PHYSICS DEPARTMENT

PHY 2048 Exam 2 October 24, 2011

Name (print, last first): ______________________ Signature: ______________________

On my honor, I have neither given nor received unauthorized aid on this examination.

YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.

(1) **Code your test number on your answer sheet (use lines 76–80 on the answer sheet for the 5-digit number).** Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY**. Code your UFID number on your answer sheet.
(2) Print your name on this sheet and sign it also.
(3) Do all scratch work anywhere on this exam that you like. **Circle your answers on the test form.** At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout.
(4) **Blacken the circle of your intended answer completely, using a #2 pencil or blue or black ink.** Do not make any stray marks or some answers may be counted as incorrect.
(5) **The answers are rounded off. Choose the closest to exact. There is no penalty for guessing. If you believe that no listed answer is correct, leave the form blank.**
(6) Hand in the answer sheet separately.

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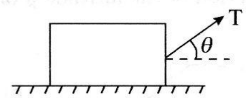
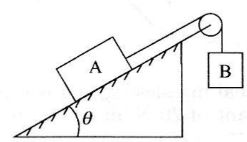
1. A block of mass m is pulled at constant velocity along a rough horizontal floor by an applied force $\vec{T}$ as shown. The frictional force is:



(1) $T\cos\theta$ (2) $T\sin\theta$ (3) zero (4) mg (5) $mg\cos\theta$

2. Block A, with a mass of 10 kg, rests on a $\theta = 35°$ incline. The coefficient of static friction is 0.40. An attached string is parallel to the incline and passes over a massless, frictionless pulley at the top. What is the smallest value of m_B for which A will not slide?



(1) 2.5 kg (2) 3.5 kg (3) 5.9 kg (4) 9.0 kg (5) 10.5 kg

3. An object of mass m and another object of mass $2m$ are each forced to move along a circle of radius 1.0 m at a constant speed of 1.0 m/s. The magnitudes of their acceleration are:

(1) equal (2) in the ratio of $\sqrt{2} : 1$ (3) in the ratio of $2 : 1$ (4) in the ratio of $4 : 1$ (5) zero

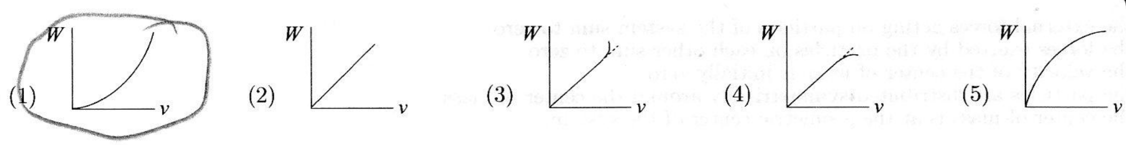
4. A man pushes an 80-N crate a distance of 5.0 m upward along a frictionless slope that makes an angle of 30° with the horizontal. The force he exerts is parallel to the slope. If the speed of the crate increases at a rate of 1.5 m/s^2, then the work done by the man is:

(1) 260 J (2) −200 J (3) 61 J (4) 140 J (5) 200 J

5. A particle moves 5 m in the $+x$ direction while being acted upon by a constant force $\vec{F} = (4\hat{\imath} + 2\hat{\jmath} - 4\hat{k})$N. The work (in Nm) done on the particle by this force is:

(1) 20 (2) 10 (3) −20 (4) 30 (5) need to know other forces

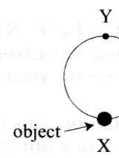
6. A particle is initially at rest on a horizontal frictionless table. It is acted upon by a constant horizontal force F. Which of the following five graphs is a correct plot of work W as a function of particle speed v?



