

MUSTAQIL ISHLASH UCHUN MASALALAR

1-masala.

Gorizontal stol ustida massasi $m_1 = 4$ kg bo'lgan jism yotibdi. Stol bilan jism orasidagi ishqalanish koeffitsiyenti $\mu = 0,20$. Jism ip orqali blokdan oshib turgan massasi $m_2 = 2,0$ kg bo'lgan yuk bilan bog'langan.

Toping:

a) sistemaning tezlanishi a ;

b) ipdagi taranglik T .

($g = 9,8$ m/s²)

Yechim

Stol ustidagi jism uchun (m_1):

∞ Og'irlik: $m_1 \cdot g$

∞ Normal reaksiya: $N = m_1 \cdot g$

∞ Ishqalanish: $F_{\text{ish}} = \mu \cdot N = \mu \cdot m_1 \cdot g$

∞ Ip tarangligi: T

Gorizontal yo'nalish bo'yicha Nyuton 2-qonuni:

$$T - \mu \cdot m_1 \cdot g = m_1 \cdot a \quad (1)$$

Osilgan jism (m_2) uchun:

$$m_2 \cdot g - T = m_2 \cdot a \quad (2)$$

(1) + (2):

$$m_2 \cdot g - \mu \cdot m_1 \cdot g = (m_1 + m_2) \cdot a$$

$$a = g \cdot (m_2 - \mu \cdot m_1) / (m_1 + m_2)$$

Son qo'yamiz:

$$m_2 - \mu \cdot m_1 = 2,0 - 0,20 \cdot 4 = 2,0 - 0,8 = 1,2$$

$$m_1 + m_2 = 4 + 2 = 6$$

$$a = 9,8 \cdot (1,2 / 6) = 9,8 \cdot 0,2 = 1,96 \text{ m/s}^2$$

Endi (1) dan T :

$$T = m_1 \cdot a + \mu \cdot m_1 \cdot g = 4 \cdot 1,96 + 0,20 \cdot 4 \cdot 9,8 = 7,84 + 7,84 \\ = 15,68 \text{ N}$$

Javob:

$$a \approx 1,96 \text{ m/s}^2$$

$$T \approx 15,7 \text{ N}$$

2-masala.

Burchagi $\alpha = 30^\circ$ bo'lgan ishqalanishsiz qiya tekislikda massasi $m_1 = 3,0 \text{ kg}$ bo'lgan jism yotibdi. U ip orqali blokdan oshib turgan massasi $m_2 = 2,0 \text{ kg}$ bo'lgan yuk bilan bog'langan.

Toping:

a) sistemaning tezlanishi a ;

b) ipdagi taranglik T .

$$(g = 9,8 \text{ m/s}^2, \sin 30^\circ = 0,5)$$

Yechim

Qiya bo'yicha m_1 uchun:

$$T - m_1 \cdot g \cdot \sin \alpha = m_1 \cdot a \quad (1)$$

Osilgan m_2 uchun:

$$m_2 \cdot g - T = m_2 \cdot a \quad (2)$$

(1)+(2):

$$m_2 \cdot g - m_1 \cdot g \cdot \sin \alpha = (m_1 + m_2) \cdot a$$

$$a = g \cdot (m_2 - m_1 \cdot \sin \alpha) / (m_1 + m_2)$$

Hisoblaymiz:

$$m_1 \cdot \sin \alpha = 3 \cdot 0,5 = 1,5$$

$$m_2 - m_1 \cdot \sin \alpha = 2,0 - 1,5 = 0,5$$

$$m_1 + m_2 = 3 + 2 = 5$$

$$a = 9,8 \cdot (0,5 / 5) = 9,8 \cdot 0,1 = 0,98 \text{ m/s}^2$$

T ni (2) dan:

$$T = m_2 \cdot g - m_2 \cdot a = 2 \cdot 9,8 - 2 \cdot 0,98 = 19,6 - 1,96 = 17,64 \text{ N}$$

Javob:

$$a \approx 0,98 \text{ m/s}^2$$

$$T \approx 17,6 \text{ N}$$

3-masala.

Gorizontal ishqalanishsiz sirt ustida ketma-ket joylashgan massalari $m_1 = 2 \text{ kg}$, $m_2 = 3 \text{ kg}$, $m_3 = 5 \text{ kg}$ bo'lgan jismlar bor. Eng chapdagi m_1 ga $F = 20 \text{ N}$ kuch chapdan o'ngga qarab ta'sir qiladi.

Toping:

- a) sistemaning tezlanishi a ;
- b) m_1 va m_2 orasidagi bosim kuchi N_{12} ;
- c) m_2 va m_3 orasidagi bosim kuchi N_{23} .

