بسم الله الرحمن الرحيم

KING SAUD UNIVERSITY
PHYSICS & ASTRONOMY DEPARTMENT
103-Phys (Dr. ABDALLAH M. AZZEER)

PROBLEM SET # 4

MULTIPLE CHOICE

CIRCLE THE RIGHT ANSWER ONLY

1. A race car travels 40 m/s around a banked (45° with the horizontal) circular (radius = 200 m) track. What is the magnitude of the resultant force on the 80-kg driver of this car?

(a) 0.68 kN (b) 0.64 kN (c) 0.72 kN (d) 0.76 kN (e) 0.52 kN

2. A highway curve has a radius of 0.14 km and is unbanked. A car weighing 12 kN goes around the curve at a speed of 24 m/s without slipping. What is the magnitude of the horizontal force of the road on the car?

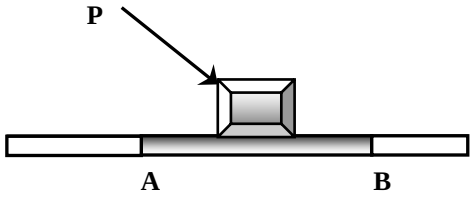
(a) 12 kN (b) 17 kN (c) 13 kN (d) 5.0 kN (e) 49 kN

3. During the time a 2.0 kg projectile moves from its initial position to a point that is displaced 20 m horizontally and 15 m above its initial position, how much work is done by the gravitational force on the projectile?

(a) +0.29 kJ (b) -0.29 kJ (c) +30 J (d) -30 J (e) -50 J

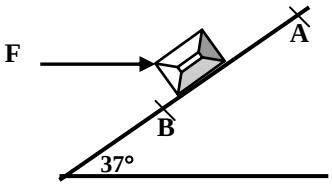
4. A block is pushed across a rough horizontal surface from point A to point B by a force (magnitude P = 5.4 N) as shown in the figure. The magnitude of the force of friction acting on the block between A and B is 1.2 N and points A and B are 0.5 m apart. If the kinetic energies of the block at A and B are 4.0 J and 5.6 J, respectively, how much work is done on the block by the force P between A and B?

(a) 2.7 J
(b) 1.0 J
(c) 2.2 J
(d) 1.6 J
(e) 3.2 J



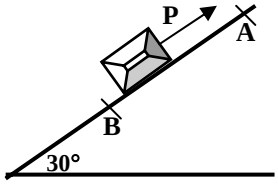
5. A 4.0 kg block is lowered down a 37° incline a distance of 5.0 m from point A to point B. A horizontal force (F = 10 N) is applied to the block between A and B as shown in the figure. The kinetic energy of the block A is 10 J and at B it is 20 J. How much work is done on the block by the force of friction between A and B?

(a) -58 J
(b) -53 J
(c) -68 J
(d) -63 J
(e) -47 J



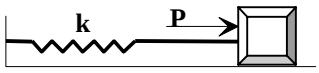
6. A 2.0-kg block slides down a frictionless incline from point A to point B. A force (magnitude P = 3.0 N) acts on the block between A and B, as shown. Points A and B are 2.0 m apart. If the kinetic energy of the block at A is 10 J, what is the kinetic energy of the block at B?

(a) 27 J
(b) 20 J
(c) 24 J
(d) 17 J
(e) 37 J



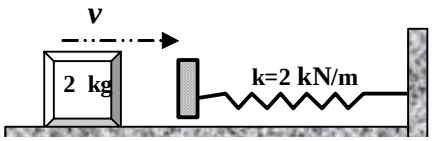
7. A 10-kg block on a horizontal frictionless surface is attached to a light spring (force constant = 1.2 kN/m). The block is initially at rest at its equilibrium position when force (magnitude P) acting parallel to the surface is applied to the block, as shown. When the block is 8.0 cm from the equilibrium position, it has a speed of 0.80 m/s. How much work is done on the block by the force P as the block moves the 8.0 cm?

(a) 8.3 J
(b) 6.4 J
(c) 7.0 J
(d) 7.7 J
(e) 3.8 J



8. The horizontal surface on which the block slides is frictionless. The speed of the block before it touches the spring is 6.0 m/s. How fast is the block moving at the instant the spring has been compressed 15 cm?

(a) 3.7 m/s
(b) 4.4 m/s
(c) 4.9 m/s
(d) 5.4 m/s
(e) 14 m/s



9. A 2.0-kg block situated on a frictionless incline is connected to a light spring (k = 100 N/m), as shown. The block is released from rest when the spring is unstretched. The pulley is frictionless and has negligible mass. What is the speed of the block when it has moved 0.20 m down the plane?

