Kuwait University Physics Department

Physics 101
Second Midterm Examination

July 24, 2004

Name: ..... Student No. .....

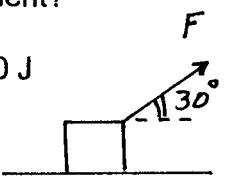
For use by Instructors only

Prob.	1	2	3	4	5	6	7	8	9	10	Total
Marks											

1. Answer all the questions.
2. The solution should be given explicitly for each problem.
3. No solution = no points.
4. Check the correct answer for each question.
5. Take $g = 10\ m/s^2$, $\cos 37 = 0.8$ $\sin 37 = 0.6$
6. Mobile phone and pagers are not allowed.

1. A force F = 100 N inclined by 30° with the horizontal pulls a 20 kg block moving in the x-direction on a rough surface with constant speed for a distance of 50 m. What is the work done by friction during this displacement?

a) 2500 J b) −4330 J c) −2980 J d) −5000 J e) −3000 J

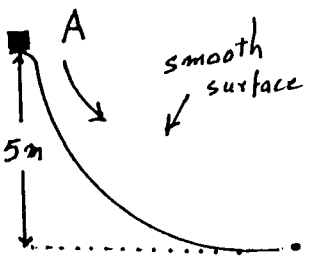


$W_F - W_f = 0$

$W_f = W_F = 100(50)\cos 30 = -4330\ \text{J}$

2. A roller coaster starts from rest at point A, 5 m from the ground level. What is its velocity at the bottom?

a) 5 m/s b) 10 m/s c) 15 m/s d) 20 m/s e) 25 m/s



$\frac{1}{2}mV^2 + 0 = mgh + 0$

$V = \sqrt{2gh} = \sqrt{2(10)5} = 10\ \text{m/s}$

3. A basket is mounted on the surface of a car going in a round circle of radius 30 m with constant speed. The coefficient of static friction (μ_s) between the basket and the surface is 0.48. What is the maximum speed of the car such that the basket does not move?

a) 8 m/s b) 25 m/s c) 17 m/s d) 12 m/s e) 6 m/s

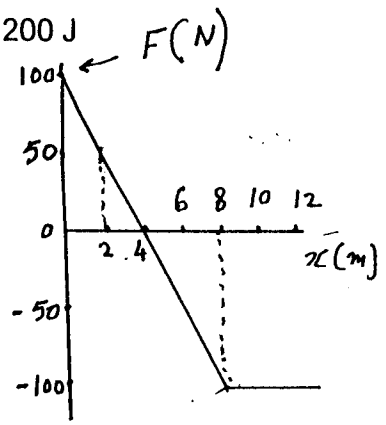
$f_s = m\frac{V^2}{r}$

$\mu_s mg = m\frac{V^2}{r} \Rightarrow V = \sqrt{\mu_s r g} = \sqrt{0.48(30)(10)}$

$= 12\ \text{m/s}$

4. A force F acting on a 5 kg particle varies with displacement according to the curve shown in the figure. If the velocity of the particle at x = 2 m is 12 m/s, what is its kinetic energy at x = 8 m?

a) 150 J b) 160 J c) 300 J d) 210 J e) 200 J



W = Area under the curve

$= \frac{1}{2}(2)(50) - \frac{1}{2}4(100) = -150\ \text{J}$

$-150 = K_f - \frac{1}{2}5(12)^2$

$K_f = 210\ \text{J}$

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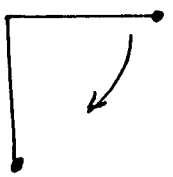
5. A 5 kg particle is attached to a cord of length 60 cm and the system is released from the horizontal position as shown. Find the tension in the cord when the particle is at its lowest position?

