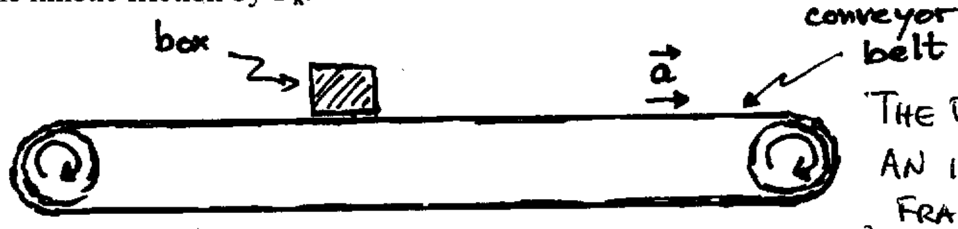
Phys 121B, Winter 2006, Exam 2 Name......SOLUTION......

Multiple Choice Questions are worth 5 points each. Use Scantron Bubble Sheet for answers, make sure to write your name, Phys 121A, and <u>student number in the bubbles</u>. There are three topics in the 10 multiple choice questions.

The first four questions refer to the drawing below and this statement. A box of mass m=1kg is placed on a conveyor belt. The coefficient of static friction between the box and belt is $\mu_s = 0.6$ and the coefficient of kinetic friction is $\mu_k = 0.4$. The conveyor belt acceleration is "a" and its velocity is "v". For simplicity, use $g = 10\ m/s^2$ (instead of 9.8 m/s^2). The normal force is indicated by **N**, the weight by **W**, the force of static friction by $\mathbf{F_s}$ and the kinetic friction by $\mathbf{F_k}$.

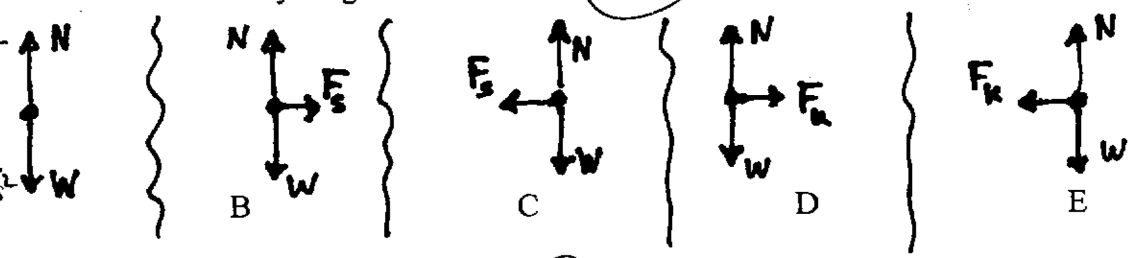


THE BELT IS NOT AN INERTIAL FRAME OF REFERENCE

An operator turns on the conveyor belt, which accelerates with $|\mathbf{a}| = 1\ m/s^2$.

Maximum force of static friction is $\mu_s mg$ which can provide an acceleration $\mu_s g = 0.6 \times 10\ m/s^2 = 6\ m/s^2$. At $1\ m/s^2$ it is not using the maximum possible friction.

Question 1. The free body diagram for the box is: (B)



Question 2. The acceleration of the box is: (D)

A. 10 m/s^2 B. 6 m/s^2 C. 4 m/s^2 D. 1 m/s^2 E. 0 m/s^2

After the belt stops and operator goes for coffee break, when he returns he turns on the conveyor belt again, this time with $|\mathbf{a}| = 10\ m/s^2$.

Question 3. The free body diagram for the forces acting on the box is: (D)

(Use drawings and choices as for Question 1)

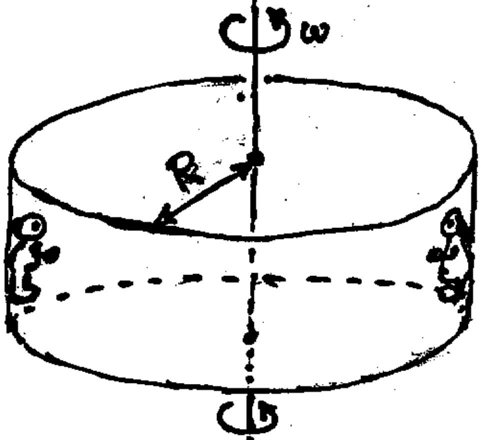
Question 4. The acceleration of the box is: (C)