(a) 76 cm/s
(b) 68 cm/s
(c) 60 cm/s
(d) 82 cm/s
(e) 57 cm/s

10. A pendulum is made by letting a 2.0-kg object swing at the end of a string that has a length of 1.5 m. The maximum angle the string makes with the vertical as the pendulum swings is 30° . What is the speed of the object as it goes through the lowest point in its trajectory?

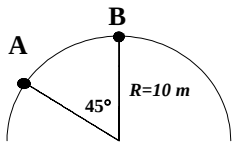
(a) 2.0 m/s (b) 2.2 m/s (c) 2.5 m/s (d) 2.7 m/s (e) 3.1 m/s

11. A 2.0-kg mass swings at the end of a light string (length = 3.0 m). Its speed at the lowest point on its circular path is 6.0 m/s. What is its kinetic energy at an instant when the string makes an angle of 50° with the vertical?

(a) 21 J (b) 15 J (c) 28 J (d) 36 J (e) 23 J

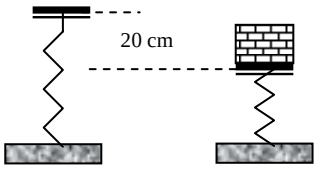
12. A skier weighing 0.70 kN goes over a frictionless circular hill as shown. If the skier's speed at point A is 9.2 m/s, what is his speed at the top of the hill (point B)?

(a) 3.1 m/s
(b) 6.2 m/s
(c) 5.2 m/s
(d) 4.1 m/s
(e) 6.5 m/s



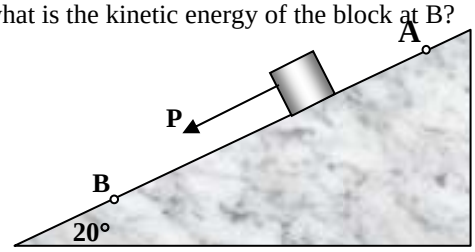
13. A spring (k = 600 N/m) is placed in a vertical position with its lower end supported by a horizontal surface. The upper end is depressed 20 cm, and a 4.0-kg block is placed on the depressed spring. The system is then released from rest. How far above the point of release will the block rise?

(a) 46 cm
(b) 36 cm
(c) 41 cm
(d) 31 cm
(e) 20 cm



14. A 2.0-kg block slides down a frictionless incline from point A to point B. A force (magnitude P = 3.0 N) acts on the block between A and B, as shown. Points A and B are 2.0 m apart. If the kinetic energy of the block at A is 10 J, what is the kinetic energy of the block at B?

(a) 32 J
(b) 27 J
(c) 35 J
(d) 29 J
(e) 17 J



15. A 2.5-kg object suspended from the ceiling by a string that has a length of 2.5 m is released from rest with the string 40° below the horizontal position. What is the tension in the string at the instant the object passes through its lowest position?

(a) 11 N (b) 25 N (c) 42 N (d) 18 N (e) 32 N

16. A 2.0-kg block slides down a plane (inclined at 40° with the horizontal) at a constant speed of 5.0 m/s. At what rate is the gravitational force on the block doing work?

(a) +98 W (b) +63 W (c) Zero (d) +75 W (e) -75 W

17. A 3.0-kg ball with an initial velocity of $(4\hat{i} + 3\hat{j})$ m/s collides with a wall and rebounds with a velocity of $(-4\hat{i} + 3\hat{j})$ m/s. What is the impulse exerted on the ball by the wall?

(a) $+24\,\hat{i}$ N s
(b) $-24\,\hat{i}$ N s
(c) $+18\,\hat{j}$ N s
(d) $-18\,\hat{j}$ N s
(e) $+8\,\hat{i}$ N s

18. A 2.4-kg ball falling vertically hits the floor with a speed of 2.5 m/s and rebounds with a speed of 1.5 m/s. What is the magnitude of the impulse exerted on the ball by the floor?

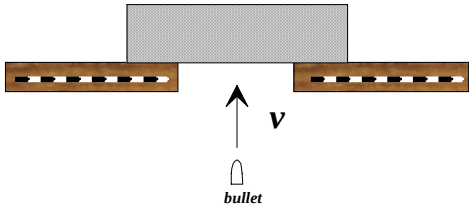
(a) 9.6 N s (b) 2.4 N s (c) 6.4 N s (d) 1.6 N s (e) 1.0 N s