Yechim

Umumiy massa:

$$M = m_1 + m_2 + m_3 = 2 + 3 + 5 = 10 \text{ kg}$$

$$F = M \cdot a \Rightarrow a = F / M = 20 / 10 = 2,0 \text{ m/s}^2$$

N_{12} ni topish uchun m_2 va m_3 ni bitta sistema deb qaraymiz:

$$(m_2 + m_3) \cdot a = N_{12}$$

$$N_{12} = (3 + 5) \cdot 2 = 8 \cdot 2 = 16 \text{ N}$$

N_{23} uchun faqat m_3 :

$$N_{23} = m_3 \cdot a = 5 \cdot 2 = 10 \text{ N}$$

Javob:

$$a = 2,0 \text{ m/s}^2$$

$$N_{12} = 16 \text{ N}$$

$$N_{23} = 10 N$$

4-masala.

Massasi $m = 70 \text{ kg}$ bo'lgan odam lift ichida tarozi ustida turibdi.

a) Lift yuqoriga tezlanayotganda tarozi $P_1 = 840 \text{ N}$ ko'rsatdi. Liftning tezlanishi a_1 ni toping.

b) Boshqa vaqtda lift pastga tezlanayotganda tarozi $P_2 = 490 \text{ N}$ ko'rsatdi. Bu holatda tezlanish a_2 ni toping.

($g = 9,8 \text{ m/s}^2$)

Yechim

Normal reaksiya $N = P$

a) Yuqoriga tezlanish

$$N - m \cdot g = m \cdot a_1$$

$$a_1 = (N - m \cdot g) / m$$

$$m \cdot g = 70 \cdot 9,8 = 686 \text{ N}$$

$$a_1 = (840 - 686) / 70 = 154 / 70 \approx 2,2 \text{ m/s}^2 \text{ (yuqoriga)}$$

b) Pastga tezlanish

$$N - m \cdot g = -m \cdot a_2 - m \cdot a_2 = N - m \cdot g$$

$$a_2 = (m \cdot g - N) / m$$

$$a_2 = (686 - 490) / 70 = 196 / 70 \approx 2,8 \text{ m/s}^2 \text{ (pastga)}$$

Javob:

$$a_1 \approx 2,2 \text{ m/s}^2 \text{ yuqoriga}$$

$$a_2 \approx 2,8 \text{ m/s}^2 \text{ pastga}$$

5-masala.

Qiya tekislik burchagi asta-sekin oshirilmoqda. Massasi $m = 1,5 \text{ kg}$ bo'lgan jism qiya tekislik ustida tinch turgan edi. Burchak $\alpha = 25^\circ$ ga yetganda jism sirpanib ketdi.

Qiya tekislik bilan jism orasidagi ishqalanish koeffitsiyentini μ ni toping.
($g = 9,8 \text{ m/s}^2, \text{tg}25^\circ \approx 0,466$)

Yechim

Tinch turish chegarasida:

$$m \cdot g \cdot \sin\alpha = \mu \cdot m \cdot g \cdot \cos\alpha$$

$$\mu = (m \cdot g \cdot \sin\alpha) / (m \cdot g \cdot \cos\alpha) = \text{tg}\alpha$$

$$\mu = \text{tg}25^\circ \approx 0,466$$

Javob:

$$\mu \approx 0,47$$

6-masala.

Burchagi $\alpha = 30^\circ$ bo'lgan qiya tekislikda massasi $m = 4,0 \text{ kg}$ bo'lgan jism bor. Jism bilan tekislik orasidagi ishqalanish koeffitsiyenti $\mu = 0,20$. Jism qiya tekislik bo'ylab yuqoriga qarab $F = 30 \text{ N}$ kuch bilan tortilmoqda.

Toping:

a) jismning tezlanishi a ;

b) qaysi yo'nalishda harakat qiladi (yuqoriga yoki pastga).

$$(g = 9,8 \text{ m/s}^2, \sin 30^\circ = 0,5, \cos 30^\circ \approx 0,866)$$

Yechim

Qiya bo'yicha kuchlarni ko'ramiz. Yuqoriga yo'nalishni musbat deb olamiz.

📖 F (yuqoriga)

📖 Og'irlik tarkibi: $m \cdot g \cdot \sin\alpha$ (pastga)

📖 Ishqalanish kuchi: ishqalanish harakatga qarshi, lekin yo'nalishni bilish uchun taxmin qilamiz: agar F yetarli bo'lsa, yuqoriga harakat qilmoqchi, demak ishqalanish pastga.

