Physics

دليل الفزكس

101

Old Exams

☎ 0502010680

CHAPTER

5

13. Two forces $\vec{F}_1$ & $\vec{F}_2$ are acting on a 3.0 kg box in the x-y plane. Fig. 3 shows only $\vec{F}_1$ and the acceleration $\vec{a}$ of the box. Find $\vec{F}_2$

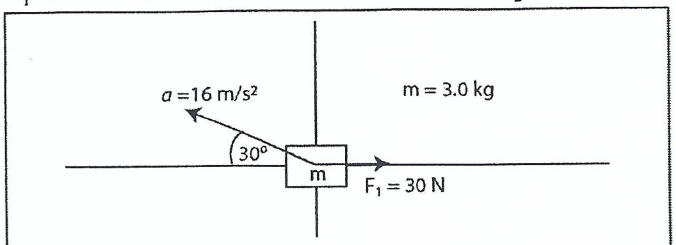


Fig. 3

A) $(-72\hat{i}+24\hat{j})N$

B) $(-72\hat{i}-24\hat{j})N$

C) $(72\hat{i}+24\hat{j})N$

D) $(-36\hat{i}-48\hat{j})N$

E) $(-36\hat{i}+48\hat{j})N$

$$\vec{a} = \frac{\vec{F_1}+\vec{F_2}}{m}$$

$$-16\cos 30\,i + 16\sin 30\,j = \frac{30\,i + \vec{F_2}}{3}$$

$$3(-13.85\,i + 8\,j) = 30\,i + \vec{F_2}$$

$$-30\,i - 41.57\,i + 24\,j = \vec{f_2}$$

$$-71.57\,i + 24\,j = \vec{f_2}$$

14. A block of mass m_1=5.7 kg on a frictionless 30° inclined plane is connected by a cord over a massless, frictionless pulley to a second block of mass m_2=3.5 kg hanging vertically as shown in Fig 4. The acceleration of m_2 is:

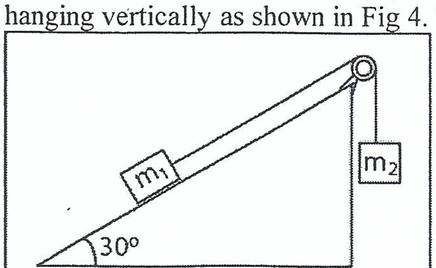


Fig. 4

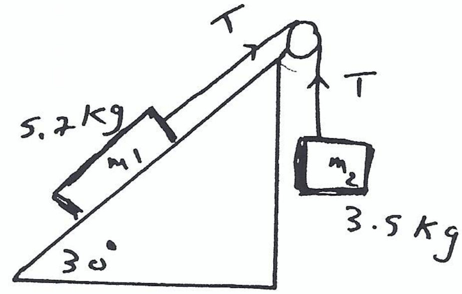
A) 0.69 m/s^2 downward
B) 0.54 m/s^2 upward
C) 0.36 m/s^2 downward
D) 0.78 m/s^2 upward

(No friction)

$(5.7)(9.8)\sin 30^\circ = 27.93$

$(3.5)(9.8) = 34.3$

$\therefore\ m_2 g > m_1 g \sin 30$



$\therefore$ m_2 accelerates downward with a

$\therefore\quad T = m_2(g-a)$ For block 2

$T - m_1 g \sin 30 = m_1 a$

$\therefore\quad m_2 g - m_2 a - m_1 g \sin 30 = m_1 a$

$34.3 - 3.5a - 27.93 = 5.7a$

$6.37 = 9.2a$

$\therefore\ a = \dfrac{6.37}{9.2} = 0.692\ m/s^2$

15. Fig.5 shows a block A of mass 6.0 kg and block B of 8.0 kg connected by a rigid rod of negligible mass. Force $\vec{F}_a = (16N)\hat{i}$ acts on block A; force $\vec{F}_b = -(30N)\hat{i}$ acts on block B. The tension (T) in the rod is: (Neglect friction)

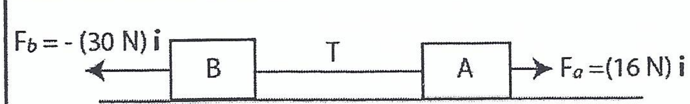
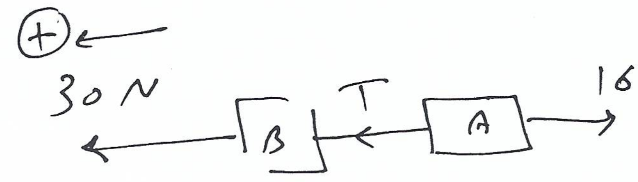


Fig. 5

A) 22 N
B) 30 N
C) 16 N
D) 46 N
E) 14 N

$$a = \frac{F_{net}}{\Sigma m} = \frac{30-16}{6+8} = \frac{14}{14} = 1\ m/s^2$$

$$T = m_A a + 16$$
$$= 6(1) + 16$$
$$= 22\ N$$



16. A 5.0-kg mass is held at an angle θ from the vertical by a horizontal force F=15 N as shown in Fig 6. The tension (T) in the string supporting the mass (in Newton) is:

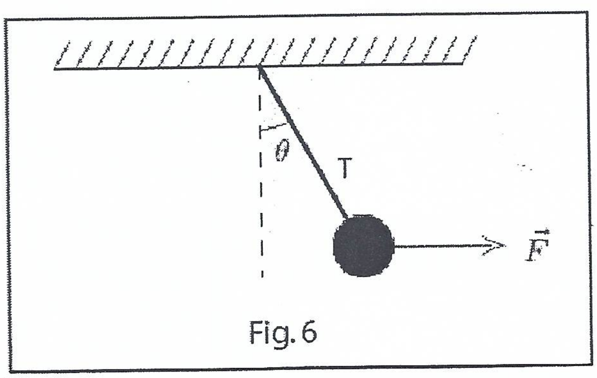
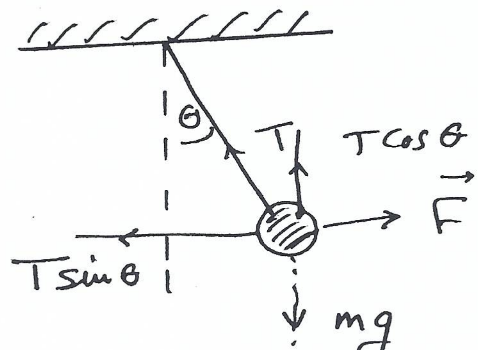


Fig. 6

A) 51
B) 2/ cos θ
C) cos θ/2
D) cos θ
E) 0



$$T\cos\theta = (5)(9.8) \rightarrow (1)$$

$$T\sin\theta = 15 \rightarrow (2)$$

① ÷ ②

$$\frac{\cos\theta}{\sin\theta} = \frac{49}{15}$$

$$\cot\theta = 3.266$$

$$\theta = 17^\circ$$

$$\therefore\ T = \frac{15}{\sin 17^\circ} = 51.24\ N$$

Q4.
To measure your weight, you stand on a spring scale on the floor of an elevator. Among the following situations, select the one that gives the highest reading on the scale:

A) The elevator moves upward with increasing speed.
B) The elevator remains stationary.
C) The elevator moves downward at constant speed.
D) The elevator moves upward with decreasing speed.
E) The elevator moves downward with increasing speed.

The scale gives highest reading when the elevator moves upward with increasing speed, that means there is (a), where

$$w = m(g+a)$$

∴ Ans Ⓐ

Q8.
A 7.0 kg block and a 3.0 kg block are connected by a string as shown in Fig 5. If the pulley is massless and the surface is frictionless, the magnitude of the acceleration of the 3.0 kg block is:

A) 4.9 m/s^2
B) 3.3 m/s^2
C) 2.9 m/s^2
D) 9.8 m/s^2
E) 6.7 m/s^2

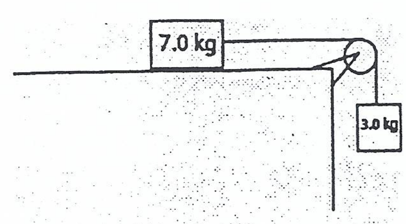


Figure 5

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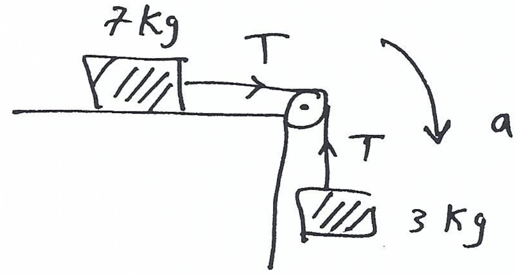
$T = m_2(g-a)$

$T = m_1 a$



$\therefore m_1 a = m_2(g-a)$

$7a = 3(9.8-a)$

$10a = 29.4$

$a = 2.94 \ m/s^2$ ∴ Ans (C)

Q14.
An elevator cab with a total mass of 2000 kg is pulled upward by a cable. If the elevator accelerates at 2.00 m/s^2 upward, find the tension in the cable..

A) 1.56×10^4 N
B) 0.00 N
C) 3.25×10^4 N
D) 2.36×10^4 N
E) 9.80 N

$T = m(g+a)$

$= 2000(9.8+2)$

$= 23600$

$= 2.3 \times 10^4 N$ ∴ Ans (D)

Q19.
A 4.0 kg block is pushed upward a 30° inclined frictionless plane with a constant horizontal force F (Fig 4). If the block moves with a constant speed find the magnitude of the force F.

