Kuwait University Physics Department

Physics 101
Second Midterm Examination

May 19, 2003

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

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For use by Instructors only

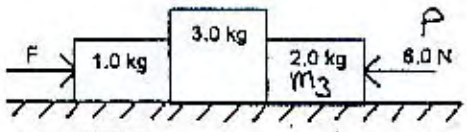
Prob.	1	2	3	4	5	6	7	8	9	10	11	12	Total
Marks													

1. Answer all the questions.
2. The solution should be given explicitly for each problem.
3. No solution = no grade.
4. Check the correct answer for each question.
5. Take g = 10 m/s^2.

NOTE: IT IS STRICTLY FORBIDDEN TO BRING ANY MOBILE COMMUNICATION DEVICES (MOBILE PHONES, PAGERS, ETC.), INTO THE EXAMINATION HALL.

1. In the figure below, the horizontal surface on which the objects slide is frictionless. If F = 18N, *what is the magnitude of the force exerted on the 2.0-kg block by the 3.0-kg block?*

(a) 10 N b) 12 N c) 14 N d) 16 N e) 18 N f) Other



$$a = \frac{\text{driving force}}{\text{moving mass}}$$

$$a = \frac{F - P}{m_1 + m_2 + m_3}$$

$$= \frac{18 - 6}{6} = 2\ m/s^2$$

$$F_{23} - P = m_3 a \Rightarrow F_{23} = 6 + 2(2) = 10\ N$$

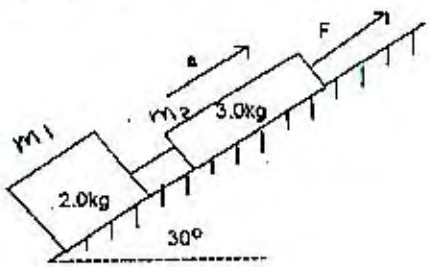
2. The surface of the inclined plane shown below is frictionless. If a = 1.25m/s^2, *what is F?*

(a) 31 N b) 37 N c) 35 N d) 33 N e) 39 N f) Other

$$a = \frac{F - (m_1 + m_2) g \sin\theta}{m_1 + m_2}$$

$$1.25 = \frac{F - (2+3)(10)(0.5)}{2+3}$$

$$F = 13.25 \simeq 31\ N$$



3. A 85-kg passenger is standing in an elevator that accelerates downwards at a rate of 4 m/s^2. *Find the apparent weight of the passenger.*

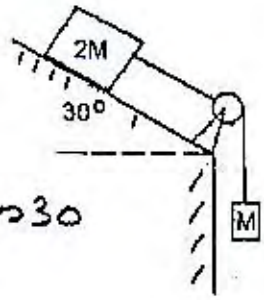
a) 850 N b)1190 N (c)510 N d)340 N e) 85 N f) Other

$$W' = m(g + a)$$

$$= 85(10 - 4) = 510\ N$$

4. In the figure shown below, the coefficient of kinetic friction between the block and the incline is 0.29. *What is the magnitude of the acceleration of the suspended block as it falls?* Disregard any pulley mass or friction in the pulley.

a) 5.4 m/s² b) 5.2 m/s² c) 4.9 m/s² d) 5.6 m/s² e) 7.9 m/s² f) Other



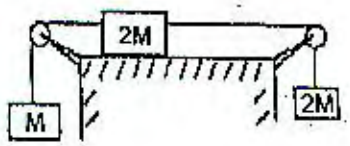
$$a = \frac{Mg + 2Mg\sin\theta - \mu_k(2M)g\cos\theta}{3M}$$

$$a = \frac{10 + 2(10)\sin 30 - 0.29(2)(10)\cos 30}{3}$$

$$= 4.9 \text{ m/s}^2$$

5. The three blocks shown below are released from rest and are observed to move with accelerations that have a magnitude of 1.5 m/s². *What is the magnitude of the friction force on the block that slides horizontally?* Disregard any pulley mass or friction in the pulley and let M = 2.0 kg.

a) 6.0 N b) 5.0 N c) 5.5 N d) 4.6 N e) 3.7 N f) Other

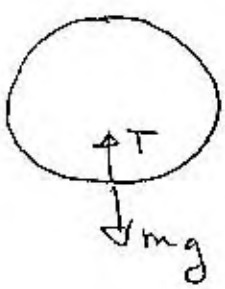


$$a = \frac{2Mg - f_R - Mg}{5M}$$

$$1.5 = \frac{2(20) - f_R - 20}{5(2)} \Rightarrow f_R = 5 \text{ N}$$

6. A 0.50-kg mass attached to the end of a string swings in a vertical circle (radius = 2.0 m). When the mass is at the lowest point on the circle, the speed of the mass is 12 m/s. *What is the magnitude of the force of the string on the mass at this position?*

a) 31 N b) 36 N c) 41 N d) 46 N e) 23 N f)Other



$r = 2$ m

$v = 12$ m/s

$$T - mg = \frac{mv^2}{r}$$

$$T = 0.5\left(10 + \frac{(12)^2}{2}\right)$$

$$T = 41 \text{ N}$$

7. 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?*

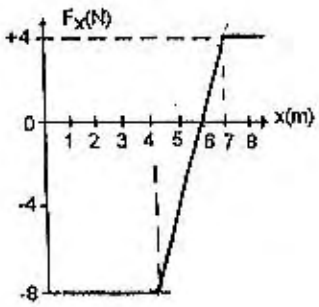
a) +0.30 kJ (b) –0.30 kJ c) +30 J d) -30 J e) –50 J f) Other

$W = -mgh = -2(10)(15) = -300\ J$

$W = -0.3\ kJ$

8. A body moving along the x-axis is acted upon by a force F_x that varies with x as shown below. *What work is done by the force as the object moves from x = 1 m to x = 8 m?*

a) –2 J b) –18 J c) –10 J (d) –26 J e) +18 J f) Other



W = area under the curve.