Normal reaksiya:

$$N = m \cdot g \cdot \cos\alpha$$

$$= 4 \cdot 9,8 \cdot 0,866 \approx 4 \cdot 8,4968 \approx 33,987 \approx 34,0 \text{ N}$$

Ishqalanish:

$$F_{\text{ish}} = \mu \cdot N \approx 0,20 \cdot 34,0 \approx 6,8 \text{ N (pastga)}$$

Og'irlik tarkibi:

$$m \cdot g \cdot \sin \alpha = 4 \cdot 9,8 \cdot 0,5 = 4 \cdot 4,9 = 19,6 \text{ N}$$

Qiya bo'yicha Nyuton 2-qonuni:

$$F - m \cdot g \cdot \sin \alpha - F_{\text{ish}} = m \cdot a$$

$$30 - 19,6 - 6,8 = 4 \cdot a$$

$$30 - 26,4 = 4 \cdot a$$

$$3,6 = 4 \cdot a \rightarrow a = 3,6 / 4 = 0,9 \text{ m/s}^2 \text{ (yuqoriga)}$$

Javob:

$$a \approx 0,90 \text{ m/s}^2$$

Jism yuqoriga harakatlanadi.

7-masala.

Gorizontal ishqalanishsiz sirt ustida ip bilan bog'langan ikki jism bor: chapdagi $m_1 = 3,0 \text{ kg}$, o'ngdagi $m_2 = 2,0 \text{ kg}$. Chapdagi jismga chapdan o'ngga $F = 25 \text{ N}$ kuch ta'sir qiladi.

Toping:

- a) sistemaning tezlanishi a ;
- b) ipdagi taranglik kuchi T .

Yechim

Umumiy massa:

$$M = m_1 + m_2 = 3 + 2 = 5 \text{ kg}$$

Tezlanish:

$$a = F / M = 25 / 5 = 5,0 \text{ m/s}^2$$

Endi ip tarangligini m_2 uchun olamiz (o'ngga +):

$$T = m_2 \cdot a = 2 \cdot 5 = 10 \text{ N}$$

Tekshiruv: m_1 uchun:

$$F - T = m_1 \cdot a \rightarrow 25 - 10 = 3 \cdot 5 \rightarrow 15 = 15$$

Javob:

$$a = 5,0 \text{ m/s}^2$$

$$T = 10 \text{ N}$$

8-masala.

Gorizontal bilan $\alpha = 40^\circ$ burchak hosil qiluvchi qiya tekislik ustida massasi $m = 5,0 \text{ kg}$ bo'lgan jism turibdi. Jism bilan tekislik orasidagi ishqalanish koeffitsiyenti $\mu = 0,25$. Jism gorizontal yo'nalishda pastga qarab $F = 30 \text{ N}$ kuch bilan itarilmoqda (ya'ni klinni devorga surayotgandek).

Qiya bo'yicha jismning tezlanishi a ni toping.
($g = 9,8 \text{ m/s}^2$, $\sin 40^\circ \approx 0,643$, $\cos 40^\circ \approx 0,766$)

Yechim

Bu biroz qiyinroq: gorizontal kuchni qiya bo'yicha proyeksiya qilamiz.

Koordinata o'qi – qiya bo'ylab pastga (tekislik bo'ylab), shu yo'nalishni musbat deb olamiz.

Jismga ta'sir etuvchi qiya bo'yicha kuchlar:

1. Og'irlik tarkibi: $m \cdot g \cdot \sin \alpha \rightarrow$ pastga (musbat)
2. Gorizontal F kuchining qiya bo'yicha proyeksiyasi:
 $F_{\text{qiya}} = F \cdot \cos \alpha \rightarrow$ ham pastga (chunki F gorizontal, qiya bilan u burchagi α , qiya bo'ylab pastga proyeksiya $F \cdot \cos \alpha$)
3. Ishqalanish: harakat yo'nalishiga qarshi, agar jism pastga sirpanayotgan bo'lsa, ishqalanish yuqoriga.

Avval normal reaksiya N :

$$N = m \cdot g \cdot \cos \alpha - F \cdot \sin \alpha$$

Chunki og'irlikning normal tarkibi pastga tekislikka ($m \cdot g \cdot \cos\alpha$), F ning normal tarkibi esa yuqoriga ($F \cdot \sin\alpha$) bo'ladi.

Hisoblaymiz:

$$m \cdot g \cdot \cos\alpha = 5 \cdot 9,8 \cdot 0,766 \approx 5 \cdot 7,503 \approx 37,515 \approx 37,5 \text{ N}$$

$$F \cdot \sin\alpha = 30 \cdot 0,643 \approx 19,29 \text{ N}$$

$$N \approx 37,5 - 19,29 \approx 18,21 \text{ N}$$

Ishqalanish:

$$F_{\text{ish}} = \mu \cdot N \approx 0,25 \cdot 18,21 \approx 4,55 \text{ N (yuqoriga)}$$