A) 0 N
B) 33 N
C) 9.8 N
D) 40 N
E) 23 N

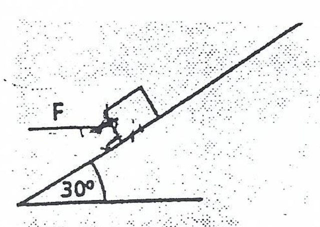


Figure 4:

6

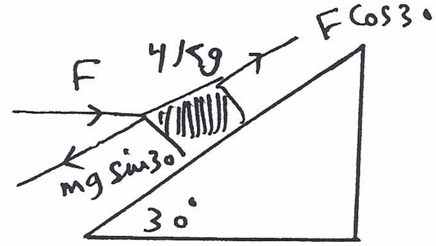
At constant speed

$\Sigma F = 0$

$mg \sin 30° - F \cos 30° = 0$

$(9.8) \sin 30° = F \cos 30°$

$F = 22.63\ N$ Ans (E) (96)



Q15.
Two blocks of masses $m_1 = 4.00\ kg$ and $m_2 = 2.00\ kg$ are connected by a string passing over a massless and frictionless pulley and placed on a frictionless horizontal table as shown in Fig. 3. A force of $F = 10.0\ N$ at an angle of 60.0° with the horizontal is applied to m_1. The magnitude of acceleration of the system is:

Fig#

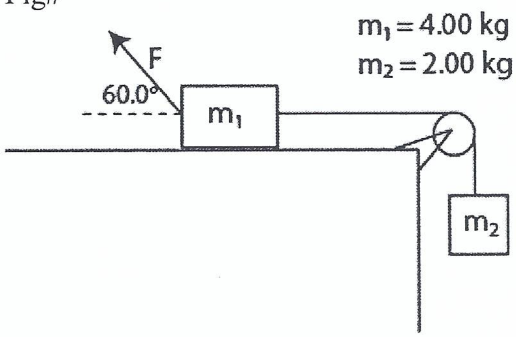
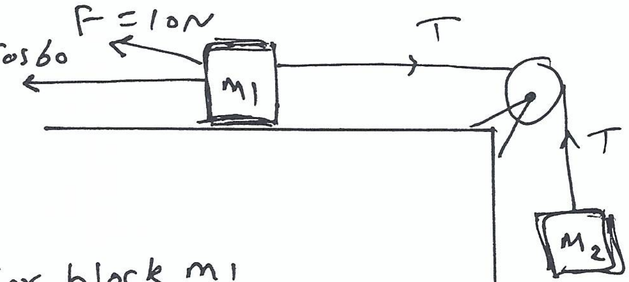


Figure 3

A) 2.43 m/s^2
B) 9.80 m/s^2
C) 3.27 m/s^2
D) 10.84 m/s^2
E) 1.36 m/s^2



For block m1

$T - 10 \cos 60 = 4a$

$T - 5 = 4a$

For block m2

$T = m_2 (g - a)$

$= 2(9.8 - a) = 19.6 - 2a$

$\Rightarrow$ $19.6 - 2a - 5 = 4a$

$14.6 = 6a$

$a = 2.43\ m/s^2$

Q19.
Two boxes, one of mass $m = 5.00\ kg$ and the other with an unknown mass M are connected with a string passing over a massless frictionless pulley and are placed on frictionless planes as shown in Fig. 5.What must be the mass M, if it goes down the plane with an acceleration of $a = 2.45\ m/s^2$?

Fig#
m = 5.00 kg
θ = 45.0°
ϕ = 30.0°

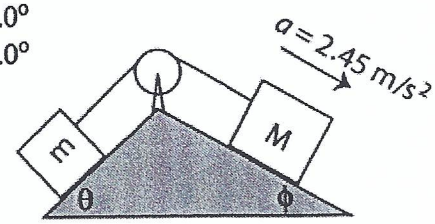
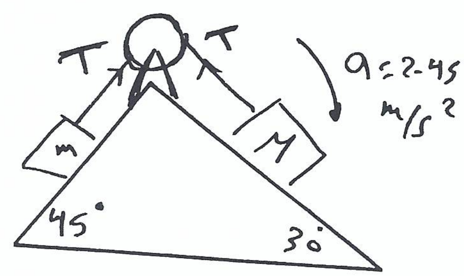


Figure 5

A) 19.1 *kg*
B) 8.70 *kg*
C) 13.5 *kg*
D) 2.50 *kg*
E) 10.0 *kg*



For Block m :

$$T - mg\sin 45° = ma$$
$$T - (5)(9.8)\sin 45° = (2.45)(5)$$
$$T = 46.89\ N$$

For Block M :

$$T = M(g\sin 30° - a)$$
$$= M(4.9 - 2.45)$$
$$= 2.45\ M$$

$$\therefore\ 2.45\ M = 46.89\ N$$

$$M = \frac{46.89}{2.45} = 19.1\ kg$$

Two boxes A and B ($m_A = 3.0\ kg$ and $m_B = 1.0\ kg$) are in contact on a horizontal frictionless surface and move along the x-axis (see Fig. 4). A horizontal force $\vec{F} = 10.0\,\hat{i}\ N$ is applied on Box A. The net force acting on A is $\vec{F}_1$ and on B is $\vec{F}_2$. Which one of the following statements is correct?

Fig#

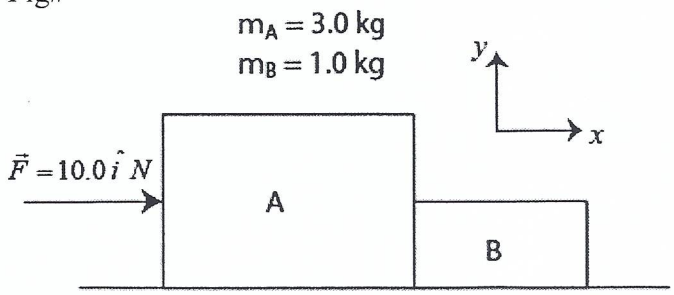


Figure 4

A) $\vec{F}_1 = 7.5\,\hat{i}\ N$ and $\vec{F}_2 = 2.5\,\hat{i}\ N$
B) $\vec{F}_1 = 5.0\,\hat{i}\ N$ and $\vec{F}_2 = -5.0\,\hat{i}\ N$
C) $\vec{F}_1 = 2.5\,\hat{i}\ N$ and $\vec{F}_2 = 7.5\,\hat{i}\ N$
D) $\vec{F}_1 = 0\ N$ and $\vec{F}_2 = 0\ N$
E) $\vec{F}_1 = 2.5\,\hat{i}\ N$ and $\vec{F}_2 = -2.5\,\hat{i}\ N$

$$F = (m_A + m_B)\,a$$

$$10 = (3 + 1)\,a \implies a = 2.5\ m/s^2$$

$$F_1 = m_A a = (3)(2.5) = 7.5\,\hat{i}\ N$$

$$F_2 = m_B a = (1)(2.5) = 2.5\,\hat{i}\ N$$

ch 5
1

082

You stand on a spring scale on the floor of an elevator. The scale shows the highest reading when the elevator:

A) moves downward with decreasing speed
B) moves downward with increasing speed
C) remains stationary
D) moves upward with decreasing speed
E) moves upward at constant speed

decreasing speed means (-ve)

acceleration so

weight ⇒ $w = m(g - -a)$
$= m(g + a)$

082

Q16.
A 70 N block A and a 35 N block B are connected by a string, as shown in Fig 3. If the pulley is massless and the surface is frictionless, the magnitude of the acceleration of the 35 N block is:

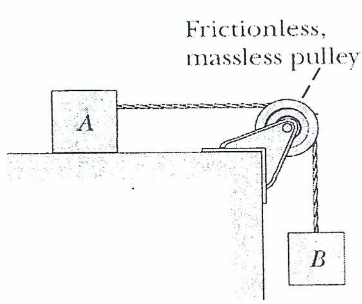


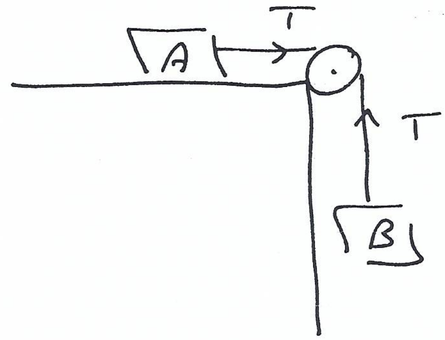
Fig. 3

A) 3.3 m/s^2
B) 1.5 m/s^2
C) 4.9 m/s^2
D) 6.7 m/s^2
E) 9.8 m/s^2

$m_B = \frac{35}{9.8} = 3.6$ kg

ch 5
2

For Block A



$T = m_A a$

$= 7.14 a$

For Block B

$T = m_B (g - a)$

$= 3.6 (9.8 - a)$

$\Rightarrow \quad 7.14 a = 3.6 (9.8 - a)$

$7.14 a = 35.28 - 3.6 a$

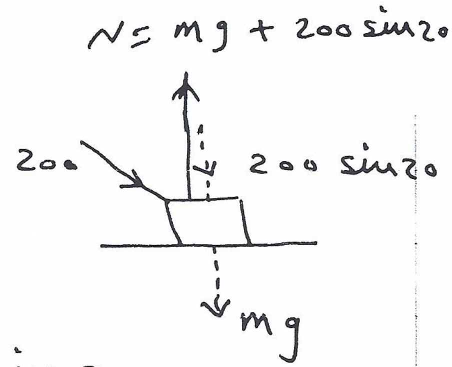
$7.14 a + 3.6 a = 35.28$

$10.74 a = 35.28$

$a = 3.29 \ m/s^2$

Q17.
When a 25.0 kg crate is pushed across a frictionless horizontal floor with a force of 200 N, directed 20° below the horizontal, the magnitude of the normal force of the floor on the crate is:

A) 313 N
B) 680 N
C) 180 N
D) 250 N
E) 210 N



$N = mg + F \sin 20$

$= (25)(9.8) + 200 \sin 20$

$= 313.4 \ N$

Q15.

