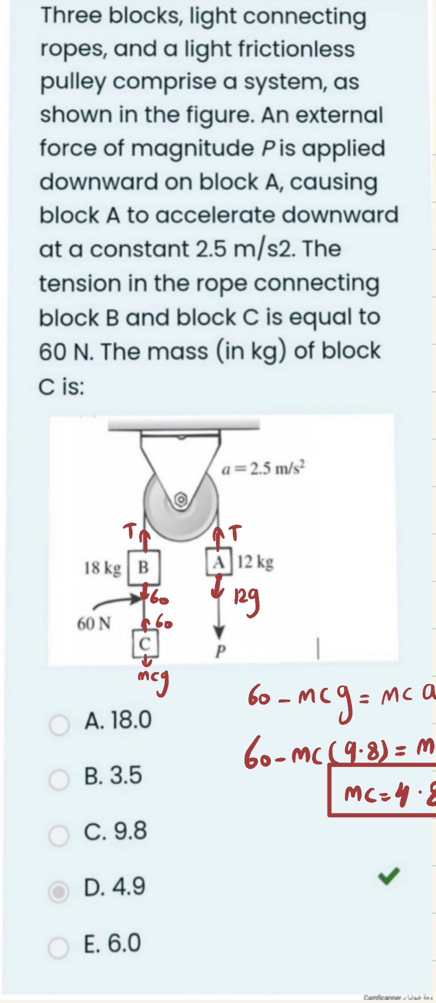
○ E. 0

$63g - \cancel{T} = 63a$

$\cancel{T} = 10a$

$63g = 73a$

$\boxed{a = 8.46 \text{ m/s}^2}$



Three blocks, light connecting ropes, and a light frictionless pulley comprise a system, as shown in the figure. An external force of magnitude *P* is applied downward on block A, causing block A to accelerate downward at a constant 2.5 m/s2. The tension in the rope connecting block B and block C is equal to 60 N. The mass (in kg) of block C is:

○ A. 18.0

○ B. 3.5

○ C. 9.8

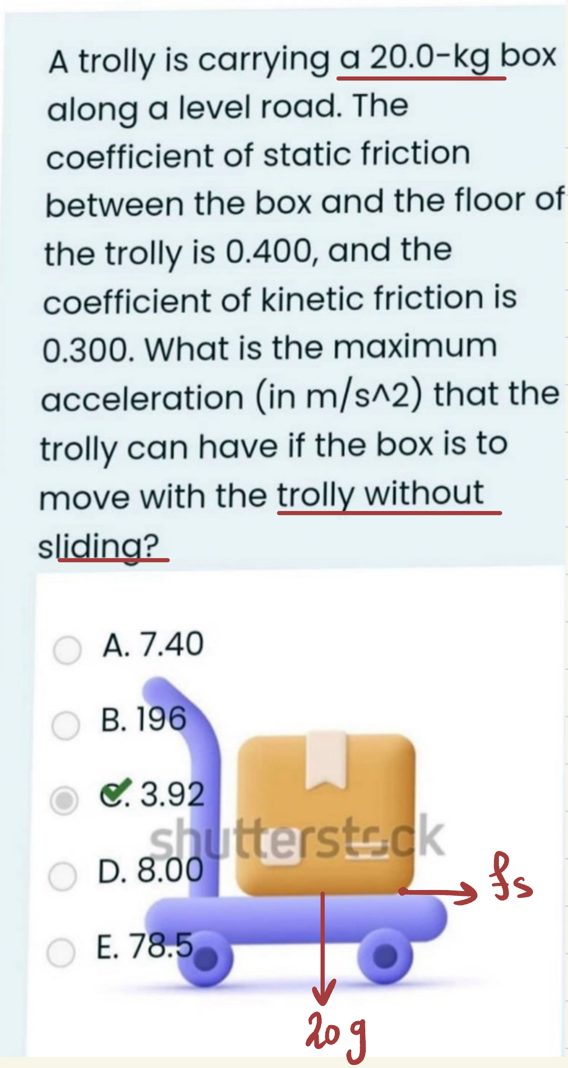
● D. 4.9 ✓

○ E. 6.0

$$60 - m_C g = m_C a$$

$$60 - m_C(9.8) = m_C(2.5)$$

$$\boxed{m_C = 4.87}\ \text{kg}$$



A trolly is carrying a 20.0-kg box along a level road. The coefficient of static friction between the box and the floor of the trolly is 0.400, and the coefficient of kinetic friction is 0.300. What is the maximum acceleration (in m/s^2) that the trolly can have if the box is to move with the trolly without sliding?

○ A. 7.40

○ B. 196

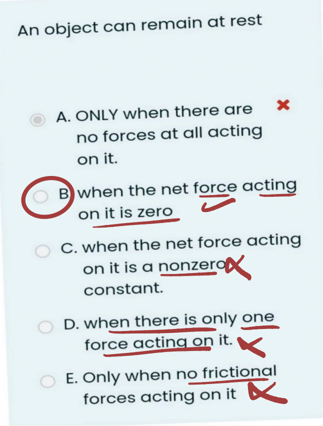
● C. 3.92 ✓

○ D. 8.00

○ E. 78.5

$$f_s = \mu_s 20g = 20a$$

$$a \rightarrow \frac{0.4 \times 20 \times 9.8}{20} = 3.92\ \text{m/s}^2$$



An object can remain at rest

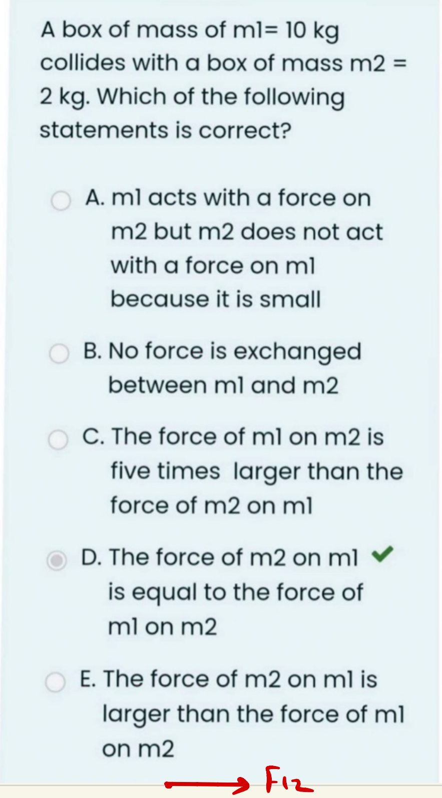
● A. ONLY when there are no forces at all acting on it. ✗

○ B. when the net force acting on it is zero

○ C. when the net force acting on it is a nonzero constant.

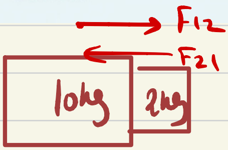
○ D. when there is only one force acting on it.

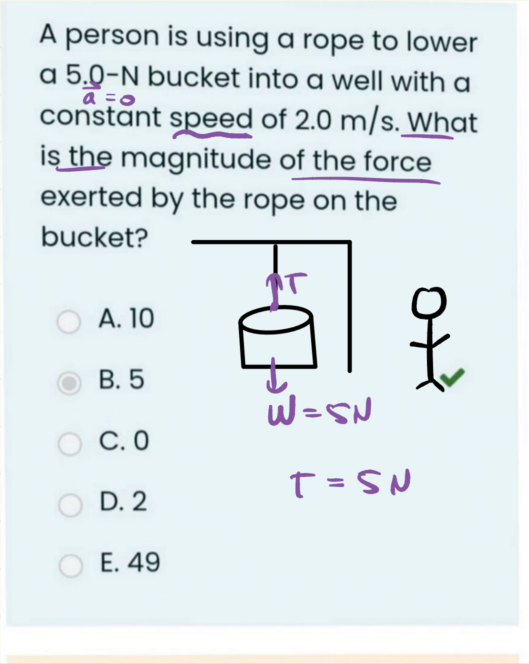
○ E. Only when no frictional forces acting on it



A box of mass of m1= 10 kg collides with a box of mass m2 = 2 kg. Which of the following statements is correct?

