103 學年第一學期 普通物理 B 第一次段考試題

[Wolfson Ch. 5-9] 2014/10/28, ***8:20AM – 09:50AM***

B

(i)答案卷第一張正面為封面。第一張正、反兩面<u>不要寫任何答案</u>。

(ii)依空格號碼順序在第二張<u>正面</u>寫下所有填充題答案，不要寫計算過程。

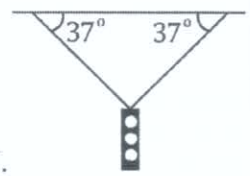
(iii)依計算題之題號順序在第二張<u>反面</u>以後寫下演算過程與答案，<u>每題從新的一頁寫起</u>。

Note: $M_{earth} = 5.97\times10^{24}$ kg, $M_{moon} = 7.35\times10^{22}$ kg, $G = 6.67\times10^{-11}$ N·m^2/kg^2, $R_{earth} = 6378$ km, $R_{moon} = 1737$ km, $g = 9.8$ m/s^2.

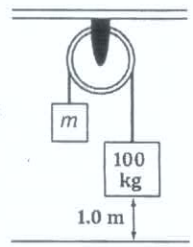
$1\times2\times\frac{1}{2}=1$ God like

Part I. Filling the blank (5 points per blank)

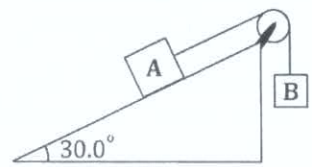
•A traffic light weighing 100 N is supported by two ropes as shown in the figure. The tensions in the ropes are 【1】 N.



•The right figure shows a 100-kg block being released from rest at a height of 1.0 m. It then takes it 0.90 s to reach the floor. The mass m of the other block is 【2】 kg. The pulley has no appreciable mass or friction.



• Block A has a mass of 3.00 kg and can slide over a rough plane inclined 30.0° to the horizontal. It is connected with block B of mass 2.77 kg by means of a string that goes over an ideal pulley as shown in the figure. The coefficient of kinetic friction between block A and the plane is 0.400. The acceleration of the blocks is 【3】 m/s^2.



•An object attached to an ideal massless spring is pulled across a frictionless surface. If the spring constant is 45 N/m and the spring is stretched by 0.88 m when the object is accelerating at 2.0 m/s^2, the mass of the object is 【4】 kg.

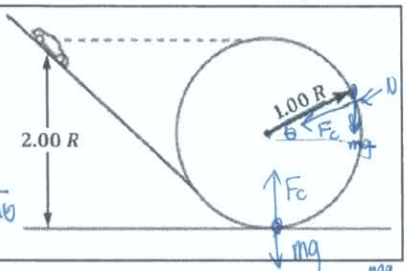
$h=\frac{1}{2}$ $N=\frac{2h}{R}(mg)-mg=0$

•A 1000.0 kg car is moving at 15 km/h. If a 2000.0 kg truck has 18 times the kinetic energy of the car, how fast is the truck moving? 【5】 km/h.

$N-mg \Rightarrow F_c=\frac{mv^2}{R}$ $N-mg=\frac{m(2gh)}{R}=0$

•In the figure, a very small toy race car of mass m is released from rest on the loop-the-loop track. If it is released at a height 2.00 R above the floor, how high is it above the floor when it leaves the track? 【6】 R. Neglect friction.

$N+\frac{mg}{\sin\theta}=F_c=\frac{2mgh}{R}$

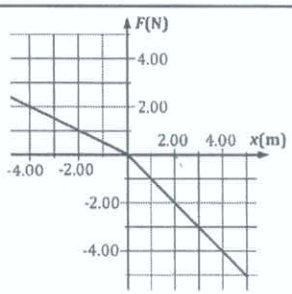


$\frac{2h}{R}=\frac{1}{\sin\theta}$ $\frac{mg}{\sin\theta}$

•A rough plane is inclined 30° to the horizontal. An object of mass 4.0 kg starts to move at rest from the top of the plane at a height of 10 m. If the speed of the object at the bottom of the inclined plane is 10 m/s, the work done by friction on this object as it slides down the incline is 【7】 J.