A. 10 m/s^2 B. 6 m/s^2 C. 4 m/s^2 D. 1 m/s^2 E. 0 m/s^2

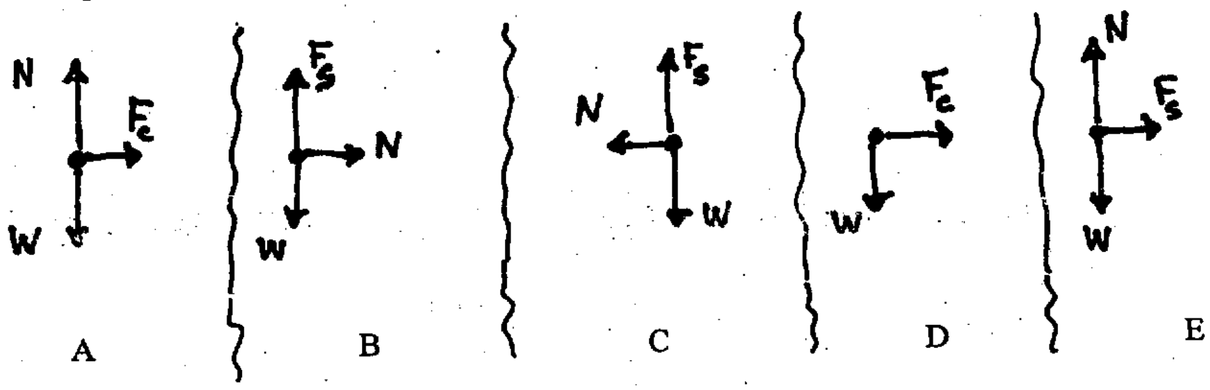
Maximum acceleration box can have is $6\ m/s^2$ if static or $4\ m/s^2$ if kinetic friction. Thus it will slip and be kinetic friction

Phys 121B, Exam 2 Name... Solution OEV...

In a short film demo, professors and student at Ohio State University went into a "rotor" in an amusement park, see picture below. The rotor has a radius of 5 meters. In steady state conditions, the rotor turns with a frequency of 20 revolutions per minute in a horizontal plane. As per movie, the floor "goes away" and everyone is "pinned" to the wall. Vectors have the same meaning as in Questions 1 through 4. $\mathbf{F_c}$ is the so-called centripetal force.



Question 5. The free body diagram for the student on the left of the picture is: (B)



Question 6. The minimum value of the coefficient of static friction for the students not to fall off is approximately: (E)

A. Infinite or person falls
B. 0.75
C. 0.65
D. 0.55
E. 0.45

$\mu_s N = mg$

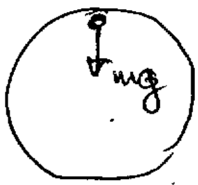
$N = m\omega^2 R = m(2\pi f)^2 R$

$\mu_s m (2\pi f)^2 R = mg$

$\mu_s = \frac{g}{(2\pi f)^2 R} = \frac{9.8\,m/s^2}{(2\pi \frac{20}{60s})^2 \times 5m} \doteq 0.45$

Question 7. If the rotor now was tilted to rotate in the vertical plane, what is the minimum frequency for which people at the top will not fall off? (B)