In the system shown in Figure 6, a horizontal force $\vec{F}$ acts on the 8.0-kg object. The horizontal surface is frictionless. What is the magnitude of $\vec{F}$ if the 5.0-kg object has a downward acceleration of 1.0 m/s^2?

A) 54 N
B) 9.6 N
C) 3.6 N
D) 84 N
E) zero

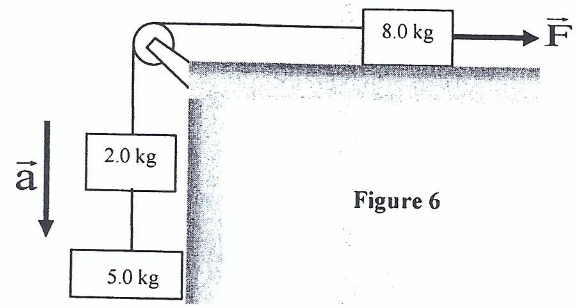
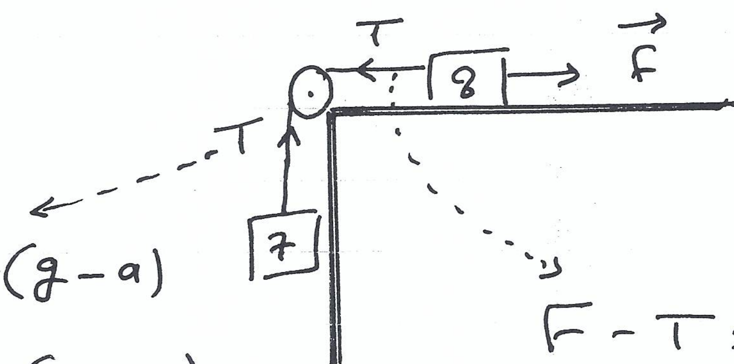


Figure 6



$T = 7(g - a)$

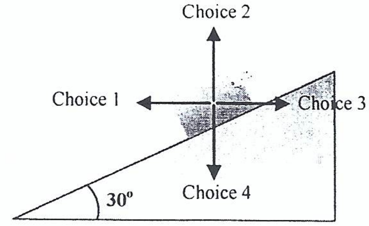
$T = 7(9.8 - 1)$
$= 61.6$ N

$F - T = 8a$

$F - 61.6 = -8$
$F = 53.6$ N
$= 54$ N

Q17.

Figure 7 shows four possible choices for the direction of **ONE force** of magnitude F to be applied to a block on an inclined plane of angle 30˚. The directions are either horizontal or vertical. (for all choices, we assume that the block remains on the inclined plane). Rank the choices according to the magnitude of **the normal force** on the block from the plane, **greatest first.**



A) choice 4, choice 3, choice 1, choice 2
B) choice 3, choice 4, choice 1, choice 2
C) choice 1, choice 3, choice 4, choice 2
D) choice 2, choice 3, choice 1, choice 4
E) (choice 3 and choice 4) tie, (choice 1 and choice 2) tie

تعتمد فكرة السؤال على أى من الاتجاهات الأربع

الموضحة يعطى أكبر قوة عمودية "Normal" من المستوى

على القالب ، ونجد أن F_4 هى الأكبر لأنه ضاغطة

على القالب وكذلك F_3 ثم F_1 لأنها تشد القالب ثم F_2

لأنها تشد القالب أكثر فيكون

$F_4 > F_3 > F_1 > F_2$

Q18.

A block of mass 2.0 kg is being pushed by a force $\vec{F}$ parallel to the ground as shown in Figure 8. The block is observed to have an acceleration of 1.0 m/s^2 down the incline. Assume the incline is frictionless. Calculate the magnitude of the force $\vec{F}$.

A) 9.0 N
B) 11 N
C) 6.5 N
D) 1.9 N
E) 14 N

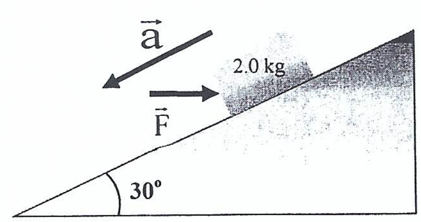


Figure 8

$m = 2$ kg

$a = 1$ m/s^2 downward

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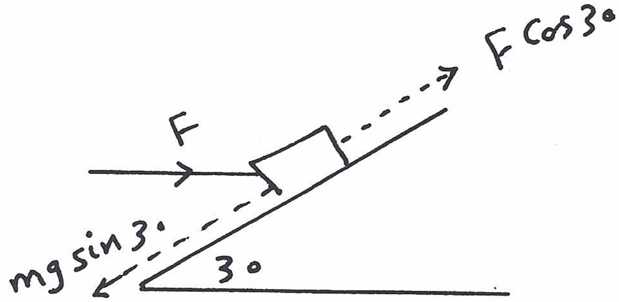
5



$\Sigma F = ma$

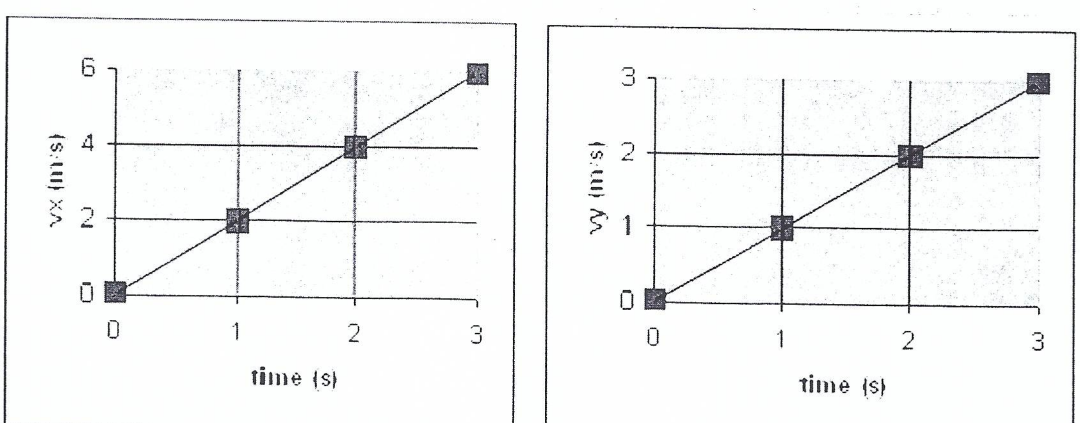
$F\cos 30 - mg\sin 30 = ma$

$F\cos 30 - (2)(9.8)(\frac{1}{2}) = -(2)(1)$

$F\cos 30 = 7.8$

$F = 9\ N$

Q14.
A constant force in the *xy*-plane pushes a 2.0 kg object across a horizontal frictionless floor on which an *x-y* coordinate system is drawn. The *x* and y components of the velocity of the object as a function of time are shown in **Figure 4.** The magnitude of the force is:



A) 4.5 N
B) 6.0 N
C) 2.2 N
D) 4.0 N

5/6

$$F = ma$$

$$a_x = \frac{6}{3} = 2 \ m/s^2$$

$$a_y = \frac{3}{3} = 1 \ m/s^2$$

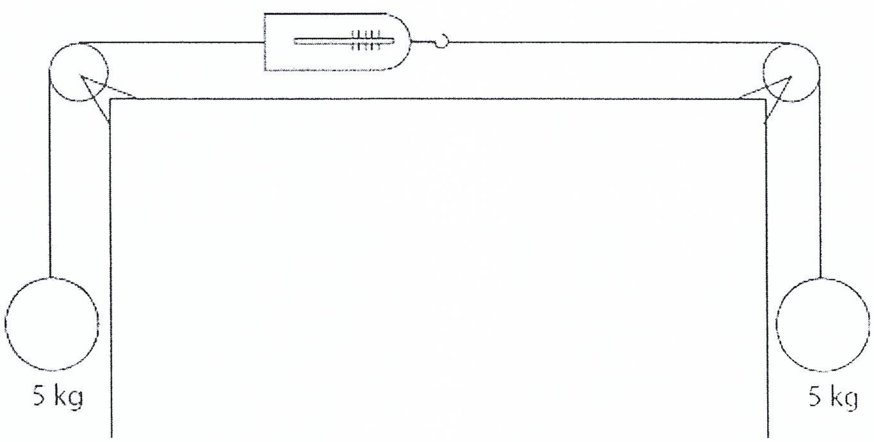
$$\Longrightarrow a = \sqrt{a_x^2 + a_y^2}$$

$$= \sqrt{2^2 + 1^2} = \sqrt{5} \ m/s^2$$

$$\Longrightarrow F = ma = (2)(\sqrt{5})$$

$$= 4.47 \ N$$

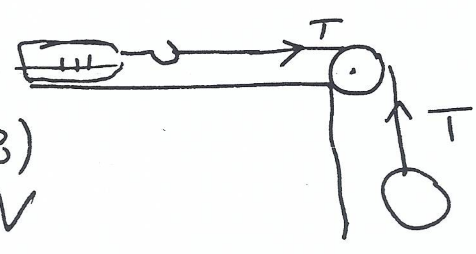
Q16.
The system shown in **Figure 6** is in equilibrium. If the spring scale is calibrated in N, what does it read?



