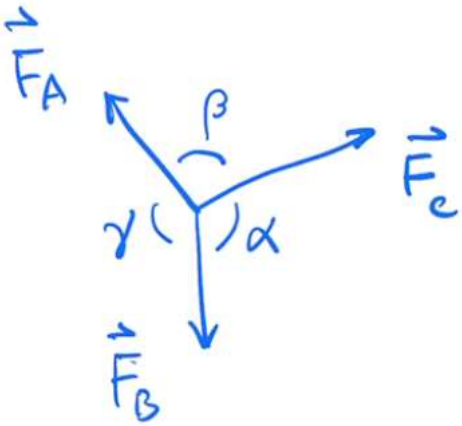
Problem 1

An object remains still while 3 forces acting on it(see fgiure). The forces and angles between the forces are shown in the figure: $F_A = 150\,\text{N}, F_C = 250\,\text{N}, \gamma = 125^\circ$. Answer the following questions. (02小題)



(a)The magnitude of force B, $|\vec{F}_B|$=_____ N

01: **ANS:=303.8**

(b)The angle α=_____ degree

02: **ANS:=150.6**

Problem 2

Answer the following questions: (04小題)

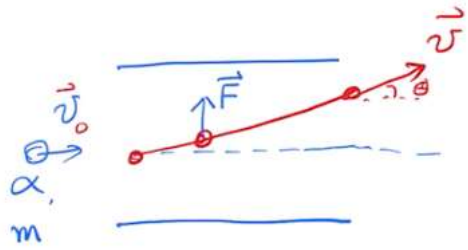
(a)A spaceship of mass 750 kg is accelerated by solar wind. Suppose the acceleration and force of Sun's push is constant $F = 30$ N. Assume the spaceship is initially at rest, find the distance of it travels in one day. distance=____ m

03: **ANS:=1.493E8**

(b)An elevator of mass 1600 kg is initially at rest and held by a rope. Then the elevator starts to fall. Its speed increases constantly from zero to 10 m/s in 2.5 s. Calculate the tension in the rope. Tension=_____ N

04: **ANS:=9280**

(c) An α particle of mass 6.68×10^{-27} kg and charge 3.2×10^{-19} C and velocity $\vec{v} = 10^6 \hat{i}$ m/s enters a region of constant electric field shown in the figure. The α particle is exerted a constant electric force of 8.2×10^{-13} N upward by the electrically charged plates(see figure). The particle passes this region in 2×10^{-8} s. Find the angle of made by the velocity with the +x-axis when it just comes out of this region. The angle θ=____ degree (the angle is defined between 0 and 90 degree).

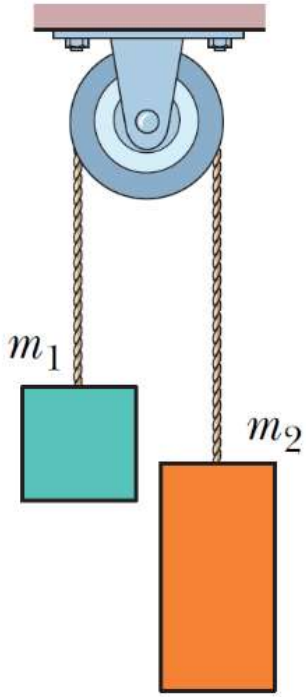


05: **ANS:=67.84**

(d)following (c) the final speed of the α-particle when it just comes out of the region. The speed=_____ m/s

06: **ANS:=2.651E6**

Problem 3



如圖所示是有名的Atwood機械，利用右邊的物體具有較大的質量m_2可以帶動左側的m_1質量向上運動。假設滑輪沒有摩擦，繩子是剛硬的且其質量可以不計，重力加速度為g。整體系統初始時間為靜止，請回答下列問題。 (02小題)

(a)m_2下降H的高度所需要的時間t=_____ [H, m_1, m_2, g]

