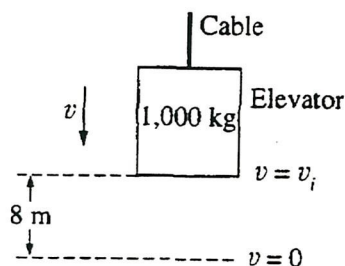


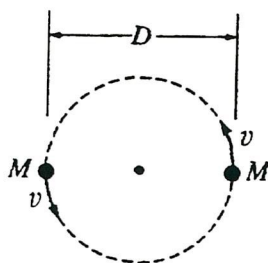
18. A frictionless pendulum of length 3 m swings with an amplitude of 10° . At its maximum displacement, the potential energy of the pendulum is 10 J. What is the kinetic energy of the pendulum when its potential energy is 5 J?

- (A) 3.3 J
 (B) 5 J
 (C) 6.7 J
 (D) 10 J
 (E) 15 J



19. A descending elevator of mass 1,000 kg is uniformly decelerated to rest over a distance of 8 m by a cable in which the tension is 11,000 N. The speed v_i of the elevator at the beginning of the 8 m descent is most nearly

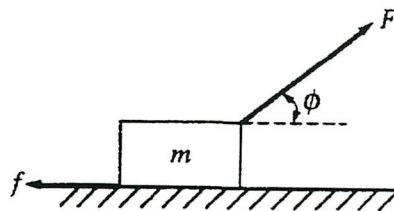
- (A) 4 m/s
 (B) 10 m/s
 (C) 13 m/s
 (D) 16 m/s
 (E) 21 m/s



20. Two identical stars, a fixed distance D apart, revolve in a circle about their mutual center of mass, as shown above. Each star has mass M and speed v . G is the universal gravitational constant. Which of the following is a correct relationship among these quantities?

- (A) $v^2 = GM/D$
 (B) $v^2 = GM/2D$
 (C) $v^2 = GM/D^2$
 (D) $v^2 = MGD$
 (E) $v^2 = 2GM^2/D$

Questions 21-22



A block of mass m is accelerated across a rough surface by a force of magnitude F that is exerted at an angle ϕ with the horizontal, as shown above. The frictional force on the block exerted by the surface has magnitude f .

21. What is the acceleration of the block?

- (A) $\frac{F}{m}$
 (B) $\frac{F \cos \phi}{m}$
 (C) $\frac{F - f}{m}$
 (D) $\frac{F \cos \phi - f}{m}$
 (E) $\frac{F \sin \phi - mg}{m}$

22. What is the coefficient of friction between the block and the surface?

- (A) $\frac{f}{mg}$
 (B) $\frac{mg}{f}$
 (C) $\frac{mg - F \cos \phi}{f}$
 (D) $\frac{f}{mg - F \cos \phi}$
 (E) $\frac{f}{mg - F \sin \phi}$