A) 49
B) 98
C) 75
D) 0
E) 25

$$T = mg = 5(9.8)$$

$$= 49 N$$



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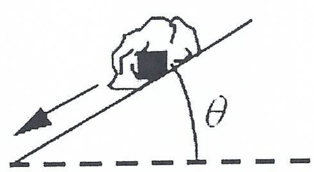
Q17.
A 500 N man is riding in an elevator. At a certain instant his feet push against the floor with a force greater than 500 N. At this instant, the elevator may be (Choose the **CORRECT** Answer):

✓A) Moving downward but decreasing in speed
B) Moving upward but decreasing in speed
C) Moving downward but increasing in speed
D) Not moving (Standing still)
E) Moving at a constant speed

in D, E The force is 500 N

in B, C The force less than 500 N

Q14.
As shown in **Figure 3**, a 2.0-N rock slides down on a frictionless inclined plane. Which one of the following statements is TRUE concerning the magnitude of the normal force that the plane exerts on the rock?
Fig#



A) The normal force is less than 2.0 N.
B) The normal force is zero.
C) The normal force is 2.0 N.
D) The normal force is greater than 2.0 N.
E) The normal force *increases* as the angle of inclination, θ, is *increased.*

On an inclined plane

$N = mg \cos \theta$

from graph $\cos \theta < 1 \Rightarrow$

$N < 2\ N$

Q16.
With what force will the feet of a person of mass 60.0 kg press downward on an elevator floor when the elevator has an upward acceleration of 1.20 m/s^2?

A) 660 N
B) 600 N
C) 516 N
D) 588 N
E) 980 N

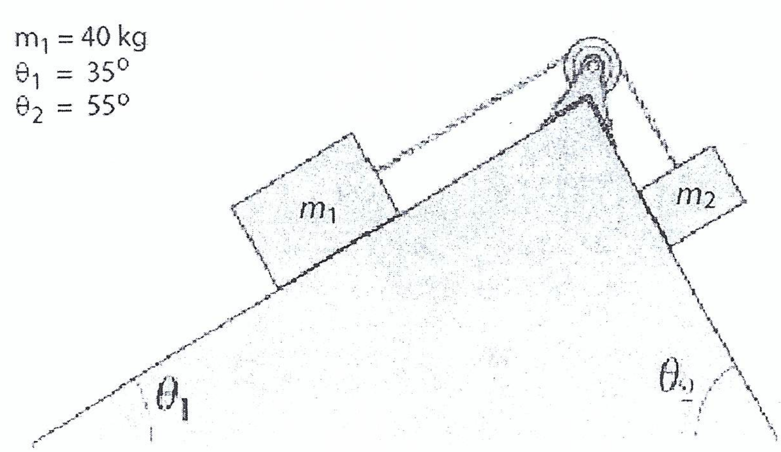
Q17.

$m = 60$ kg

$a = 1.2$ m/s^2 upward

$F = m(g + a)$
$= 60(9.8 + 1.2)$
$= 660$ N

As shown in **Figure 5**, two masses rest on opposite sides of a frictionless pulley on frictionless inclines. What is the mass m_2 if the system remains at rest?
Fig#



A) 28 kg
B) 25 kg
C) 63 kg
D) 57 kg
E) 46 kg

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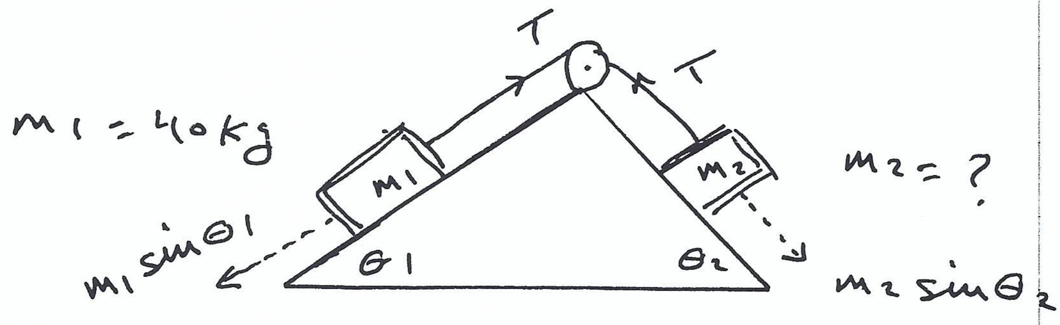


AT REST

For Block m_1

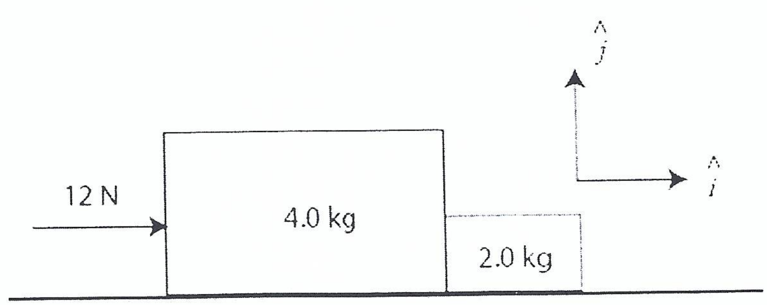
$$T = m_1 \sin\theta_1$$
$$= 40 \sin 35$$
$$= 22.94 \ N$$

For Block m_2

$$T = m_2 \sin\theta_2$$
$$= m_2 \sin 55^\circ$$

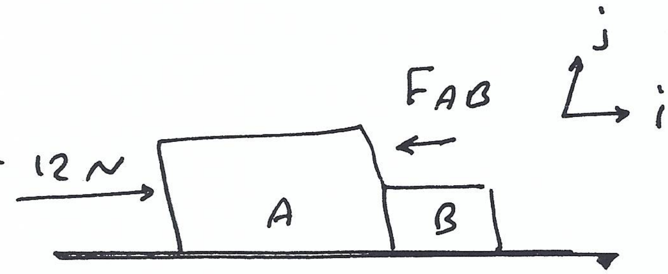
$$\Longrightarrow \quad 22.94 = m_2 \sin 55^\circ$$
$$m_2 = 28 \text{ kg}$$

Q15.
As shown in **Figure 4**, a 4.0-kg block and a 2.0-kg block move on a horizontal frictionless surface while being accelerated by a 12-N force. In unit vector notation, determine the force that the 2.0-kg block exerts on the 4.0-kg block.
Fig#



A) $-(4.0\,\hat{i})$ N
B) 0
C) $(+8.0\,\hat{i})$ N
D) $(-12\,\hat{i})$ N
E) $(+4.0\,\hat{i})$ N

$$a = \frac{12}{4+2} = 2\ m/s^2$$



The force that the 2 kg block exerts on the 4 kg block F_{AB}

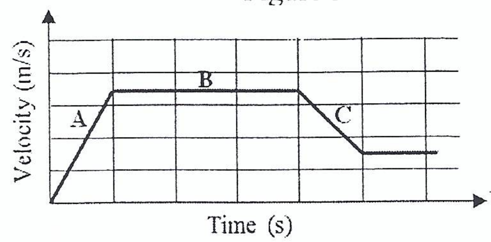
$$F_{AB} = 12 - (2)(4)$$
$$= 4\ N \text{ to left}$$
$$= -4\hat{i}\ N$$

CHAPTER

6

Figure 3 shows the velocity versus time curve for a car traveling along a straight line. Which of the following statements is **False**?

Figure 3



A) ... magnitude of the net force acting during interval A is less than that during interval C ✓
B) Net forces act on the car during intervals A and C
C) Opposing forces may be acting on the car during interval B
D) Opposing forces may be acting on the car during interval C
E) No net force acts on the car during interval B

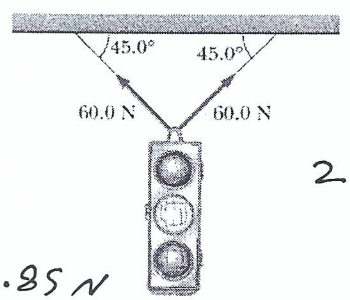
مقدار التسارع في الفترة A < مقدار التسارع في الفترة C

F at C < F at A   F = ma

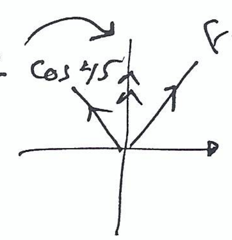
Find the resultant force exerted by the two cables supporting the traffic light as shown in **Figure 2**.

