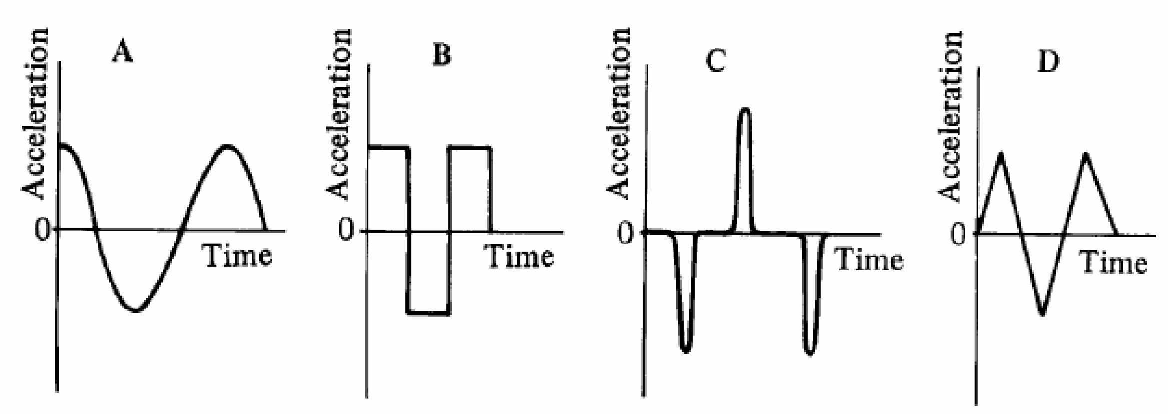
Multiple choice questions (Select one answer in each question.)

[1] An air-track vehicle moves freely to and fro along an air track, colliding elastically with the buffers at each end of the track. Which one of the graphs A, B, C or D best represents how the acceleration of the vehicle varies with time?

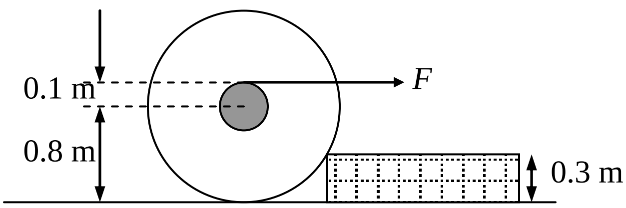


(a) A (b) B (c) C (d) D

[2] A car of mass m is slipping down a slope of inclination angle θ at a constant acceleration a. The static friction coefficient between the wheels and the slope is μ. What is the friction force between the wheels and the slope?

(a) $\mu mg\cos\theta$. (b) μmg. (c) $mg(\sin\theta - \mu)$. (d) $m(g - a)$.
(e) $mg\sin\theta - ma$.

[3] As shown, a wheel of weight W and radius 0.8 m is placed against a 0.3 m height rectangular block fixed on the ground. The wheel has an axle of radius 0.1 m. A force F is applied tangentially to the axle to lift the wheel. The minimum value of F is___.

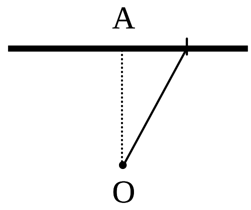


(a) $1.05W$ (b) $0.86W$ (c) $0.69W$ (d) $0.32W$
(e) $2.45W$

[4] Suppose the force by air to a plane is always perpendicular to its wings' surfaces. The plane is moving in a circle of radius R at speed v. The inclination angle θ of the wings should satisfy ________.

(a) $\sin\theta = \dfrac{v^2}{Rg}$ (b) $\cos\theta = \dfrac{v^2}{Rg}$ (c) $\tan\theta = \dfrac{v^2}{Rg}$
(d) $\tan\theta = \dfrac{Rg}{v^2}$ (e) $\theta = \dfrac{Rg}{v^2}$

[5] As shown in the figure, a smooth rod is mounted horizontally on a tabletop. A 10-kg collar, which is able to slide on the rod without friction, is fastened to a spring whose other end is fixed at point-O. The nearest point of the rod to point-O is point-A, and the distance is 20 cm. The spring has a natural length of 10 cm and of negligible mass, and a spring constant of 500 N/m. The collar is released at 15 cm from point-A. Find its speed when reaching point-A.