A. 0.11 rev/sec B. 0.22 rev/sec C. 0.33 rev/sec D. 0.44 rev/sec E. 0.55 rev/sec



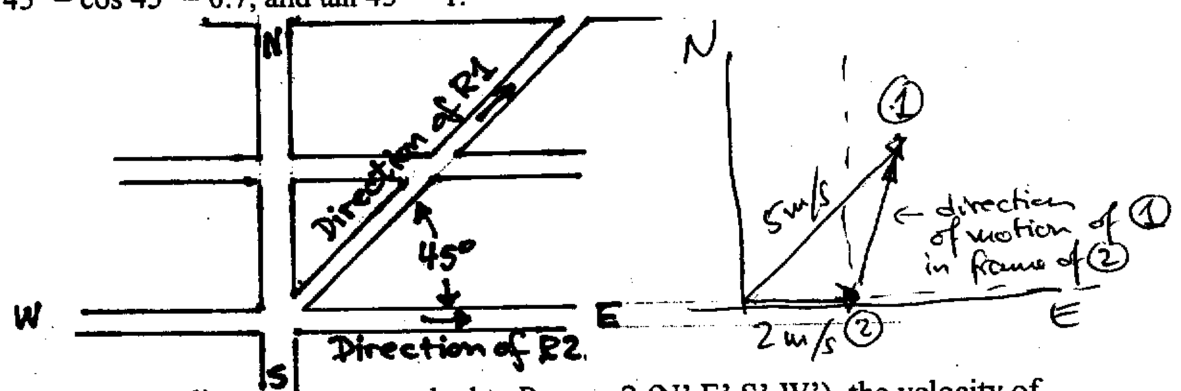
$mg = m(2\pi f)^2 R \Rightarrow \sqrt{\frac{g}{R}}\frac{1}{2\pi} = f = 0.22\,\frac{rev}{sec}$

Physics 121[illegible], Exam 2

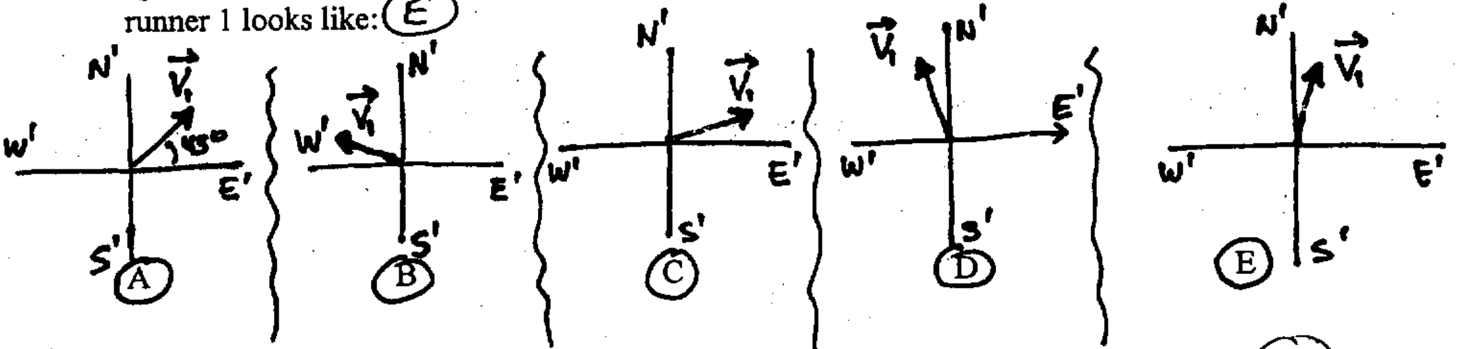
Name. Solution OEV

The next three questions refer to the picture below.

Runner 1, moving at constant $|v_1| = 5$ m/s, takes the diagonal (45°) street moving North East. Runner 2, moving at $|v_2| = 2$ m/s continues moving straight East. Both runners were at the corner of North and East streets at the same time. Useful information, perhaps, is that sin 45° = cos 45° = 0.7, and tan 45° = 1.



Question 8. In a coordinate system attached to Runner 2 (N',E',S',W'), the velocity of runner 1 looks like: (E)



Question 9. The magnitude of the velocity of Runner 1 as measured by Runner 2 is: (D)

$$\{(5\ m/s \cos 45° - 2\ m/s)^2 + (5\ m/s \sin 45°)^2\}^{1/2} =$$

A. 5 m/s B. 3 m/s C. 3.5 m/s D. 3.8 m/s E. 2 m/s

Question 10. Runner 1 sends a small rocket propelled toy forward along her direction of travel, with the acceleration of the toy rocket as measured by her being 2 m/s^2. The magnitude of the acceleration of the rocket as measured by Runner 2 is: (E)

A. 5 m/s^2 B. 3 m/s^2 C. 3.5 m/s^2 D. 3.8 m/s^2 E. 2 m/s^2

All objects have the same acceleration in inertial frames of reference.