HW

1. A 10 kg crate rests on a floor. A horizontal force (F_{app}) is applied to it. The relationship between the force of static friction (F_s) and the force of kinetic friction (F_k) during the transition from rest to motion is critical. Which of the following statements is mathematically and conceptually accurate?

A. F_s is a constant value equal to $\mu_s F_N$ until F_{app} exceeds $\mu_s F_N$, at which point F_k instantly becomes $F_k = \mu_s F_N$.

B. For any applied force $F_{app} < \mu_s F_N$, the static friction force F_s equals F_{app}. Once F_{app} reaches the maximum static friction $F_{s,\max}$, motion begins, and the friction force drops to $F_k = \mu_k F_N$.

C. Static friction F_s is always less than kinetic friction F_k because it prevents motion, while kinetic friction opposes it once started.

D. Once the object is in motion, the kinetic friction force F_k will be exactly equal to the maximum static friction force, $F_{s,\max} = \mu_s F_N$.

2. A 50 kg crate of aluminum is pulled across a steel floor. The coefficient of kinetic friction (μ_k) between the surfaces is 0.47. What horizontal force is required to accelerate the crate at a constant rate of 1.5 \ m/s^2? (Assume g = 9.8 m/s^2).

A. 73.5 N
B. 75 N
C. 260.3 N
D. 379.5 N

3. An 8 kg block of wood is placed on a wooden surface. A force of 33.6 N is required to *just* overcome static friction and start the block sliding. What is the coefficient of static friction (μ_s) between the wood block and the surface? (Assume g = 9.8 m/s^2).

A. 0.42
B. 0.35
C. 0.3
D. 0.25

4. The advice to drive slower during the rainy season (Activity 4.9) is a direct application of the physics of friction. A car braking on a dry asphalt road experiences a coefficient of kinetic friction of 0.67, but on wet asphalt, this drops to 0.58. For the same car and braking conditions, by what percentage is the maximum braking *deceleration* reduced when driving on wet asphalt compared to dry asphalt?

A. 8.96 %
B. 13.4 %
C. 86.57 %
D. 100 %

5. In the interleaved book experiment (Activity 4.10), why is the resulting total static friction force so enormous that separating the books becomes virtually impossible for a single person, despite the relatively low coefficient of friction for paper?

A. The kinetic friction is being utilized, and the force is proportional to the total contact area, which is maximized by the many pages.

B. The total force is independent of the normal force, and the difficulty arises from overcoming the molecular bonds of the paper itself.

C. The tension generated by pulling on the covers creates a tremendous compressive normal force perpendicular to each of the many hundreds of interleaved pages, and the total maximum static friction is the sum of $\mu_s F_N$ for all surfaces.

D. The rough texture of the paper fibers interlocks and effectively increases the coefficient of static friction (μ_s) to a value much greater than 1.

6. A 4 kg object is sliding to the right on a horizontal floor with an initial speed of 10 m/s. The coefficient of kinetic friction between the object and the floor is 0.3. How far will the object slide before coming to rest? (Assume g = 9.8 m/s^2).

A. 3.3 m
C. 33.3 m
B. 17 m
D. 100 m

7. A student pushes a 2 kg box of steel on a steel surface ($\mu_s = 0.74, \mu_k = 0.57$) with a horizontal force (F_{app}) that is slowly increased from 0 N to 10 N. If the box remains motionless at $F_{app} = 10N$, which statement accurately describes the relationship between the applied force and the static friction force (F_s)? (Assume g = 9.8 m/s^2).

A. F_s has remained constant at its maximum possible value, $F_{s,\max} = 14.5N$.

B. F_s is 0 N because the box has not moved, demonstrating no opposition to the applied force.

C. The static friction force F_s has varied from 0 N to 10 N, always remaining equal in magnitude to F_{app}.

D. The static friction force F_s has varied from 0 N to 14.5 N, which is why the box remained stationary.