Quiz # 3 Ch 7 Phys101-1, T113-v1

Student Name: **Student ID:** **Section #**

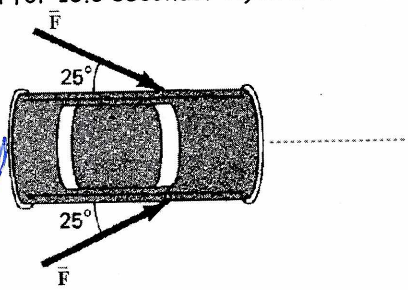
Q#1. A block of mass 1.6 kg, resting on a horizontal frictionless surface, is attached to a horizontal spring fixed at one end. The spring, having a spring constant of 1.0×10^3 N/m, is compressed to x = -2.0 cm (x = 0.0 is the equilibrium position) and the block is released from rest. The speed of the block as it passes through the position x = - 1.0 cm is: (A)0.43 m/s

$\Delta K = W_s = \frac{1}{2}k(x_i^2 - x_f^2) = \frac{1}{2}mv_f^2$

$v_f = \sqrt{\frac{2}{m} \times \frac{k}{2}(x_i^2 - x_f^2)} = \sqrt{\frac{1000}{1.6}\left((0.02)^2 - (0.01)^2\right)}$

$= \sqrt{0.1875} = 0.43$ m/s

Q#3 Two persons pushed a car initially at rest at its front doors, each applying a force with magnitude F = 300 N at 25.0° to the forward direction, as shown in **Figure 1**. How much average power does **each person** requires in pushing the car 10.0 m for 10.0 seconds? A) 272 W



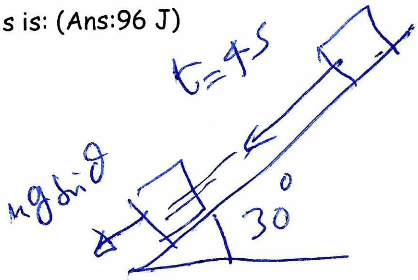
$P_{avg} = \frac{W}{t} = \frac{F \cdot d}{t} = \frac{Fd\cos\theta}{t}$

$P_{av} = \frac{2 \times 300 \times 10 \times \cos 25}{10} = 543.8$ W

Power required by one person $= \frac{P_{avg}}{2}$

$= \frac{543.8}{2} = 271.95$ W

Q#3. A 0.50 kg block slides down a frictionless 30° incline, starting from rest. The work done by the net force on this block after sliding for 4.0 s is: (Ans:96 J)



$\Delta K = W_g$, $t = 4$ s

$W_g = \Delta K = K_f - K_i$

$= \frac{1}{2}mv_f^2$

$a = g\sin\theta$

$v_f = v_i + at = g\sin\theta\, t$

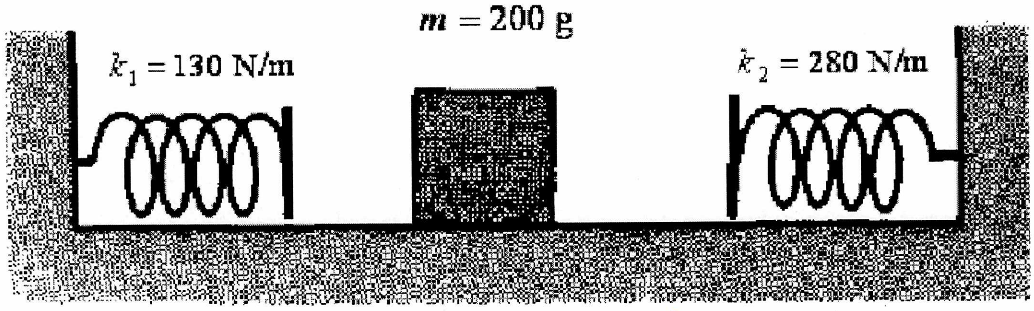
$v_f = 9.8 \times \sin 30 \times 4 = 19.6$ m/s

$W_g = \frac{1}{2}mv_f^2 = \frac{1}{2} \times 0.5 \times (19.6)^2 = 96.04$ J

Quiz # 3 Ch 7 Phys101-1, T113-v2

Student Name: **Student ID:** **Section #**

Q#1.: Q4. A block, of mass m =200 *gm*, slides back and forth on a **frictionless surface** between two springs, as shown in **Figure 3**. The left-hand side spring has k_1=130 N/m and its maximum compression is 16 cm. The right-hand side spring has k_2=280 N/m. Find the maximum compression of the right-hand side spring. A) 11 cm.



