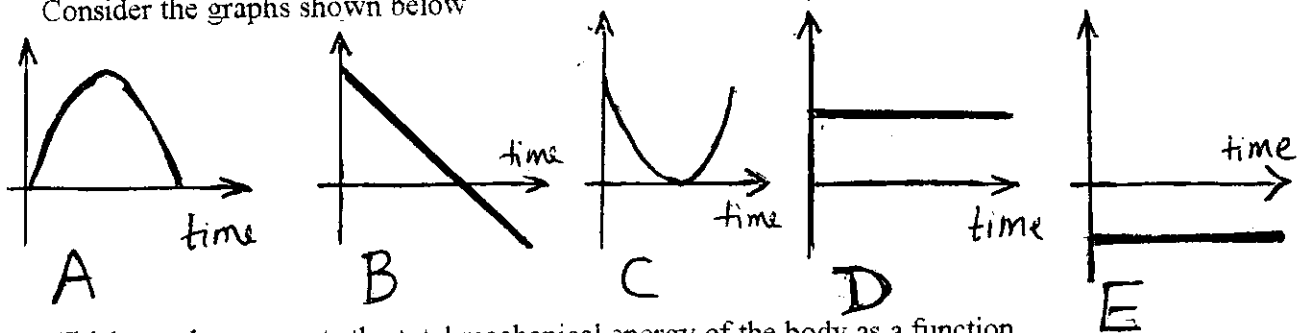


Multiple Choice Questions

- 2 (1) When the velocity of a body is doubled:  
 (a) Its acceleration is doubled  
 (b) Its kinetic energy is doubled  
 (c) Its total energy remains the same  
 (d) Its momentum is doubled
- 2 (2) A ball of momentum  $P$  in the  $x$ -direction strikes a wall and bounces off. The magnitude of the change of momentum is:  
 (a) zero      (b)  $P/2$       (c)  $2P$       (d)  $\sqrt{2} P$
- 2 (3) The moment of inertia of a body is independent of  
 (a) its mass  
 (b) its size  
 (c) its angular velocity  
 (d) location of the axis of rotation
- 3 (4) Two balls are thrown vertically upward, one with initial velocity twice that of the other. The ball with the greater velocity will reach the height:  
 (a) 2 times that of the other  
 (b)  $\frac{1}{2}$  times that of the other  
 (c) 4 times that of the other  
 (d) 8 times that of the other

- 6 (5) A body is projected vertically upward. Air friction is neglected. Consider the graphs shown below



- 3 (a) Which graph represents the total mechanical energy of the body as a function of time (circle one answer)

A

B

C

**D**

- 3 (b) The graph that best displays the momentum of the body

A

**B**

C

D

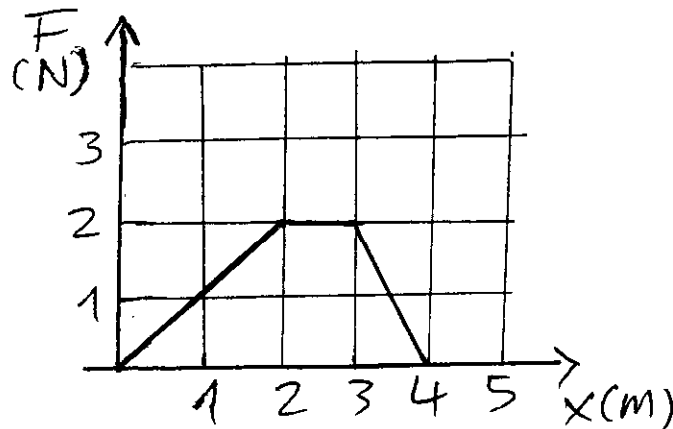
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10

1. A particle of mass  $m = 0.5 \text{ kg}$  is initially at rest. A variable force acts on the particle over a distance of  $4.0 \text{ m}$  as shown in the figure.

5 (a) What is the work done by this force over that distance?

5 (b) What is the speed of the particle At  $x = 3.0 \text{ m}$ ?



10

2. A lead ball is dropped into a lake from a diving board  $10 \text{ m}$  above the level of the water. The ball reaches the water with a certain velocity and sinks to the bottom of the lake with constant velocity. The time needed for the ball to reach the bottom from the initial height is  $5 \text{ seconds}$ .

5 (a) How much time took the ball to reach the water?

5 (b) How deep is the lake?

10

3. A pilot wishes to fly in the west direction. A wind is blowing at  $50 \text{ km/h}$  toward south. If the speed of the plane in calm air is  $193 \text{ km/h}$ :

5 (a) In what direction should the pilot fly in order the plane fly west?

5 (b) What is the speed of the plane relative to the ground?