- ○ A. m1 acts with a force on m2 but m2 does not act with a force on m1 because it is small
- ○ B. No force is exchanged between m1 and m2
- ○ C. The force of m1 on m2 is five times larger than the force of m2 on m1
- ● D. The force of m2 on m1 is equal to the force of m1 on m2 ✓
- ○ E. The force of m2 on m1 is larger than the force of m1 on m2

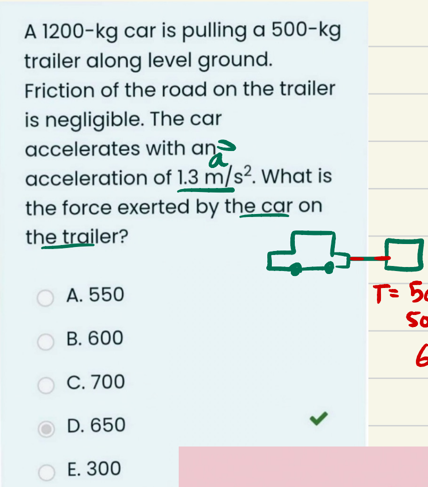




A person is using a rope to lower a 5.0-N bucket into a well with a constant speed of 2.0 m/s. What is the magnitude of the force exerted by the rope on the bucket?

- ○ A. 10
- ● B. 5 ✓
- ○ C. 0
- ○ D. 2
- ○ E. 49

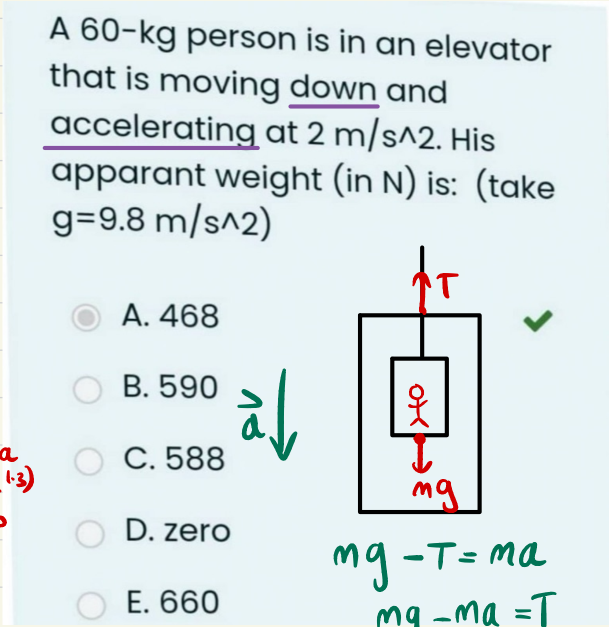
T = 5N



A 1200-kg car is pulling a 500-kg trailer along level ground. Friction of the road on the trailer is negligible. The car accelerates with an acceleration of 1.3 m/s^2. What is the force exerted by the car on the trailer?

- ○ A. 550
- ○ B. 600
- ○ C. 700
- ● D. 650 ✓
- ○ E. 300

T= 500a
500(1.3)
650



A 60-kg person is in an elevator that is moving down and accelerating at 2 m/s^2. His apparent weight (in N) is: (take g=9.8 m/s^2)

- ● A. 468 ✓
- ○ B. 590
- ○ C. 588
- ○ D. zero
- ○ E. 660

$$mg - T = ma$$

$$mg - ma = T$$

$$60(9.81-2) = T$$

$$\boxed{T = 468.6\,N}$$

سبحان الله وبحمده عدد خلقه ورضا نفسه

وزنة عرشه ومداد كلماته