Figure 2

A) 84.9 N vertically upward
B) 60.0 N vertically upward
C) 84.9 N vertically downward
D) 120 N vertically upward
E) 120 N vertically downward



$2F \cos 45$



$F = 2(60)\cos 45 = 84.85\,N$
$= 84.9\,N$

A 71.0 kg man stands on a bathroom scale in an elevator. What does the scale read if the elevator is moving upward with an increasing velocity and at constant acceleration of 3.00 m/s^2?

A) 909 N
B) 482 N
C) 699 N
D) 833 N
E) 999 N

$F_N = m(g + a)$
$= 71(9.8 + 3)$
$= 909\,N$

$a = 3\,m/s^2$

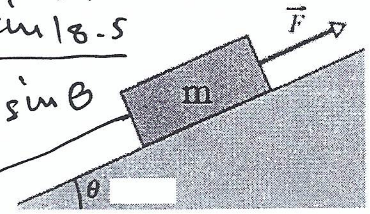
A 40.0 kg mass is pulled up by a rope along an inclined frictionless surface which makes an angle of 18.5° with the horizontal. The pulling rope is parallel to the incline and has a tension of 140 N. Assume that the mass starts from rest at the bottom of the incline; find its velocity after moving 80.0 m up the incline?

A) 7.90 m/s
B) 3.90 m/s
C) 1.39 m/s
D) 0
E) 9.80 m/s

$a = \frac{F_{net}}{m} = \frac{F - mg\sin\theta}{m}$

$= \frac{140 - 40(9.8)\sin 18.5}{40}$

$= 0.4\ m/s^2$



$mg\sin\theta$

$\Rightarrow v^2 = v_0^2 + 2a\Delta x$

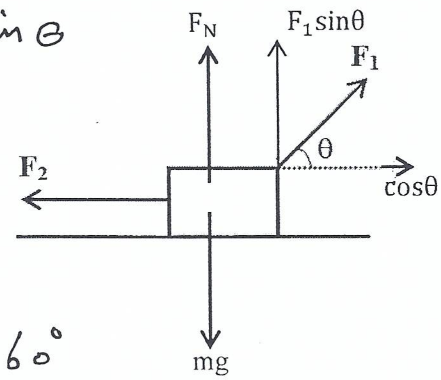
$v^2 = 0 + 2(0.41)(80) = 62.47 \Rightarrow v = 7.9\ m/s$

Figure 1 shows two constant forces F_1= 60 N and F_2= 30 N applied to a box of mass 10 kg and it slides with a constant velocity on a horizontal frictionless surface. Find the magnitude of the normal force.

Figure 1

A) 46 N
B) 98 N
C) 49 N
D) 9.8 N
E) 53 N

$F_N = mg - F_1\sin\theta$



ونظرا لثبات السرعة

$\Rightarrow F_2 = F_1\cos\theta$

$30 = 60\cos\theta$

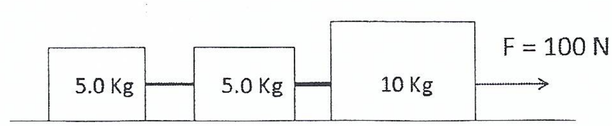
$\Rightarrow \theta = \cos^{-1}(\frac{1}{2}) = 60°$

$\Rightarrow F_N = 10(9.8) - 60\sin 60 = 46\ N$

Figure 3 shows three connected blocks by two cords and being pulled across a horizontal frictionless surface by a constant horizontal force F = 100 N. Find the tension in the cord between the 5 kg and 10 kg blocks.

Figure 3

A) 50 N
B) 10 N
C) 90 N
D) 20 N
E) 0



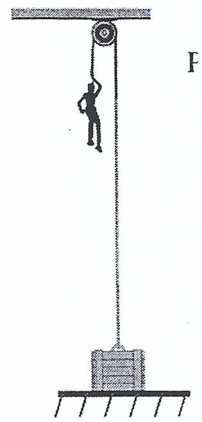
$a = \frac{F_{net}}{\Sigma m} = \frac{100}{20} = 5\ m/s^2$

$T = (\Sigma m)a = (5+5)5 = 50\ N$

_A 75 kg person lowers himself from rest to the ground by means of a rope that passes over a frictionless pulley and is attached to a 60 kg box, as shown in **FIGURE 6**. The person and the box move along vertical lines. What is the magnitude of the acceleration of the person?

Figure # 6

A) $1.1\ m/s^2$
B) $9.8\ m/s^2$
C) $5.4\ m/s^2$
D) $3.6\ m/s^2$
E) $4.6\ m/s^2$

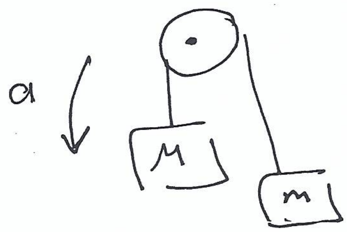


mass of person M

" " box m

$\Rightarrow a = \dfrac{M - m}{M + m} g$

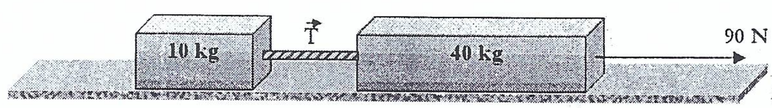
$a = \dfrac{75 - 60}{75 + 60}(9.8) = 1.1\ m/s^2$



A 10 kg block is connected to a 40-kg block through a massless rope, as shown in **Figure 5**. A force of 90 N pulls the blocks to the right on a frictionless surface. What is the magnitude of the tension $\vec{T}$ in the rope that connects the two blocks?

Figure 5

A) 18 N
B) 11 N
C) 22 N
D) 23 N
E) 12 N



$a = \dfrac{F_{net}}{\Sigma m} = \dfrac{90}{50} = 1.8\ m/s^2 \Rightarrow T = 10a$

$= 10(1.8) = 18 N$

Two blocks with masses $m_1 = 2.0$ kg and $m_2 = 6.0$ kg are in contact on a frictionless horizontal surface. The blocks are accelerated by a horizontal force F applied to the block m_1 as shown in **Figure 8**. Find the magnitude of the force $\vec{F}$ if the contact force between the blocks is 1.1 N.

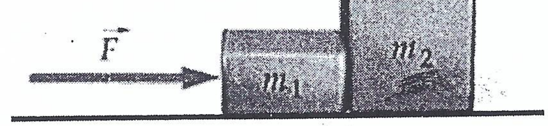
Figure 8

$F_{contact} = m_2 a$

$1.1 = 6a$

$a = \dfrac{1.1}{6}$

A) 1.5 N
B) 1.1 N
C) 3.2 N
D) 2.3 N
E) 3.1 N

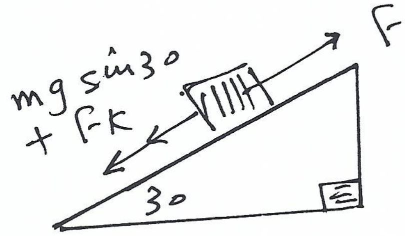


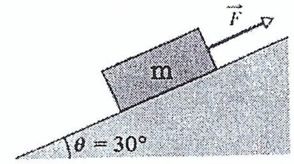
$\Rightarrow F = (\Sigma m) a$

$= 8\left(\dfrac{1.1}{6}\right) = 1.466 \simeq 1.5 N$

A block, of mass m = 4.0 kg, is pulled upward an inclined rough plane with a constant force $\vec{F}$ parallel to the incline (See Figure 5). The incline makes an angle $\theta = 30°$ with the horizontal and the coefficient of the kinetic friction between the plane and the block is 0.35. What value of $\vec{F}$ is required to move the block up the incline at constant velocity?

A) 31.5 N
B) 28.0 N
C) 20.0 N
D) 44.4 N
E) 13.1 N





$F_k = mg \cos 30 = 4(9.8) \cos 30 = 11.88$ N

$F = mg \sin 30 + F_k$ ⇐ وعند الصعود بسرعة ثابتة

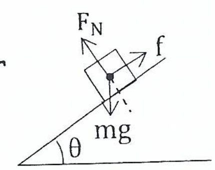
$= 4(9.8) \sin 30 + 11.88 = 31.5$ N

A block is initially at rest at the top of a rough inclined plane. The coefficients of friction between the block and the incline are $\mu_s = 0.500$ and $\mu_k = 0.400$. The angle θ between the incline and the ground is gradually increased. At what value of θ will the block start sliding down the incline?

A) 26.6°
B) 21.8°
C) 63.4°
D) 68.2°
E) 45.0°

تبدأ في الحركة عندما تكون

$f_{s\,max} = mg \sin \theta$

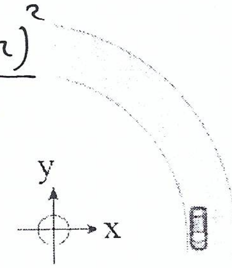


$\mu_s mg \cos \theta = mg \sin \theta \Rightarrow \tan \theta = \mu_s$

$\theta = \tan^{-1}(\mu_s) = \tan^{-1}(0.5) = 26.5650 \simeq 26.6$

A 55.0 kg man drives his car through a flat circular track of radius 300 m with a constant speed of 80.0 km/h. What is the magnitude of the net force exerted by the seat of the car on the man at the moment shown in **Figure 4**?