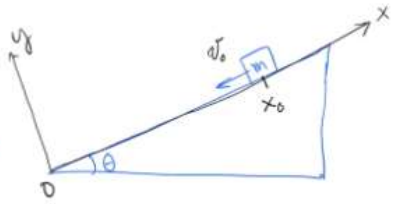
07: **ANS:=sqrt((2*H*(m_1+m_2))/(m_2-m_1)/g)**

(b)m_2下降H的高度時其速度=_____ [H, m_1, m_2, g]

08: **ANS:=sqrt((2*(m_2-m_1)*g*H)/(m_1+m_2))**

Problem 4

As shown in the figure a block of mass m is initially at $x = x_0$ and moving at velocity v_0 on the slope. The slope is frictionless. Answer the following questions. Take $m = 10$ kg, $x_0 = 20$ m, and $\theta = 30^\circ$. (03小題)



(a)For $v_0 = -10$ m/s i.e., initially the block moving downward, find the time the block reach $x = 0$. t=_____ s

09: **ANS:=1.47**

(b)repeat (a), but with $v_0 = 10$, i.e., the block initially moving upward. the time the block reach $x = 0$, t=_____ s

10: **ANS:=5.55**

(c)the normal force on the block due to the slope=_____ N

11: **ANS:=84.87**

Problem 5

一個25.0 kg的箱子以27°的傾斜角度自斜面上釋放，並以0.30 m/s^2的加速度向斜面下加速。 (a)計算阻礙其運動的摩擦力。 (b)動摩擦係數是多少？ (02小題)

(a)摩擦力=_____ N

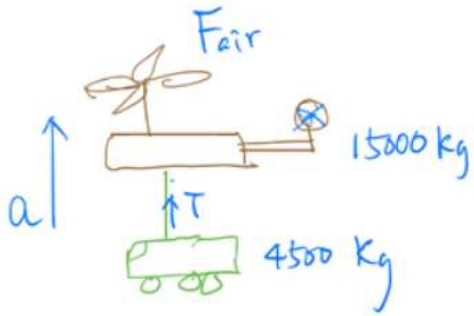
12: **ANS:=103.7**

(b)動摩擦係數=_____

13: **ANS:=0.48**

Problem 5

一架 15000 kg 的直升機以 1.4 m/s^2 的向上加速度以纜繩拉起一輛 4500 kg 的卡車。 計算 (a) 從空中作用在直升機槳葉上的淨向上力和 (b) 直升機和卡車之間纜繩的張力。 (02小題)



(a) 來自空氣的淨向上力=_____ N

14: **ANS:=2.2E5**

(b)電纜的張力=_____ N

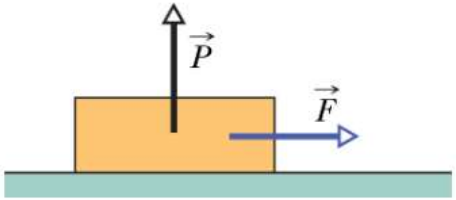
15: **ANS:=5.0E4**

Problem 6

Answer the following questions. (02小題)

(a)**friction problem A:**

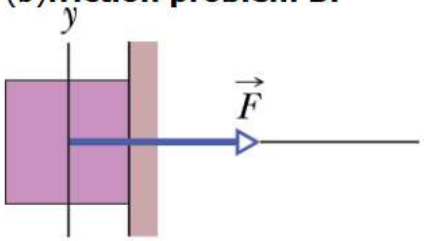
A 5 kg block is initially at rest on a horizontal surface. A horizontal force $\vec{F}$ of magnitude 16 N and a vertical force are $\vec{P}$ are then applied to the block (in the Fig). The coefficients of friction for the block and surface are $\mu_s = 0.4$ and $\mu_k = 0.25$. Determine the magnitude of the frictional force acting on the block if the magnitude of $\vec{P}$ is 12N.質量為 5 kg 的物塊最初靜止在水平面上。然後，對該物塊施加一個大小為 16 N 的水平力 F 和一個大小為 P 的垂直力（如圖）。物塊與水平面的摩擦係數分別為 μ_s = 0.4 與 μ_k = 0.25。若 P 的大小為 12 N，求作用在物塊上的摩擦力的大小。