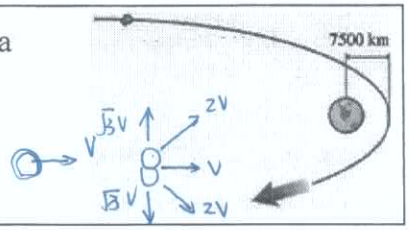
$\sin\theta=\frac{R}{2h}$

•A graph of the force F on an object as a function of its position x is shown in the figure. The work done by this force on the object during a displacement from $x = -2.00$ m to $x = 2.00$ m is 【8】 J.



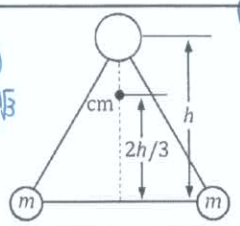
•Space explorers land on a planet that has the same mass as Moon, but find they weigh as much as they would on Earth. The planet's radius is 【9】 km.

•A meteoroid is 300,000 km from Earth's center and moving at 3.5 km/s on a path that will come within 7,500 km of Earth's center. The speed of the meteoroid at its closest approach is 【10】 km/s. Will the meteoroid ever return to Earth's vicinity? 【11】.



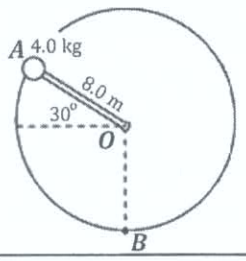
•An object with kinetic energy K explodes into two pieces, each of which moves with twice the speed of the original object. The ratio of internal energy to center-of-mass energy after the explosion is 【12】.

•Two particles of equal mass m are at the vertices of the base of an equilateral triangle. The triangle's center of mass (cm) is above 2/3 h of the base as shown in right figure. The mass at the third vertex is 【13】 m.



•A 75-kg skater, at rest on frictionless ice, tosses a 15-kg snowball with velocity $\vec{v} = 43\hat{\imath} + 17\hat{\jmath}$ m/s, where the x- and y- axes are in the horizontal plane. The skater's subsequent velocity is 【14】.

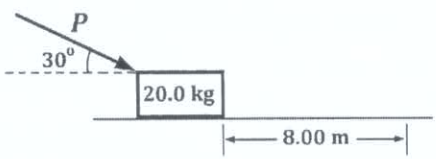
•An 8.0-m massless rod is loosely pinned to a frictionless pivot at O, as shown in the figure. A very small 4.0-kg ball is attached to the other end of the rod. The ball is held at A, where the rod makes a 30° angle above the horizontal, and is released. The tension in the rod when the ball passes through the lowest point at B is 【15】 N.



Part II Problems (10 points per problem)

1. A car moving at speed v undergoes a one-dimensional collision with an identical car initially at rest. The collision is neither elastic nor fully inelastic; 8/25 of the initial kinetic energy is lost. Find the velocities of the two cars after the collision.

2. In the figure, a constant external force P = 160 N is applied to a 20.0-kg box, which is on a rough horizontal surface. While the force pushes the box a distance of 8.00 m, the speed changes from 0.500 m/s to 2.60 m/s. What is the work done by friction during this process?



3. A 5.00-kg object moves clockwise around a 50.0 cm radius circular path. At one location, the speed of the object is 4.00 m/s. When the object next returns to this same location, the speed is 3.00 m/s.
(a) How much work was done by nonconservative forces as the object moved once around the circle?
(b) If the magnitude of the above nonconservative forces acting on the object is constant, what is the value of this magnitude?

4. A ball of mass 5.0 kg is suspended by two wires from a horizontal arm that is attached to a vertical shaft, as shown in the figure. The shaft is in uniform rotation about its axis. The rate of rotation is adjusted until the tensions in the two wires are EQUAL. At that speed, the radial acceleration of the ball is ?