a) 50 N b) 100 N c) 150 N d) 200 N e) 250 N



$T = mg + m\frac{v^2}{R}$

$mg(R) = \frac{1}{2}mv^2$

$v^2 = 2Rg$

$= mg + \frac{m}{R}(2Rg)$

$= 3mg = 3(5)(10) = 150\ N$

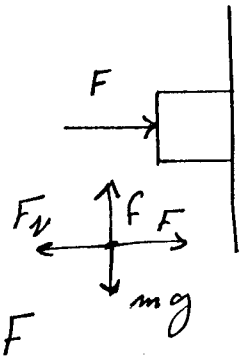
6. A horizontal force of 100 N pushes a 5-kg block against a vertical wall as shown in figure. What is the minimum value of the coefficient of static friction between the block and the wall in order to prevent the block from falling down?

a) 0.2 b) 0.3 c) 0.4 d) 0.5 e) 0.6

$f_s = mg \Rightarrow \mu_s F_N = mg$

$\mu_s F = mg$

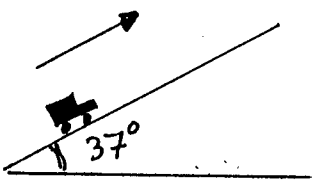
$\mu_s = \frac{mg}{F} = \frac{5(10)}{100} = 0.5$



$F_N = F$

7. A 3730 kg car moves with constant speed of 20 m/s along a 37° incline road. If the coefficient of friction between the car and the road is 0.5 what is the power of the car engine? (1 hp = 746 W)

a) 10^3 hp b) 10^4 hp c) 10^5 hp d) 10^6 hp e) 10^7 hp



$F_{up} = F_g + f$

$= mg\sin\theta + \mu_k mg\cos\theta$

$= (3730)(10)[0.6 + 0.5(0.8)]$

$= 37300$

$P = \frac{(37300)(20)}{746} = 1000\ hp$

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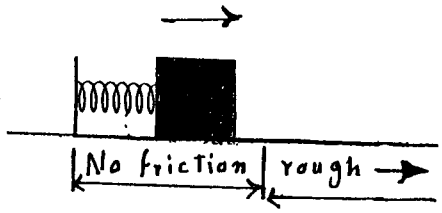
8. A 6 kg block is pushed against a horizontal spring (k=12000 N/m) compressing it by 8 cm? When the spring is released the block moves on a rough horizontal surface of coefficient of friction 0.64. How far will it stop from the release point of the spring?

(a) 1 m b) 10 m c) 10^2 m d) 10^3 m e) 10^4 m

$$\tfrac{1}{2}kx^2 - \mu_k mgd = 0$$

$$d = \frac{\frac{1}{2}kx^2}{\mu_k mg} = \frac{\frac{1}{2}(12000)(0.08)^2}{0.64(6)(10)}$$

$$= 1\ m$$



$$\Sigma W = \Delta K$$

9. A block of 5 kg falls from a height of 20 m on a spring of spring constant 3600 N/m. After the spring has been compressed it rebounces and pushes the mass sending it to a height of 15 m above the relaxed position of the spring. What is the work done by air resistance during the whole trip?

(a) −250 J b) −1000 J c) −750 J d) −500 J e) −1250 J

$$W_{air} = E_f - E_i$$

$$= mgh_f - mgh_i$$

$$= 5(10)[15-20] = -250\ J$$

10. Three masses $m_1 = 4$ g, $m_2 = 5$ g and $m_3 = 6$ g are arranged along the x-axis in such a way that their CM lies at the origin. If m_2 is removed the center of mass moves 2 cm toward the negative x-direction. What is the original position of m_2?

a) −2 cm b) − 4 cm c) 6 cm d) 2 cm (e) 4 cm

$$0 = m_1x_1 + m_2x_2 + m_3x_3 \quad \text{— (1}$$

$$-2 = \frac{m_1x_1 + m_3x_3}{m_1 + m_2} \quad \text{— (2}$$

$$m_1x_1 + m_3x_3 = (-2)(10)$$

$$= -20$$

$$\therefore\ 0 = m_2x_2 - 20$$

$$x_2 = \frac{20}{5} = 4\ cm$$

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