(a)friction f_r=_____N

16: **ANS:=9.25**

(b)**friction problem B:**



A 12 N horizontal force $\vec{F}$ pushes a block weighing 5 N against a vertical wall (see the figure). The coefficient of static friction between the wall and the block is 0.6, and the coefficient of kinetic friction is 0.4. Assume that the block is not moving initially. The magnitude of the force that the wall acting on the block=_____ N。一個大小為 12 N 的水平力 F 將一個重 5 N 的物塊推向一面垂直的牆（見圖）。牆與物塊之間的靜摩擦係數為 0.6，動摩擦係數為 0.4。假設物塊初始靜止。牆壁對物塊的作用力大小為_____ N

17: **ANS:=13**

Problem 7

The Rotor is essentially a large, hollow cylinder that is rotated rapidly around its central axis. Before the ride begins, a rider enters the cylinder through a door on the side and stands on a floor, up against a canvas-covered wall. The door is closed, and as the cylinder begins to turn, the rider, wall, and floor move in unison. When the rider's speed reaches some predetermined value, the floor abruptly and alarmingly falls away. The rider does not fall with it but instead is pinned to the wall while the cylinder rotates, as if an unseen agent is pressing the body to the wall. Suppose that the coefficient of static friction $\mu_s = 0.5$ between the rider's clothing and the canvas wall and the cylinder's radius $R = 3$ m. (a)What is the minimum speed v must the cylinder have if the rider is not to fall? (b)If the mass of the rider is 60 kg, calculate the magnitude of the resultant force(合力) on the rider when the cylinder rotates in speed $v = 15$ m/s.

旋轉器本質上是一個大型空心圓柱體，它繞著中心軸高速旋轉。在遊樂設施開始前，乘客從側面的門進入圓柱體，站在地板上，背靠著帆布覆蓋的牆壁。門關閉後，隨著圓柱體開始旋轉，乘客、牆壁和地板同步移動。當乘客的速度達到某個預設值時，地板會突然且令人擔憂地脫落。乘客不會隨之墜落，而是被固定在牆上，圓柱體繼續旋轉，彷彿有一股看不見的力量將乘客壓在牆上。假設乘客衣服與帆布牆之間的靜摩擦係數為 $\mu_s = 0.5$，圓柱體的半徑為 $R = 3$ m。 (a) 如果乘客不墜落，圓柱體的最小速度 v 必須是多少？ (b) 若騎手的質量為 60 kg，計算當圓柱體以速度 $v = 15$ m/s 旋轉時，騎手所受合力的大小。 (02小題)

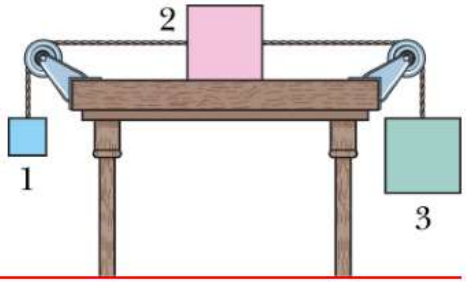
(a)the minimum speed=_____ m/s

18: **ANS:=7.668**

(b)the magnitude of the resultant force=_____ N

Problem 7

When the three blocks in the figure are released from rest, they accelerate with a magnitude of 1.5 m/s^2. Block 1 has mass M, block 2 has $2M$, and block 3 has $3M$. What is the coefficient of kinetic friction between block 2 and the table?



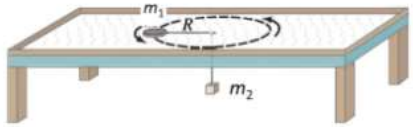
如圖所示，三個物塊從靜止釋放後，加速度大小為 1.5 m/s^2。物塊 1 的質量為 M，物塊 2 的質量為 $2M$，物塊 3 的質量為 $3M$。求物塊 2 與桌面之間的動摩擦係數。 (01小題)

μ_k=_____

20: **ANS:=0.541**

Problem 8

A flat puck (mass m1) is revolved in a circle(radius R) on a frictionless air hockey table top, and is held in this orbit by a light cord which is connected to a dangling(懸空的) mass (mass m2) through a central hole as shown in figure. Find the speed of the puck.