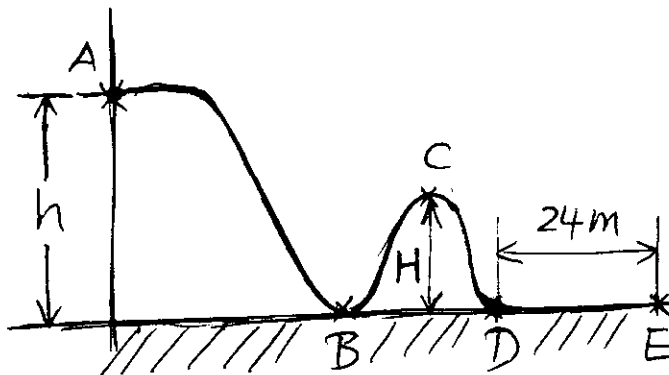
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4. A roller coaster car starts from rest at position A which is  $30 \text{ m}$  above ground level (see figure on the right)

5 (a) What is the velocity of the car at position B.

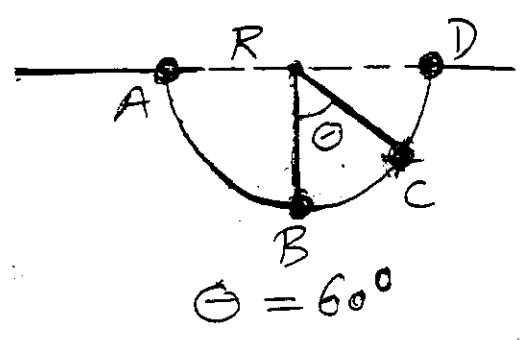
5 (b) What is the height  $H$  at point C if the speed at this point is  $20 \text{ m/s}$ .

5 (c) At position D, the car's breaks are applied, such that the car stops at position E covering  $24 \text{ m}$  between D and E. What is the coefficient of friction between the car and the surface along this track?



45

10 5. A particle of mass  $M$  is initially at position A in the figure and starts sliding from rest on a frictionless circular track ABCD whose radius is  $R$ . When the ball is at position C, the angle to the vertical is  $\theta = 60^\circ$ .



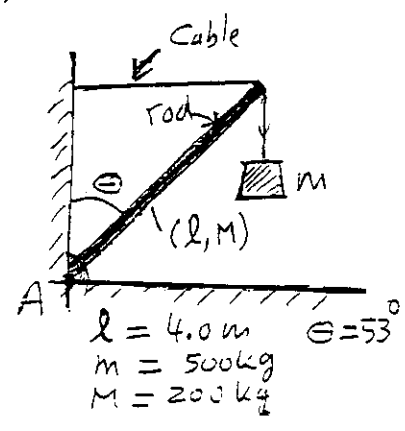
5 (a) The angular velocity  $\omega$  in (rad/s) of the ball is (crossing only does not count, you have to show your work):

- (a)  $\frac{g}{R}$       (b)  $\frac{2g}{R}$       (c)  $\sqrt{\frac{g}{R}}$       (d)  $\sqrt{\frac{g}{2R}}$       (e) none of the above

5 (b) The reaction force  $N$  exerted by the track on the ball at position C is (show your work otherwise no grade).

- (a)  $Mg$       (b)  $4Mg$       (c)  $\frac{Mg}{2}$       (d)  $\frac{3}{2}Mg$       (e) none of the above

10 6. A rod of mass  $M = 200$  kg and length  $\ell = 4.0$  m makes an angle  $\theta = 53^\circ$  with the vertical (see figure). Its upper end is fastened by a horizontal cable. A mass  $m = 500$  kg is supported by a string hanging from the end of the rod. The rod can pivot about point A.



5 (a) What is the tension  $T$  in the cable?  
 5 (b) What is the force  $R$  exerted by the vertical supporting wall on the rod.

10 7. A 2.0 kg particle moving along the positive x-direction with a speed of 6.0 m/s makes an elastic head-on collision with another particle of mass  $M$ . After collision the 2.0-kg particle is observed to be at rest, and  $M$  is moving with a speed of 12.0 m/s.

5 (a) What is the mass  $M$ ?  
 5 (b) What is the velocity of  $M$  prior to collision?

10 8. A girl mass  $m = 40$  kg stands at the edge of a Merry-Go-Round (MGR) of mass  $M = 100$  kg and radius  $R = 2.0$  m, rotating with 1.0 rad/s. The girl jumps from the MGR to the ground. After that, the MGR rotates with 1.40 rad/s.

5 (a) What is the moment of inertia of the MGR  
 5 (b) Calculate the ratio of the final to the initial kinetic energy of the system.

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