$W = -(8)(3) - \frac{1}{2}(8)(2) + \frac{1}{2}(1)(4) + (1)(4)$

$W = -26\ J$

9. A 65 kg hiker climbs to the top of a 3900 m high mountain. The climb is made in 5 hours starting at an elevation of 2200 m. *The average power output is:*

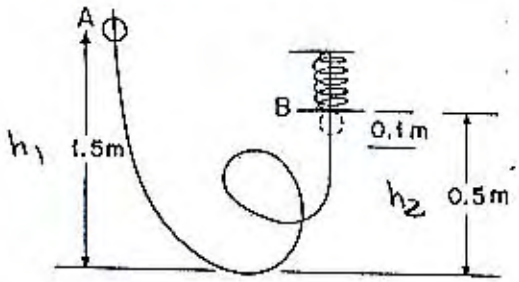
a) 80 W (b) 61 W c) 45 W d) 65 W e) 50 W f) Other

$P = \frac{W}{\Delta t} = \frac{mgh}{\Delta t}$

$P = \frac{65(10)(3900-2200)}{5(60)(60)} = 61\ W$

10. A 0.2 kg bead slides on a frictionless wire as shown in figure. The bead starts from rest at A and ends up at B after colliding with a light spring of force constant k. If the spring is compressed by the bead a distance of 0.1 m, *what is the force constant of the spring?*

a) 290 N/m b) 140 N/m c) 360 N/m
d) 400 N/m e) 600 N/m f) Other



$E_i = E_f$

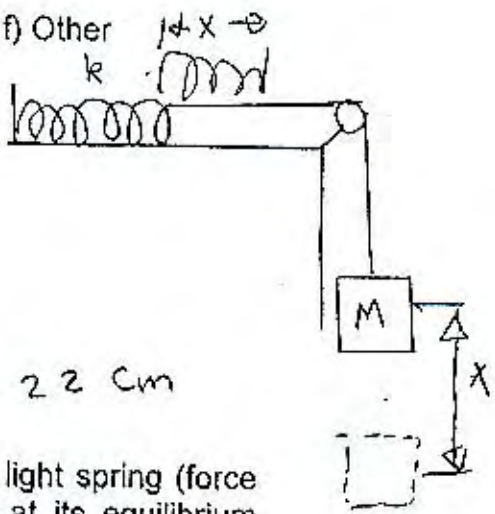
$mgh_1 = mgh_2 + \frac{1}{2}kx^2$

$0.2(10)(1.5) = 0.2(10)(0.5) + \frac{1}{2}k(0.1)^2$

$k = 400 \ N/m$

11. The block shown below is released from rest with the spring unstretched. The pulley and the horizontal surface are frictionless. If k=409 N/m and M = 4.5 kg, *what is the maximum extension of the spring?*

a) 11 cm b) 66 cm c) 22 cm d) 33 cm e) 55 cm f) Other



$E_i = E_f$

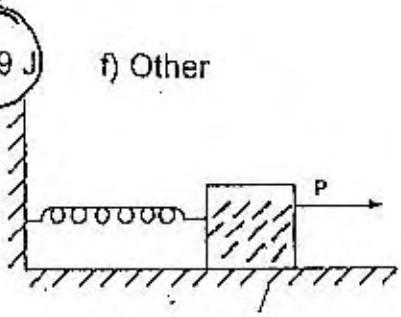
$Mgx = \frac{1}{2}kx^2$

$x\left(\frac{1}{2}kx - Mg\right) = 0$

$x = \frac{2Mg}{k} = \frac{2(4.5)(10)}{409} = 22 \ cm$

12. A 10-kg block on a horizontal surface is attached to a light spring (force constant = 0.80 kN/m). The block is initially at rest at its equilibrium position when a force (magnitude P = 80 N) acting parallel to the surface is applied to the block, as shown below. If the coefficient of kinetic friction between the block and the surface is μ_k= 0.25, *what is the kinetic energy of the block* when it is 13 cm from its equilibrium position?

a) 0.85 J b) 0.89 J c) 0.77 J d) 0.64 J e) 0.39 J f) Other



$m = 10 \ kg$, $k = 800 \ N/m$

$P = 80 \ N$, $\mu_k = 0.25$, $x = 0.13 \ m$

$W_f + W_p = \Delta E = U_f + K_f - 0$

$-\mu_k mgx + Pd = \frac{1}{2}kx^2 + K_f$

$K_f = -0.25(10)(10)(0.13) + 80(0.13) - \frac{1}{2}(800)(0.13)^2$

$K_f = 0.39 \ J$