$\Delta K = W_s \Rightarrow \Delta K = W_{SR} = W_{SL}$

$W_{SR} = \frac{1}{2} k_R x_R^2 \; ; \; W_{SL} = \frac{1}{2} k_L x_L^2$

$\frac{1}{2} k_R x_R^2 = \frac{1}{2} k_L x_L^2 \Rightarrow x_R = \sqrt{\frac{k_L}{k_R} \times x_L^2} = \sqrt{\frac{130}{280} \times (0.16)^2}$

$= 0.109 \text{ m}$

Q#2. A 0.50 kg object, moving along the *x*-axis, experiences the force shown in **Figure 1**. The object's velocity at *x* = 0.0 m is *v* = 2.0 m/s, and at *x* = 4.0 m is *v* = 8.0 m/s. What is F_{max}? A) 5.0 N

$\Delta K = W = \text{Area} \; ; \; \Delta K = \frac{1}{2} m (v_f^2 - v_i^2)$

$\Delta K = \frac{1}{2} \times 0.5 \times (8^2 - 2^2)$

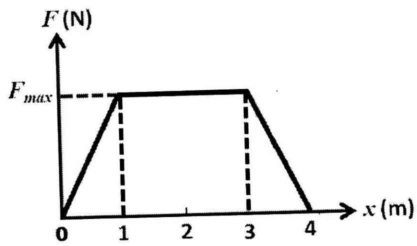
$\Delta K = 15 \text{ J}$

$\text{Area} = \frac{F_{max} \times 1}{2} + 2 \times F_{max} + \frac{F_{max} \times 1}{2}$

$\text{Area} = 3 F_{max}$

$\Delta K = W = \text{Area} \Rightarrow \text{Area} = 3 F_{max} = 15$

$F_{max} = \frac{15}{3} = 5 \text{ N}$



Q#2. A 2000 kg elevator moves 20 m upward in 4.9 sec at a constant speed. At what average rate does the force from the cable do the work on the elevator? (Ans: 80000 W)

$F_g = 2000 \times 9.8 = 19{,}600 \text{ N}$

Force from the Cable $T = F_g$

Rate of doing work $= \frac{W}{t} = \frac{F \cdot d}{t} = \frac{T \cdot d}{t} = \frac{19{,}600 \times 20}{4.9}$

$= 80{,}000 \text{ W}$

Quiz # 3 Ch 7 Phys101-1, T113-v3

Student Name: **Student ID:** **Section #**

Q#1): A single force acts on a 5.0 kg object. The position of the object as a function of time is given by $x = 10\,t - 5.0\,t2$, where x is in meters and t is in seconds. Find the work done by this force on the object in the interval from $t = 0$ s to $t = 5.0$ s.
A) 3.8 ×103 J

$$x = 10t - 5t^2 \Rightarrow v = 10 - 10t \Rightarrow a = -10\ m/s^2 \Rightarrow F = ma = 5\times(-10) = -50N$$

$$W = \vec{F}\cdot\vec{d}\ ;\ d = x_f - x_i \Rightarrow x_i(t=0) = 0\ ;\ x_f(t=5) = 10\times5 - 5\times(5)^2 = -75m$$

$$d = x_f - x_i = -75 - 0 = -75$$

$$W = Fd = (-50)\times(-75) = 3750J$$

Q#2: A particle is acted on by a constant force $F = (2.0\text{ N})\,\hat{i} - (5.0\text{ N})\,\hat{j}$ and is displaced from an initial position of $d_i = (0.50\text{ m})\,\hat{i} + (0.80\text{ m})\,\hat{j}$ at time $t = 0$ s to a final position of $d_f = (3.5\text{ m})\,\hat{i} + (9.8\text{ m})\,\hat{j}$ at time $t = 10$ s. Find the average power (in Watts) on the particle due to this force in this time interval. (A) -3.9)

$$P_{avg} = \frac{W}{t} = \frac{\vec{F}\cdot\Delta\vec{d}}{t} = \frac{F\Delta d}{t}\ ;\ \Delta d = d_f - d_i = (3.5 - 0.5)\vec{i} + (9.8 - 0.8)\vec{j}$$

$$\Delta\vec{d} = 3\vec{i} + 9\vec{j}$$

$$P_{avg} = \frac{\vec{F}\cdot\Delta\vec{d}}{t} = \frac{(2\vec{i} - 5\vec{j})\cdot(3\vec{i} + 9\vec{j})}{10} = \frac{6 - 45}{10} = -3.9W$$