如圖所示，一個扁平的冰球（質量為 m1）在光滑的氣墊球桌面上做圓週運動（半徑為 R），並透過一條輕繩連接到懸掛在桌面中央小孔中的物體（質量為 m2）。求冰球的速度。 (01小題)

---

the speed v=_____ [m1,m2,R,g]

21: **ANS:=sqrt(m2*g*R/m1)**

nprob= 8 8

Problem 8

一個質量為 M 的熱氣球正垂直下降，向下的加速度為 a。 必須拋出多少質量才能使氣球向上加速，設其大小為 a？ 假設來自空氣的向上力（升力）不會因為質量的減少而改變。 重力加速度為g。 (01小題)

---

the mass to be thrown out=_____ [M,g,a]

22: **ANS:=(2*M*a)/(g+a)**

Problem 9

Find the minimum stopping distance for an automobile (mass m) traveling at speed v, the coefficient of static friction between the tires and the road is μ_s=mu_s, and g is the acceleration of gravity.

求質量為 m 的汽車以速度 v 行駛的最小停車距離，輪胎與路面間的靜摩擦係數為 μ_s=mu_s，g 為重力加速度。 (01小題)

---

minimum stopping distance=_____ [v,mu_s,g,m]

23: **ANS:=v**2/(2*mu_s*g)**

nprob= 9 9

Problem 9

A block of mass m slides along a floor while a force of magnitude F is applied to it at an upward angle θ=theta. The coefficient of kinetic friction between the block and the floor is μ_k=mu_k. Find the block's acceleration magnitude a.

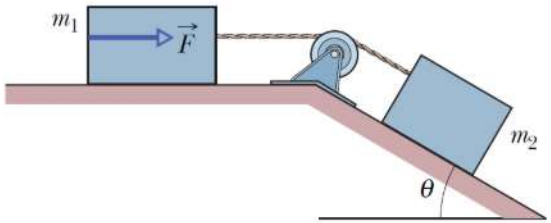
質量為 m 的物塊沿著地面滑動，同時受到大小為 F 的向上作用力 θ=theta 的作用。物塊與地面之間的動摩擦係數為 μ_k=mu_k。求物塊的加速度大小 a。 (01小題)

---

the acceleration a=_____ [g,F,m,theta,mu_k]

24: **ANS:=F/m*cos(theta)-mu_k*(g-F/m*sin(theta))**

Problem 10



The figure shows a box of mass $m_2 = 1.0$ kg on a frictionless plane inclined at angle $\theta = 30°$. It is connected by a cord of negligible mass to a box of mass $m_1 = 3.0$ kg on a horizontal frictionless surface. The pulley is frictionless and massless. If the magnitude of horizontal force F is 2.3 N, (a)what is the tension in the connecting cord? (b)what is the acceleration? (c) What is the largest value the magnitude of F may have without the cord becoming slack(鬆弛)?

如圖所示，一個質量為 $m_2 = 1.0$ kg 的箱子放置在傾角為 $\theta = 30°$ 的光滑斜面上。它透過一條質量可忽略不計的繩子與一個放置在水平光滑表面上的質量為 $m_1 = 3.0$ kg 的箱子相連。滑輪無摩擦且質量忽略不計。若水平力 F 的大小為 2.3 N，(a) 連接繩中的張力為何？ (b) 加速度是多少？ (c) 在繩子不鬆弛的情況下，力 F 的最大大小是多少？ (03小題)

(a)the tension, T=_____ N

25: **ANS:=3.1**

(b)the acceleration a=_____ m/s^2

26: **ANS:=1.8**

(c)F=_____ N

27: **ANS:=14.7**