Figure 4



$v = 22.2$ m/s

A) 546.5 N
B) 402.4 N
C) 300.0 N
D) 600.0 N
E) 354.4 N

$F_c = m \frac{v^2}{r} = \frac{55(22.2)^2}{300}$

$= 90.35$ N

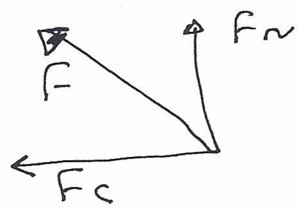
$F_N = mg = 55(9.8)$

$= 539$ N

$F = \sqrt{F_c^2 + F_N^2}$

$= \sqrt{(90.35)^2 + (539)^2}$

$= 546.52$ N



A 40.0 kg child swings in a swing supported by two chains, each 3.00 m long, as shown in **Figure 7**. The tension, T, in each chain at the lowest point of his swing is 350 N. Find the child's speeds at the lowest point of his swing.

$F = 2T$

A) 4.8 m/s
B) 5.3 m/s
C) 2.3 m/s
D) 6.6 m/s
E) 1.0 m/s

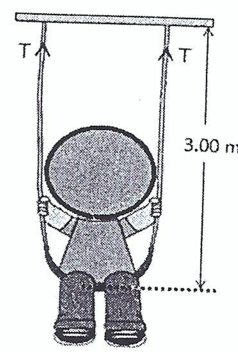
$F - mg = m\frac{v^2}{r}$

$2T - mg = m\frac{v^2}{r}$

$700 - 40(9.8) = 40\frac{v^2}{3}$

$\Rightarrow v = 4.8$ m/s

Figure 7



A 3.00 kg block starts from rest at the top of a 30.0° incline and slides a distance of 2.00 m down the incline in 1.50 s. Calculate the magnitude of the frictional force acting on the block.

A) 9.37 N
B) 13.5 N
C) 1.50 N
D) 14.7 N
E) 8.98 N

$d = v_0 t + \frac{1}{2} a t^2$

$2 = 0 + \frac{1}{2} a (1.5)^2$

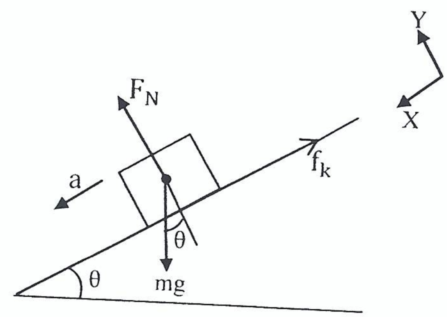
$a = 1.78$ m/s²

$\Rightarrow mg \sin\theta - F_k = ma$

$F_k = m(g \sin\theta - a)$

$= 3(9.8 \sin 30 - 1.78)$

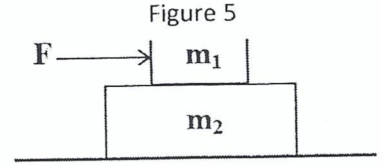
$= 9.366 \simeq 9.37$



A small block of mass m_1 = 1.0 kg is put on the top of a large block of mass m_2 = 4.0 kg. The large block can move on a horizontal frictionless surface while the coefficients of friction between the large and small blocks are μ_s= 0.60 and μ_k= 0.4. A horizontal force F = 5.0 N is applied to the small block (See **Figure 5**). Find the acceleration of the large block m_2.

A) 1.0 m/s²
B) 2.7 m/s²
C) 9.8 m/s²
D) 4.6 m/s²
E) 1.3 m/s²

Figure 5



$f_{s\,max} = \mu_s m_1 g$

$= 0.6(1)(9.8)$

$= 5.88$

$\Rightarrow f_s > F$

لذلك لم تتزحلق الكتلة m1 فوق الكتلة m2 ويتحركا كجسم واحد

$\Rightarrow F = (m_1 + m_2) a$

$5 = (1 + 4) a$

$\Rightarrow a = \frac{5}{5} = 1$ m/s²

6

1

17. A 0.20-kg stone is attached to a string and whirled in a circle of radius r = 0.60 m on a horizontal frictionless surface as shown in Fig. 7. If the stone makes 150 revolutions per minute, the tension (T) in the string is:

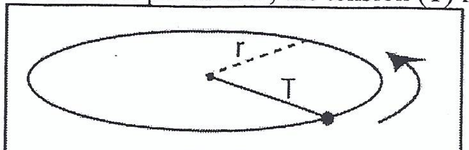


Fig. 7

A) 30 N
B) 0.20 N
C) 0.90 N
D) 1.96 N
E) 0.03 N

$$\omega = \frac{(150)(2)\pi}{60} = 5\pi$$

$$\therefore T = m\frac{v^2}{r} = (0.2)\frac{\omega^2 r^2}{r} = (0.2)(5\pi)^2(0.6)$$

$$= 29.58 \ N$$

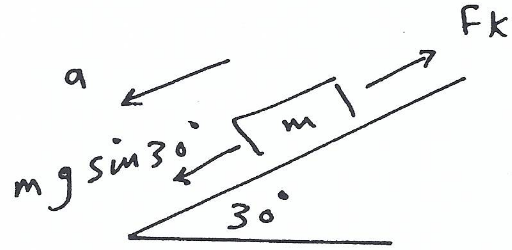
18. A block of mass M slides on a horizontal surface. Which of the following would increase the magnitude of the frictional force on the block?
A) Increasing M
B) Keeping M constant but decreasing the surface area of contact
C) Keeping M constant but increasing the surface area of contact
D) Decreasing M
E) None of the other answers

$F_K = \mu_k m g \cos\theta$

So F_K proportional to M

19. A box of mass m is sliding down a rough inclined plane (which makes an angle of 30° with the horizontal and has a coefficient of kinetic friction = μ_k) at a constant acceleration g/4 (where g = 9.8 m/s²). Find μ_k .

A) 0.29
B) 0.16
C) 2.15
D) 0.11
E) 0.64



$a = \frac{g}{4}$

$mg \sin 30° - \mu_k mg \cos 30° = \frac{mg}{4}$

$\frac{1}{2} - \mu_k \cos 30° = \frac{1}{4}$

$\mu_k = \frac{-0.25}{-\cos 30°}$

$= 0.288$

20. A 5.0 kg block is sliding on a rough horizontal plane (μ_k=0.10) under the effect of a horizontal force F. Fig. 8 shows the velocity (v) of the block as a function of time (t). Calculate F.

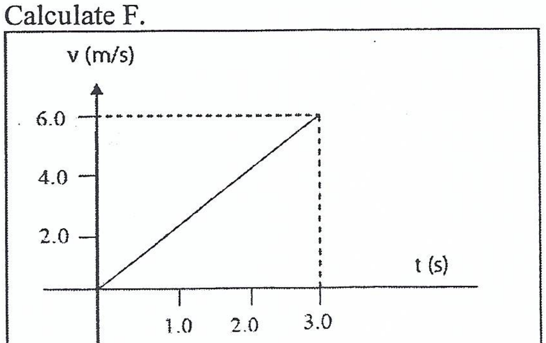


Fig. 8

A) 15 N
B) 5.0 N
C) 10 N
D) 1.0 N
E) 30 N

3

From graph: $a = \frac{V_3 - V_0}{3 - 0}$

$= \frac{6 - 0}{3} = 2\ m/s^2$

$F + F_K = ma$

$F - \mu_K mg = ma$

$F = \mu_K mg + ma = (0.1)(5)(9.8) + (5)(2)$

$= 14.9\ N$

Q2.
An 8.0 kg block is pushed against a vertical wall by a horizontal force F as shown in Fig 7. If the coefficients of friction between the block and the wall are $\mu_s = 0.60$ and $\mu_k = 0.30$ then the minimum value for (F) that will prevent the block from slipping is:

A) 260 N
B) 130 N
C) 78 N
D) 24 N
E) 87 N

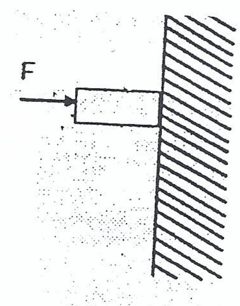
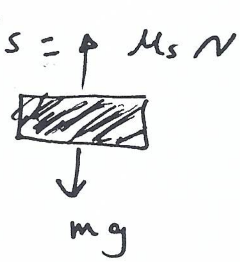


Figure 7



$mg = \mu_s N$

$(8)(9.8) = 0.6\ N$

$N = 130.67$

$F = N = 130.67\ N$

& Ans (B)

Q5.
A 1000 kg car moves on a level horizontal circular road of radius 50 m. The coefficient of static friction between the tires and the road is 0.50. The maximum speed with which this car can round this curve without slipping is:

A) 4.9 m/s
B) 3.0 m/s
C) 16 m/s
D) 9.8 m/s
E) 12 m/s

$$m \frac{v^2}{r} = \mu_s m g$$

$$v^2 = \mu_s r g$$
$$= (0.5)(50)(9.8)$$
$$= 245$$

$$\therefore v = 15.65 \text{ m/s}$$

∴ Ans (C)

Q12.
A box with a weight of 50 N rests on a horizontal surface with $\mu_s = 0.40$. A person pulls horizontally on it with a force of $F_2 = 10$ N and it does not move. To start it moving, a second person pulls vertically upward on the box with a force F_1 (see Fig 6). What is the smallest vertical force (F_1) for which the box starts moving?