Endi qiya bo'yicha Nyuton 2-qonuni:

$$\Sigma F_{\text{qiya}} = m \cdot a$$

$$m \cdot g \cdot \sin\alpha + F \cdot \cos\alpha - F_{\text{ish}} = m \cdot a$$

Hisoblaymiz:

$$m \cdot g \cdot \sin\alpha = 5 \cdot 9,8 \cdot 0,643 \approx 5 \cdot 6,3014 \approx 31,507 \approx 31,5 \text{ N}$$

$$F \cdot \cos\alpha = 30 \cdot 0,766 \approx 22,98 \text{ N}$$

Shunday qilib:

$$m \cdot a = 31,5 + 22,98 - 4,55 \approx 49,93 \text{ N}$$

$$a = 49,93 / 5 \approx 9,99 \text{ m/s}^2 \approx 10,0 \text{ m/s}^2$$

(Yaqinlashib ketgan, lekin bu sonlar tanlanishi tufayli.)

Javob:

$$a \approx 10,0 \text{ m/s}^2 \text{ (qiya bo'ylab pastga)}$$

9-masala.

Gorizontal stol ustida massasi $m_1 = 6,0 \text{ kg}$ bo'lgan jism yotibdi. Stol bilan jism orasidagi ishqalanish koeffitsiyenti $\mu = 0,30$. Jism ip orqali blokdan oshib turgan massasi m_2 bo'lgan yuk bilan bog'langan. Sistema tinchdan qo'yib yuborilganda, tezlanish $a = 1,0 \text{ m/s}^2$ bo'ldi.

m_2 massasini toping.

$$(g = 9,8 \text{ m/s}^2)$$

Yechim

m_1 uchun:

$$T - \mu \cdot m_1 \cdot g = m_1 \cdot a \quad (1)$$

m_2 uchun:

$$m_2 \cdot g - T = m_2 \cdot a \quad (2)$$

(1)+(2):

$$m_2 \cdot g - \mu \cdot m_1 \cdot g = (m_1 + m_2) \cdot a$$

$$m_2 \cdot g - m_2 \cdot a = \mu \cdot m_1 \cdot g + m_1 \cdot a$$

$$m_2 \cdot (g - a) = m_1 \cdot (\mu \cdot g + a)$$

$$m_2 = m_1 \cdot (\mu \cdot g + a) / (g - a)$$

Son qo'yamiz:

$$\mu \cdot g + a = 0,30 \cdot 9,8 + 1,0 = 2,94 + 1,0 = 3,94$$

$$g - a = 9,8 - 1,0 = 8,8$$

$$m_2 = 6,0 \cdot 3,94 / 8,8$$

$$6 \cdot 3,94 = 23,64$$

$$m_2 \approx 23,64 / 8,8 \approx 2,685 \text{ kg} \approx 2,69 \text{ kg}$$

Javob:

$$m_2 \approx 2,7 \text{ kg}$$

10-masala.

Ikki jism ip bilan bog'langan:

📖 yuqoridagi jism massasi $m_1 = 5,0 \text{ kg}$ stol ustida, stol bilan ishqalanish koeffitsiyenti $\mu = 0,10$;

📖 pastga osilgan jism massasi $m_2 = 4,0 \text{ kg}$.

Toping:

a) sistemaning tezlanishi a ;

b) ip tarangligi T ;

c) m_1 ga ta'sir etuvchi ishqalanish kuchi F_{ish} .

$$(g = 9,8 \text{ m/s}^2)$$

Yechim

Avval ishqalanish kuchi:

$$N = m_1 \cdot g = 5 \cdot 9,8 = 49 \text{ N}$$

$$F_{\text{ish}} = \mu \cdot N = 0,10 \cdot 49 = 4,9 \text{ N}$$

m_1 (gorizontal, o'ngga +):

$$T - F_{\text{ish}} = m_1 \cdot a \quad (1)$$

m_2 (pastga +):

$$m_2 \cdot g - T = m_2 \cdot a \quad (2)$$

(1)+(2):

$$m_2 \cdot g - F_{\text{ish}} = (m_1 + m_2) \cdot a$$

$$a = (m_2 \cdot g - F_{\text{ish}}) / (m_1 + m_2)$$

Son qo'yamiz:

$$m_2 \cdot g = 4 \cdot 9,8 = 39,2 \text{ N}$$

$$m_1 + m_2 = 5 + 4 = 9$$

$$a = (39,2 - 4,9) / 9 = 34,3 / 9 \approx 3,81 \text{ m/s}^2$$

Endi T ni (1) dan:

$$T = m_1 \cdot a + F_{\text{ish}} = 5 \cdot 3,81 + 4,9 \approx 19,05 + 4,9 = 23,95 \text{ N} \approx 24,0 \text{ N}$$

Javob:

$$a \approx 3,81 \text{ m/s}^2$$

$$T \approx 24,0 \text{ N}$$

$$F_{\text{ish}} = 4,9 \text{ N}$$

