Formula sheet for Common Exam 3 -Phys 105 - FALL 2009

DO NOT USE THIS SHEET DURING THE EXAM.

A COPY WILL BE PROVIDED.

Vectors: $A_x = A\cos\theta$; $A_y = A\sin\theta$; $A = \sqrt{A_x^2 + A_y^2}$; $\theta = \tan^{-1}\frac{A_y}{A_x}$; $A + B = C \Rightarrow C_x = A_x + B_x$, $C_y = A_y + B_y$;

1 m = 100 cm 1 km = 1000 m 1 mi = 1609 m 1 inch = 2.54 cm 1 hour = 60 min = 3600 s 1 rev = 2π rad 1 kg = 1000 g

One-dimensional motion: $x = \frac{v_1 + v_2}{2} t$ $x = v_o t + \frac{1}{2} at^2$, $v^2 - v^2_o = 2ax$; $v = v_o + at$; **Free fall:** $y = v_o t - \frac{1}{2} gt^2$, $v = v_o - gt$,

$y = \frac{v^2 - v_0^2}{-2g}$ $y_{max} = \frac{v_0^2}{2g}$

Projectile motion: $v_{ox} = v_o\cos\theta$; $v_{oy} = v_o\sin\theta$; $x = v_{ox} t$; $y = v_{oy} t - \frac{1}{2} gt^2$; $v_y = v_{oy} - gt$; $R = \frac{v_o^2 \sin 2\theta}{g}$;

$y = \frac{v_y^2 - v_{oy}^2}{-2g}$; $y_{max} = \frac{v_{0y}^2}{2g}$ **Circular motion**: $a_C = \frac{v^2}{R}$; period $T = \frac{2\pi R}{v}$;

Dynamic: $\sum \mathbf{F} = m\mathbf{a}$; weight: $\mathbf{F_g} = m\mathbf{g}$, ; $g = 9.8$ m/s^2; **incline:** $F_{xg} = mg\sin\theta$, $F_{yg} = mg\cos\theta$

Friction: $f_{s,max} = \mu_s F_n$; $f_k = \mu_k F_n$; **centripetal force**: $F_{net} = \frac{mv^2}{r}$;

Spring: $F = -kx$ $\Delta U_s = {}^1/_2 (kx_f^2 - kx_i^2)$, $U_s = \frac{1}{2}kx^2$

Work: $W = Fd\cos\phi$; $W_{tot} = K_f - K_i$; $W_{fr} = -f_k d$; $W_s = -{}^1/_2 (kx_f^2 - kx_i^2)$,

Energy $K = \frac{1}{2} mv^2$ $U_g = mgy$ $U_s = \frac{1}{2}kx^2$ $\Delta K = K_f - K_i = W_{net}$

$\Delta U = -W$ $E = K + U$ $\Delta E = \Delta K + \Delta U = 0$

$U_{gi} + U_{si} + K_I = U_{gf} + U_{sf} + K_f$ $U_{gi} + U_{si} + K_I = U_{gf} + U_{sf} + K_f + \Delta E_{th}$ $\Delta E_{th} = f \cdot d$

Power $P = dW/dt = \mathbf{F}\cdot\mathbf{v} = |\mathbf{F}|\,|\mathbf{v}|\cos(\mathbf{F},\mathbf{v})$ $P_{avg} = {}^{\Delta W}/_{\Delta t}$

Sample problems for Common Exam 3 -Phys 105 - FALL 2009

1. A diver of mass m drops from a board 10m above the water's surface.
Find his speed as he hits the water

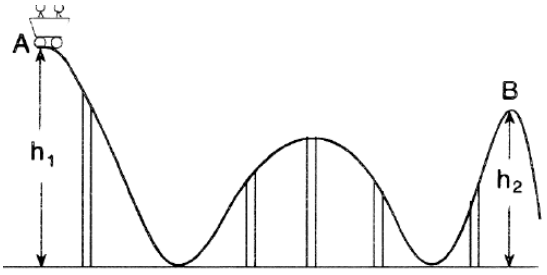
A) 10 m/s
B) 14 m/s
C) 5 m/s
D) 1 m/s
E) 8 m/s

2. Waterslides are 21.9 m high. If a 60 kg person is clocked at 18 m/s at the bottom of the slide
What was the work of the friction?