A) 25 N
B) 10 N
C) 35 N
D) 5.0 N
E) 14 N

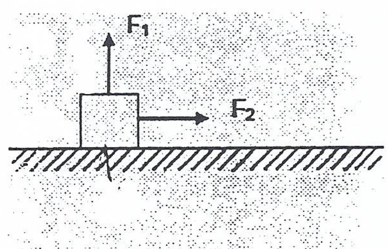
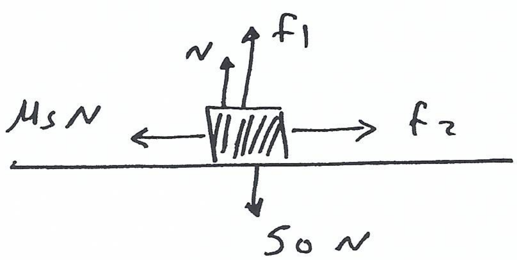


Figure 6

$$\mu_s N = F_2$$
$$N = \frac{F_2}{\mu_s}$$
$$= \frac{10}{0.4} = 25 \text{ N}$$



$$W = F_1 + N$$
$$50 = F_1 + 25$$
$$F_1 = 25 \text{ N}$$

∴ Ans (A)

Q17.
A 2.0 kg block is released from rest the top of a ramp (point A) as shown in Fig 8. The coefficient of kinetic friction between the block and the inclined surface is 0.20. The speed by which the block hits the bottom (point B) is:

A) 2.0 m/s
B) 0.0 m/s
C) 11 m/s
D) 13 m/s
E) 6.6 m/s

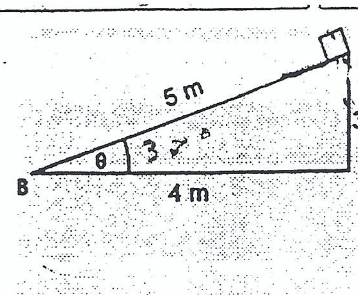
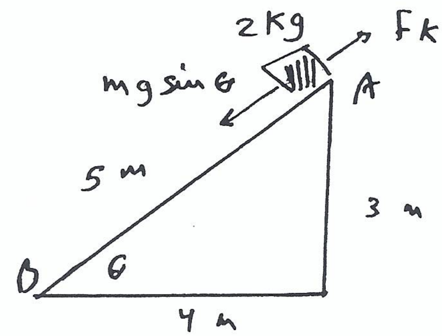


Figure 8



$\Sigma F = ma$

$mg \sin\theta - \mu_k mg \cos\theta = ma$

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

$= (9.8)\left(\frac{3}{5} - (0.2)\left(\frac{4}{5}\right)\right)$

$= 4.312$

$v^2 = v_0 + 2a\Delta x$

$v^2 = (2)(4.312)(5)$

$= 43.12$

$\therefore v = 6.57$ m/s

Ans (E)

Q14.

A 500 *kg* car moves in a vertical roller coaster of radius 10.0 *m* at a constant speed of 18.0 *m/s* (see Fig. 2). The magnitude of the force exerted by the track on the car at the bottom of the circle is:

Fig#

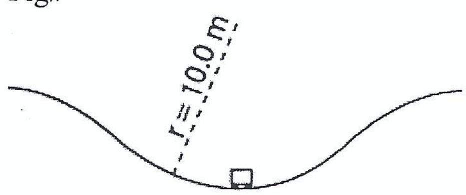


Figure 2

A) 2.11 x 10^4 *N*
B) 6.80 x 10^4 *N*
C) 1.13 x 10^4 *N*
D) 3.47 x 10^4 *N*
E) 5.19 x 10^4 *N*

$$F = \frac{mv^2}{r} + mg$$

$$= \frac{(500)(18)^2}{10} + (500)(9.8)$$

$$\approx 2.11 \times 10^4 \ N$$

Q16.

A car takes a round turn on a flat circular track at a speed of 8.00 *m/s*. The coefficient of static friction between its tires and the track is 0.300. If the car is at the verge of slipping out of the track at this speed, the radius of the track is:

A) 21.8 *m*
B) 60.0 *m*
C) 19.0 *m*
D) 2.57 *m*
E) 7.50 *m*

$$\mu_s m g = m \frac{v^2}{r}$$

$$(0.3)(9.8) = \frac{8^2}{r}$$

$$r = \frac{64}{2.94}$$

$$= 21.768 \ m$$

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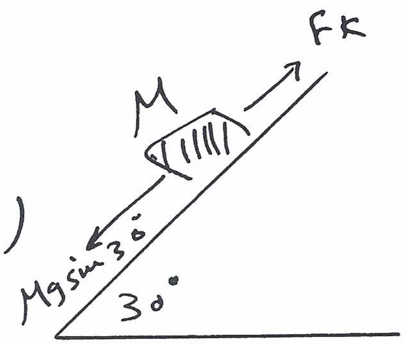
Q17.
A box of mass *M* is placed on a 30° inclined plane. The box is sliding with an acceleration equals g/2 (g is the free fall acceleration). What is the magnitude of the force of friction between the box and the plane?

A) zero
B) *Mg*/2
C) *Mg*
D) 0.866 *Mg*
E) 2*Mg*

(57)



$$Mg\sin 30 - F_k = M\left(\frac{g}{2}\right)$$

$$\frac{Mg}{2} - F_k = \frac{Mg}{2}$$

$$F_k = \frac{Mg}{2} - \frac{Mg}{2}$$

$$= 0$$

Q16.
The coefficient of kinetic friction:

A) is a dimensionless quantity
B) is greater than the coefficient of static friction
C) is the ratio of force to area
D) can have units of Newtons
E) is in the direction of the frictional force

No dimensions for kinetic Friction

A 5 kg block is placed on top of a 10 kg block which is lying on a frictionless horizontal surface, as shown in Fig. 4. A horizontal force F of 60 N is applied to the 10 kg block. Find the static frictional force on 5 kg block from the 10 kg block such that the 5 kg block does not slip.

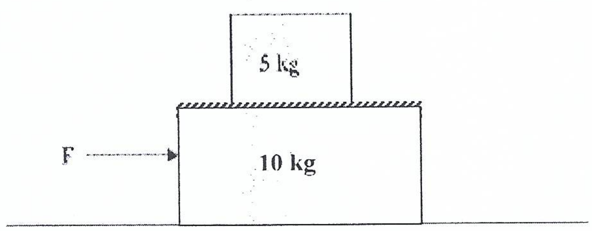


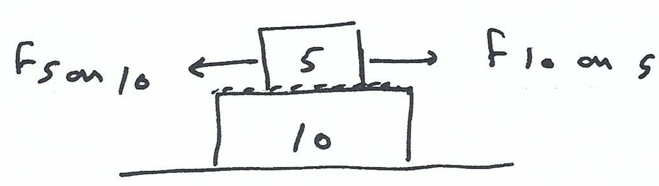
Fig. 4

A) 20 N to the right
B) 20 N to the left
C) 16 N to the right
D) 16 to the left
E) 0 N

$F = 60$ N

$F = (5+10)a \Rightarrow a = 4\ m/s^2$

$F_{s\,10\ on\ 5} = ma = 5(4) = 20$ N

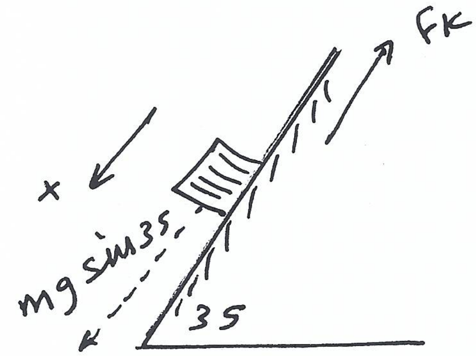


Q19.
A crate is sliding down an incline that is 35° above the horizontal. If the coefficient of kinetic friction is 0.4, the acceleration of the crate is:

A) 2.4 m/s^2
B) 0.0 m/s^2
C) 5.8 m/s^2
D) 8.8 m/s^2
E) 9.3 m/s^2

$\theta = 35°$

$\mu_k = 0.4$



$\Sigma F = ma$

$mg \sin 35° - \mu_k mg \cos 35 = ma$

$(9.8)(\sin 35°) - (0.4)(9.8)\cos 35 = a$

$2.41 = a$

Q20.
An automobile moves on a level horizontal road in a circle of radius 30 m. The coefficient of static friction between tires and road is 0.5 . The maximum speed with which this car can travel round this curve without sliding is:

A) 12 m/s
B) 4.9 m/s
C) 9.8 m/s
D) 3.0 m/s
E) 15 m/s

$\mu_s = 0.5$

$r = 30$ m

$\mu_s mg = m\frac{v^2}{r} \Rightarrow v = \sqrt{r \mu_s g}$

$= 12.12$ m/s

Q20.
A pilot of mass 75.0 kg in a jet aircraft executes a loop-the-loop, as shown in Figure 10. In this maneuver, the aircraft moves in a vertical circle of radius R = 3.00 km at a constant speed of 250 m/s. Determine the magnitude of the force exerted by the seat on the pilot at the bottom of the loop.