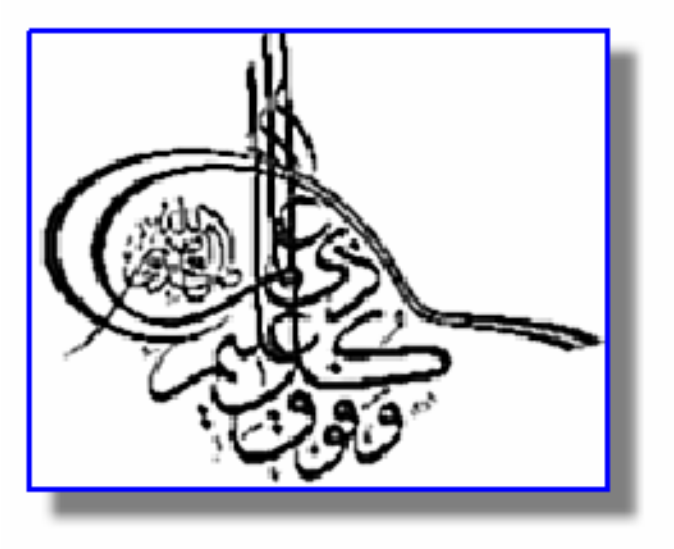
19. A 1.6-kg ball is attached to the end of a 0.40-m string to form a pendulum. This pendulum is released from rest with the string horizontal. At the lowest point of its swing, when it is moving horizontally, the ball collides with a 0.80-kg block initially at rest on a horizontal frictionless surface. The speed of the block just after the collision is 3.0 m/s. What is the speed of the ball just after the collision?

(a) 1.7 m/s (b) 1.1 m/s (c) 1.5 m/s (d) 1.3 m/s (e) 2.1 m/s

20. A 10-g bullet moving 1000 m/s strikes and passes through a 2.0-kg block initially at rest, as shown. The bullet emerges from the block with a speed of 400 m/s. To what maximum height will the block rise above its initial position?

(a) 78 cm
(b) 66 cm
(c) 56 cm
(d) 46 cm
(e) 37 cm

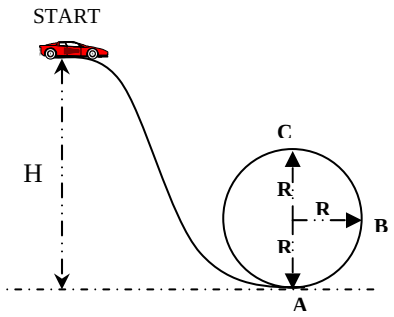




Additional Problems

P (1): *(a) From what height above the bottom of the loop must the car in the figure start in order to just make it round the loop.*

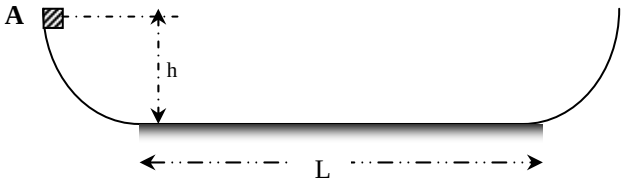
*(b) What is the velocity of the car at point **A** and at point **B**?*



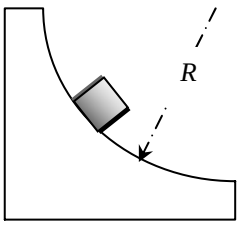
Ans: **(a) H=2.5 R**

(b) $V_A=\sqrt{5Rg}$, $V_B=\sqrt{3Rg}$

P(2): *A small particle slides along a tack with elevated ends and flat central part, as shown in the figure. The flat part has a length L = 2 m. The curved portions of the track are frictionless. For the flat part, the coefficient of kinetic friction is μ_k =0.2 . The particle is released at point A which is at height h = 1 m above the flat part of the track. Where does the particle finally come to rest?*



P(3): *Suppose a body of mass 0.5 kg slides down a track of radius R = 1 m, like that shown in the figure, but its speed at the bottom is only 3 m/s. What was the work of the frictional force acting on the body?*



***Ans*: -2.65 J**

P(4): *A block of mass M moving with a speed v_0 on a frictionless horizontal surface collides with a spring attached to a block of mass 2M initially at rest as shown in the figure . Find the maximum distance the spring will be compressed?*

Ans: $x=\sqrt{\dfrac{2Mv_0^2}{3k}}$

P(5): *The distance between the sun and the earth is 1.5×10^{11} m and the earth's orbital speed is 3×10^4 m/s. Use this information to calculate the mass of the sun. (Assume the earth's orbit around the sun is circular and $G=6.67\times10^{-11}$ Nm^2/kg^2).*

Ans: 2.02×10^{30} kg

P(6): *A waterfall is 30 m high and 10 kg of water flows over it per second. How much power does the flow represent. If all this power could be converted to electricity, how many 100-watt bulbs could be supplied?*

Ans: 2.94×10^5 W; 2940 bulb

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WRITE YOUR ANSWER ON THE ATTACHED SHEET

الاسـ ـم: . . . . . الرقم الجامعي: . . . . . .

ANSWER SHEET

1.	13.
2.	14.
3.	15.
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8.	20.
9.	*The more problems you do, the more chance to get* A^+
10.	*The more problems you do, the more chance to get* A^+
11.	*The more problems you do, the more chance to get* A^+
12.	*The more problems you do, the more chance to get* A^+