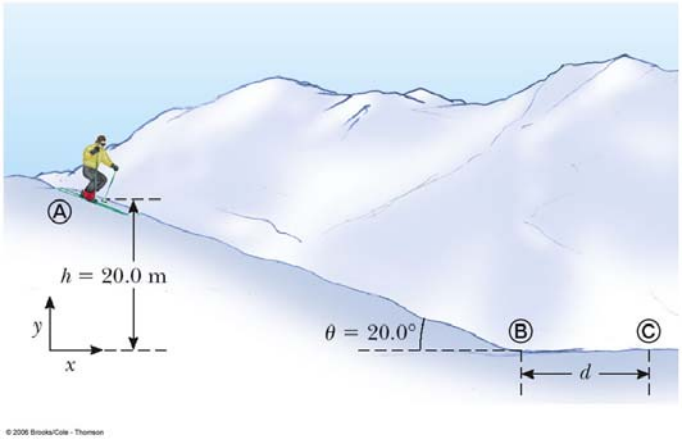
A) 1.5×10^3 J
B) -1.5×10^3 J
C) 3.16×10^3 J
D) -3.16×10^3 J
E) -2.16×10^3 J

3.A roller coaster cart of mass 200 kg starts stationary at point A, where $h_1 = 20m$ and a while later is at B, where $h_2 = 10m$. What is the speed of the cart at B, ignoring the effect of friction?

A) 12 m/s
B) 14 m/s
C) 4 m/s
D) 6 m/s
E) 18 m/s



4. A skier stars from rest at the top of a frictionless incline of height 20 m . At the bottom of the incline, the skier encounters a horizontal surface where the $\mu_k = 0.21$. How far does the skier travel on the horizontal surface before coming to rest?



A) 120 m
B) 50 m
C) 95 m
D) 60 m
E) 20 m

5. A block with mass of 5 kg is attached to a horizontal spring with spring constant $k=4x10^2$N/m . The surface the block rests upon is frictionless. If the block is pulled out to $x_i=0.05$ m and released from rest, find the speed of the block at the equilibrium point,

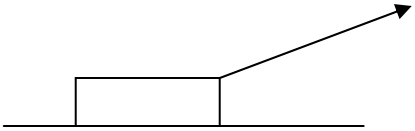
A) 0.251 m/s
B) 2.512 m/s
C) 0.447 m/s
D) 4.471 m/s
E) 3.223 m/s

6. A 1670 kg car accelerates from rest by the only one force 8217 N from engine in 3.13 s. Find the average power delivered by the force from the engine on the car.

A) 32400 W
B) 63270 W
C) 25300 W

D) 12400 W
E) 87300 W

7. A person pulls a sled with load from rest. The total mass of the sled with load is 50kg, and the person exerts a force of 1.2×10^2 N on the sled by pulling on the rope with angle 30^o ($\mu_k = 0.2$) What is the kinetic energy of the sled after he pulls the sled 5 m?



A) 50 J
B) 60J
C) 70 J
D) 80 J
E) 90 J

8. Mother is saving the child from drowning by lifting him straight up through distance 1.5 m in 1.5 s. If mass of the child 15 kg what is the average power delivered by the mother? $g = 10\frac{m}{s^2}$

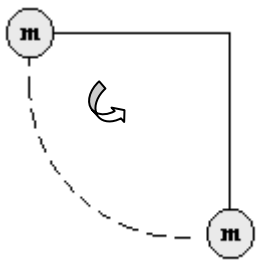
A) 100 W
B) 90 W
C) 40 W
D) 150 W
E) 300 W

9. What is the work done by the force F= (50N) i-(30N) j on the displacement R =5 m i+ 7 m j?

A) 40 j
B) 40 i
C) 40 *J*
D) 460 *J*
E) 250 *J*

10. A ball with the mass **m =1 kg** is attached to a string**, 2 m** long. The ball is thrown downward from the horizontal position with initial speed 2 m/s as shown in the drawing and is moving along the circular trajectory. What is the speed of the ball at the lowest point?

A) 4.69m/s
B) 6.63 m/s
C) 15.5 m/s
D) 6.2 m/s
E) 9.8 m/s



11. What are the work of gravity and work of tension in the string for problem 10? $g = 10\frac{m}{s^2}$

A) 20 J, 20
B) 0, 20 J
C) 20 J, 0
D) -20 J,0
E) -20 J, 20 J

Ans.

1) 14 m/s
2) -3.16×10^3 J
3) 14 m/s
4) 95 m
5) 0.447 m/s
6) 63270 W
7) 90 J
8) 150W
9) 40 J
10) 6.63 m/s
11) 20 J, 0