A) 2.30×10^3 N
B) 828 N
C) 735 N
D) 5.20×10^3 N
E) 1.50×10^3 N

$m = 75$ kg

$R = 3$ km

$v = 250$ m/s

At Bottom

$$F_N = \frac{mv^2}{R} + mg$$

$$= 75\left(\frac{(250)^2}{3000} + 9.8\right)$$

$$= 2.297 \times 10^3$$

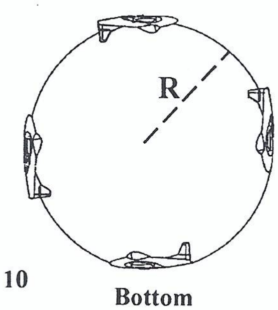


Figure 10

Q19.
A block of mass 3.0 kg is pushed against a rough wall (coefficient of kinetic friction is 0.20) by a force P = 30 N that makes an angle of 50° with the horizontal as shown in Figure 9. Assuming the block is sliding down, find the magnitude of its acceleration.

A) 0.85 m/s^2
B) 9.8 m/s^2
C) 1.8 m/s^2
D) 0.17 m/s^2
E) 2.1 m/s^2

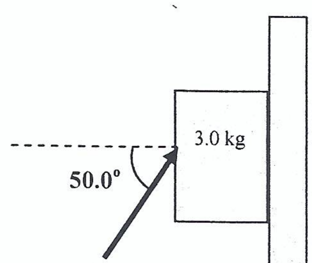
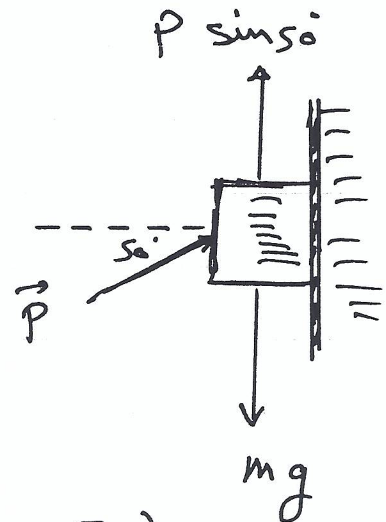


Figure 9



$$ma = \Sigma F$$

$$ma = mg - (P\sin 50 + F_k)$$

$$ma = (3)(9.8) - (30\sin 50 + (0.2)(30)(\cos 50))$$

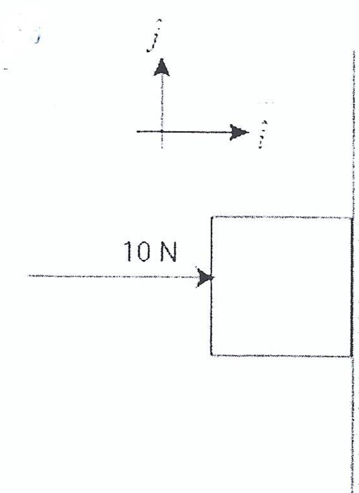
$$3a = 29.4 - 26.84$$

$$a = \frac{2.56}{3}$$

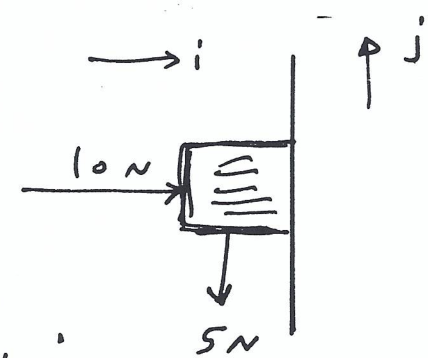
$$= 0.85\ m/s^2$$

Q18.
As shown in **Figure** 7, a block weighing 5.0 N is held at rest against a vertical wall by a horizontal force of magnitude 10 N. The coefficient of static friction between the wall and the block is 0.60, and the coefficient of kinetic friction is 0.40. In unit vector notation, find the force on the block from the wall.

A) $-10\,\hat{i} + 5.0\,\hat{j}$
B) $+10\,\hat{i} - 5.0\,\hat{j}$
C) $-10\,\hat{i} - 5.0\,\hat{j}$
D) $-10\,\hat{i} - 6.0\,\hat{j}$
E) $+10\,\hat{i} + 6.0\,\hat{j}$



The block is held at rest.



$$\Rightarrow \quad \sum F_x = 0$$

$$10\hat{i} + F_{wx} = 0$$

$$F_{wx} = -10\hat{i}$$

$$\Rightarrow \quad \sum F_y = 0$$

$$-5\hat{j} + F_{wy} = 0$$

$$F_{wy} = 5\hat{j}$$

Q19.
A 20.0 kg block is initially at rest on a rough, horizontal surface. A horizontal force of 75.0 N is required to set the block in motion. After it is in motion, a horizontal force of 60.0 N is required to keep the block moving with constant speed. Find the coefficients of static and kinetic friction.

A) 0.383; 0.306
B) 0.450; 0.306
C) 0.330; 0.286
D) 0.432; 0.185
E) 0.234; 0.123

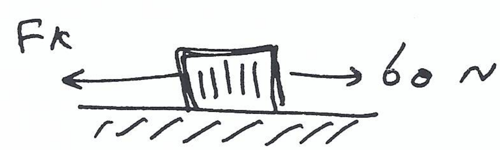
$$\Rightarrow \quad F_{s\,max} = 75$$

$$\mu_s mg = 75$$

$$\mu_s (20)(9.8) = 75$$

$$\mu_s = 0.383$$

$$\Rightarrow \quad 60 - F_k = 0$$



$$F_k = 60$$

$$\mu_k mg = 60$$

$$\mu_k = \frac{60}{(20)(9.8)} = 0.306$$

Q20.
A car rounds a flat curved road (radius = 100 m) at a speed of 25.0 m/s and is about to slide at this speed. What is the coefficient of static friction between the tires of the car and the road?

A) 0.638
B) 0.250
C) 0.753
D) 0.800
E) 0.105

$$\mu_s m g = m \frac{v^2}{R}$$

$$\mu_s = \frac{v^2}{Rg} = \frac{(25)^2}{(100)(9.8)} = 0.6377$$

Q18.
A box rests on the flatbed of a truck that is initially traveling at 15 m/s on a level road. The driver applies the brakes and the truck is brought to a stop in a distance of 38 m. If the deceleration of the truck is constant, what is the minimum coefficient of static friction between the box and the flatbed of the truck that is required to keep the box from sliding?

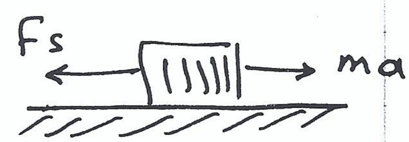
A) 0.30
B) 0.20
C) 0.10
D) 0.59
E) 0.49

$$v^2 = v_0^2 + 2a\Delta x$$

$$0 = (15)^2 - 2a(38)$$

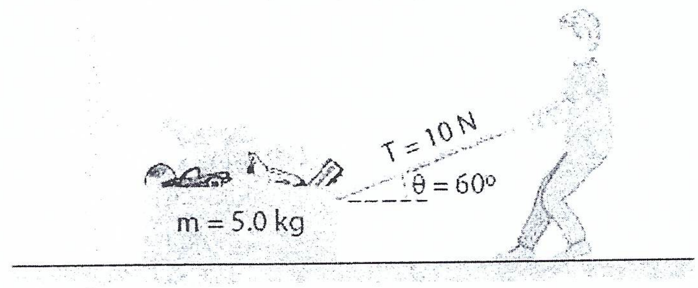
$$a = \frac{225}{76} = 2.96\ m/s^2$$

$$\mu_s m g = m a$$



$$\mu_s = \frac{a}{g} = \frac{2.96}{9.8} = 0.302$$

Q19.
As shown in **Figure 6**, a boy pulls a box of total mass m = 5.0 kg with a rope that makes an angle of 60° with the horizontal. The boy pulls on the rope with a force of 10 N; and the box moves with constant velocity. What is the coefficient of kinetic friction between the box and the surface?
Fig#



A) 0.12
B) 0.090
C) 0.060
D) 0.18
E) 0.24

$m = 5\ kg$

$T = 10\ N$

$\theta = 60°$

$F_k = \mu_k(mg - T\sin 60)$

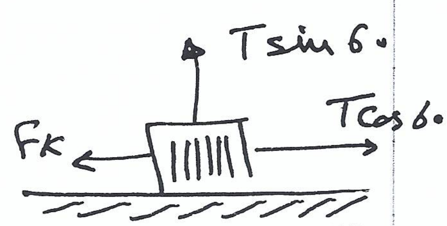
$= \mu_k((5)(9.8) - 10\sin 60)$

$= 40.34\ \mu_k$

At Constant velocity

$F_k = T\cos 60$

$40.34\ \mu_k = 10\cos 60$



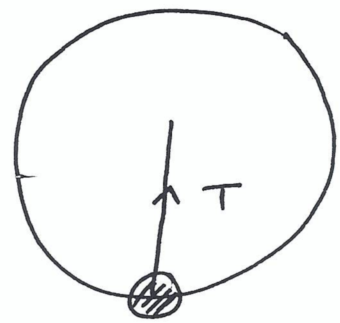
$\mu_k = \frac{5}{40.34}$

$= 0.12$

Q20.
A 0.250-kg ball attached to a string is rotating in a vertical circle of radius 0.500 m. Find the magnitude of the tension in the string at the bottom of the circle where its speed is 4.00 m/s.

A) 10.4 N
B) 7.34 N
C) 2.50 N
D) 5.65 N
E) 15.4 N

At the bottom



$$T = mg + m\frac{v^2}{R}$$

$$= 0.25\left(9.8 + \frac{4^2}{0.5}\right)$$

$$= 10.45\ N$$