Q#2: A man moves the 10-kg object shown in **Figure 2** in a vertical plane from position X to position Y along a circular track of radius R = 20 m. The work done by the force of gravity during this motion is A) – 3920 J

$$W_g = F_g\cdot y$$
$$= mg\times(-y)$$
$$= -mg\times2R$$
$$= -10\times9.8\times2\times20$$
$$W_g = -3920J$$

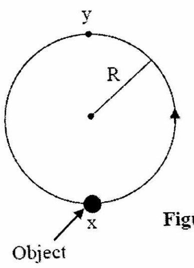
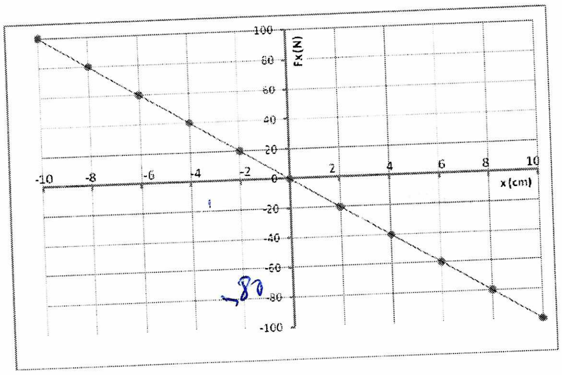


Figure 2

Quiz # 3 Ch 7 Phys101-1, T113-v4

Student Name: **Student ID:** **Section #**

Q#1: **Figure 1** shows the spring force as a function of position *x* for a spring-block system resting on a frictionless table. The block is released at *x* = + 10 cm. How much work (in Joules) does the spring do on the block when the block moves from *xi* = + 8.0 cm to xf= -4 cm? (A) +2.4)



$W_s = \frac{1}{2}k(x_i^2 - x_f^2)$

but $k = \frac{\Delta F_{app}}{\Delta x} = -\frac{\Delta F_s}{\Delta x}$

$= \frac{(-100-100)\times -1}{0.1-(-0.1)}$

$k = \frac{200}{0.2} = 1000$ N/m

$W_s = \frac{1}{2} \times 1000 \times ((0.08)^2 - (0.04)^2)$

$= 2.4$ J

Q#2: A 3.0-kg mass has an initial velocity **vo** = (6.0 i - 2.0 j) m/s. A single force **F** is applied for 5.0 s which changes its velocity to **v** = (8.0 i + 4.0 j) m/s. Find the average power delivered by the force in this interval A) 12 W.

$P_{avg} = \frac{W}{t} = \frac{\Delta K}{t} = \frac{\frac{1}{2}m(v_f^2 - v_i^2)}{t}$

$|v_f| = \sqrt{8^2 + 4^2} = 8.94$ m/s

$|v_i| = \sqrt{36+4} = 6.3$ m/s

$\Delta K = \frac{1}{2}m(v_f^2 - v_i^2) = \frac{1}{2} \times 3 \times (8.94^2 - 6.3^2) = 60.47$ J

$P_{avg} = \frac{\Delta K}{t} = \frac{60.47}{5} = 12.09$ W

Q#3: A projectile of mass m = 0.200 kg is fired at an angle of 60.0 degrees above the horizontal with a speed of 20.0 m/s. Find the work done on the projectile by the gravitational force during its flight from its firing point to the highest point on its trajectory. A) -30.0 J

$W_g = \vec{F_g} \cdot \vec{y} = \Delta K = \frac{1}{2}m(v_f^2 - v_i^2)$

$v_f = 20 \cos 60 = 10$ m/s (y-Component is Zero)

$v_i = 20$ m/s

$\Delta K = \frac{1}{2} \times 0.2 \times (10^2 - 20^2) = -30$ J

$W_g = \Delta K = -30$ J

Quiz # 3 Ch 7 Phys101-1, T113-v5

Student Name: **Student ID:** **Section #**

Q#1: A ball slides without friction around a loop-the-loop (see Fig 2). A ball is released, from rest, at a height *h* from the left side of the loop of radius *R*. What is the ratio (*h/R*) so that the ball has a speed *VR* =at the highest point of the loop? (g = acceleration due to gravity) A) (5/2)