(a) 0.59 m/s (b) 0.791 m/s (c) 1.04 m/s (d) 0.88 m/s
(e) 1.24 m/s

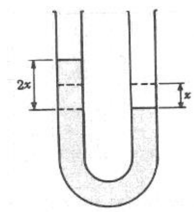
[6] Two weights, both of mass *m*, are joined by a weightless spring of natural length *l* and force constant *k*. They are placed on a smooth surface and at rest. One weight is suddenly given an impulse and acquires an initial velocity *v* towards the other weight. What is the speed of the center of mass of the weights-spring system?

(a) $0.5v$. (b) $0.5v - \sqrt{kl^2/2m}$. (c) $\sqrt{kl^2/2m} - 0.5v$.
(d) v. (e) $0.5v - \sqrt{kl^2/m}$.

[7] Following the above MC. What is the minimum distance between the two weights?

(a) $l - \dfrac{v}{2}\sqrt{\dfrac{m}{k}}$. (b) $l - v\sqrt{\dfrac{m}{2k}}$. (c) $l - v\sqrt{\dfrac{m}{k}}$. (d) $v\sqrt{\dfrac{m}{k}}$.
(e) $\dfrac{v}{2}\sqrt{\dfrac{m}{k}}$.

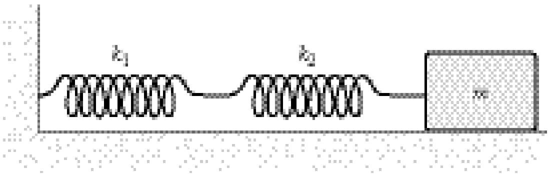
[8] 9 kg of mercury is poured into a glass U-tube with inner diameter of 1.2 cm. The mercury can flow without friction within the tube. Find the oscillation period.



(a) 1.2 s (b) 3.4 s (c) 5.6 s s
(e) 8.9 s

[9] The mass in the figure below slides on a frictionless surface. When the mass is pulled out, spring 1 is stretched a distance x_1 from its equilibrium position and spring 2 is

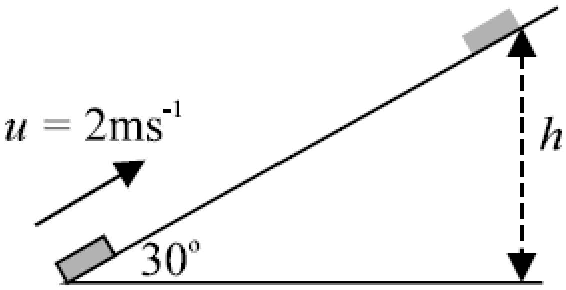
stretched a distance x_2. The spring constants are k_1 and k_2 respectively. Find the force pulling back on the mass.



(a) $-k_2x_1$. (b) $-k_2x_2$. (c) $-(k_1x_1+k_2x_2)$

(d) $-\dfrac{k_1+k_2}{2}(x_1+x_2)$ (e) $-\dfrac{k_1k_2}{k_1+k_2}(x_1+x_2)$.

[10] A small block of mass 1 kg is projected upwards along an inclined plane with an initial speed of u = 2 m s^{-1}. The angle of inclination of the inclined plane to the horizontal is 30°; the maximum static friction and dynamic friction between the small block and the inclined plane take the same value and equals to 6 N. Which of the following statements is/are correct?



(1) The maximum height that the small block can reach is h = 0.09 m.
(2) The small block will be momentarily at rest at the highest point and then moves down with a uniform acceleration.
(3) The total mechanical energy of the small block will be lost against friction.

A. (1) only
B. (1) and (2) only
C. (1) and (3) only
D. (1), (2) and (3)