Conservation of energy

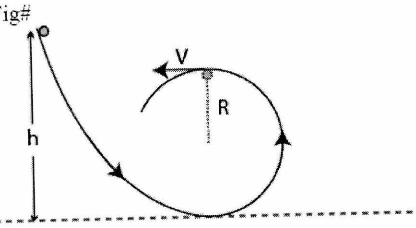
$mgh = \frac{1}{2}mv_f^2 + mg(2R)$

but $m\frac{v^2}{R} = gm \Rightarrow v^2 = Rg$

$gh = \frac{1}{2}\times Rg + 2Rg$

$h = \frac{5}{2}R \quad \Rightarrow \frac{h}{R} = 5/2$

Fig#



Q#2 An ideal spring is hung vertically from the ceiling. When a 2.0 kg mass hangs at rest from it, the spring is extended 6.0 cm from its relaxed length. A downward external force is now applied to the mass to extend the spring an additional 10 cm. While the spring is being extended by the external force, the work done by the spring is: A) −3.6 J

$k = \frac{mg}{x} = \frac{2\times 9.8}{0.06} = 326.7\, N/m$

$x_i = 0.06\, m\ ;\ x_f = 0.06 + 0.1 = 0.16\, m$

$W_s = \frac{1}{2}k(x_i^2 - x_f^2) = \frac{1}{2}\times 326.7\times((0.06)^2 - (0.16)^2)$

$= -3.594\, J$

Q#3 A net horizontal force of 50 *N* is acting on a 2.0 *kg* crate that starts from rest on a horizontal frictionless surface. At the instant the object has traveled 2.0 *m*, the rate at which this net force doing work is: A) 500 *W*

$P_{net} = \vec{F}\cdot\vec{v}_f\ ;\ v_f^2 = v_i^2 + 2ax = 2ax\ (v_i = 0)$

$v_f = \sqrt{2ax}$

but $a = \frac{F}{m} = \frac{50}{2} = 25\, m/s^2$

$v_f = \sqrt{2ax} = \sqrt{2\times 25\times 2} = 10\, m/s$

$P_{net} = \vec{F}\cdot\vec{v}_f = F v_f = 50\times 10 = 500\, W$

Quiz # 3 Ch 7 Phys101-1, T113-v6

Student Name: **Student ID:** **Section #**

Q#1: A force F= (12^i + Bj) N, where B is a constant, acts on an object and does 46 joules work as the object moves from the origin to the point r= (13^i + 11j^) m. The value of B is: −10 N

$W = \vec{F}\cdot\vec{r} = (12\hat{i} + B\hat{j})\cdot(13\hat{i} + 11\hat{j}) = 46$

$12\times13 + 11B = 46 \Rightarrow 11B = 46 - 12\times13$

$B = \frac{-110}{11} = -10$

Q#2: A helicopter lifts an 80 kg man vertically from the ground by means of a cable. The upward acceleration of the man is 2.0 m/s**2. Find the rate at which the work is being done on the man by the tension of the cable when the speed of the man is 1.5 m/s. (A1 1.4*10**3 W)

$W_T = \vec{T}\cdot\vec{v}$ but $T - mg = ma$

$T = mg + ma = m(g+a) = 80(9.8+2) = 944\,N$

$W_T = \vec{T}\cdot\vec{v} = Tv = 944\times1.5 = 1416\,W$

Q#3: A 0.50 kg block attached to an ideal spring with a spring constant of 80 N/m oscillates on a horizontal frictionless surface. The speed of the block is 0.50 m/s, when the spring is stretched by 4.0 cm. The maximum speed the block can have is: A) 0.71 m/s

$E = K + U_s = \frac{1}{2}kx_m^2 = \frac{1}{2}mv_{max}^2$

$K + U_s = \frac{1}{2}mv_{max}^2$

$\frac{1}{2}mv^2 + \frac{1}{2}\frac{kx^2}{m} = \frac{1}{2}mv_{max}^2$

$(0.5)^2 + \frac{80}{0.5}(0.04)^2 = v_{max}^2$

$v_{max} = \sqrt{0.506} = 0.71\,m/s$