7. At time $t = 0$ a 2-kg particle has a velocity in m/s of $4\hat{\imath} - 3\hat{\jmath}$. At $t = 3s$ its velocity in m/s is $2\hat{\imath} + 3\hat{\jmath}$. During this ti the work done on it was:

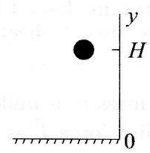
(1) -12 J (2) 4 J (3) -4 J (4) -40 J (5) $(4\hat{\imath} + 36\hat{\jmath})$ J

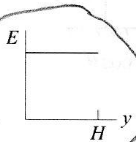
8. A man moves the 10-g object shown in a vertical plane from postion X to position Y along a circular track of radius 20 m. The process takes 0.75 min. The work done by the man is about:

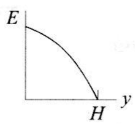


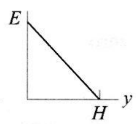
(1) 4 J (2) 1 J (3) 2 J (4) 6 J (5) 12 J

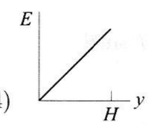
9. A ball is held at a height H above the floor. It is then released and falls to the floor. If air resistance can be ignored, which of the five graphs below correctly gives the mechanical energy E of the Earth-ball system as a function of the altitude y of the ball?

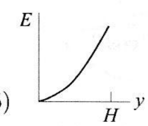


(1) 

(2) 

(3) 

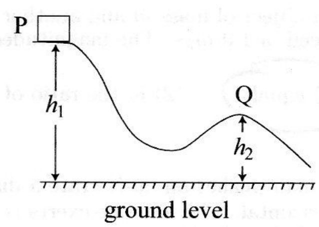
(4) 

(5) 

10. An ideal massless spring is used to fire a 15.0-g block horizontally across a frictionless table top. The spring has a spr constant of 20 N/m and is initially compressed by 7.0 cm. The speed of the block as it leaves the spring is:

(1) 2.6 m/s (2) 0 (3) 1.9×10^{-3}m/s (4) 2.6×10^{-3}m/s (5) 0.39 mm/s

11. A block is released from rest at point P and slides along the frictionless track shown. At point Q, its speed is:



(1) $\sqrt{2g(h_1 - h_2)}$

(2) $2g\sqrt{h_1 - h_2}$

(3) $(h_1 - h_2)/2g$

(4) $2g(h_1 - h_2)$

(5) $(h_1 - h_2)^2/2g$

12. The potential energy of a 0.20-kg particle moving along the x axis is given by $U(x) = 8x^2 - 2x^4$, where U is in jou and x is in meters. When the particle is at $x = 1.0$ m, its acceleration is:

(1) -40 m/s^2 (2) 0 (3) -8 m/s^2 (4) 8 m/s^2 (5) 40 m/s^2

13. The center of mass of a system of particles has a constant velocity if:

(1) the external forces acting on particles of the system sum to zero.
(2) the forces exerted by the particles on each other sum to zero.
(3) the velocity of the center of mass is initially zero.
(4) the particles are distributed symmetrically around the center of mass.
(5) the center of mass is at the geometric center of the system.

14. Block A, with a mass of 2.0 kg, moves along the x axis with a velocity of 5.0 m/s in the positive x direction. It suffer an elastic collision with block B, initially at rest, and the blocks leave the collision along the x axis. If B is much mor massive than A, the velocity of A after the collision is:

(1) -5.0 m/s (2) 0 (3) $+5.0$ m/s (4) -10.0 m/s (5) $+10.0$ m/s

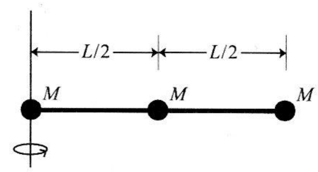
15. The angular speed in rad/s of the minute hand of a watch is:

(1) $\pi/1800$ (2) $60/\pi$ (3) $1800/\pi$ (4) π (5) $\pi/60$

16. A wheel starts from rest and has an angular acceleration that is given by $\alpha(t) = 6t^2$. After it has turned through 10 rev its angular velocity is:

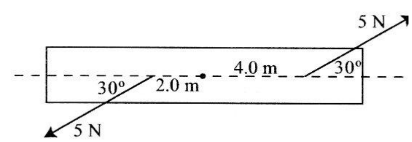
(1) 75 rad/s (2) 63 rad/s (3) 89 rad/s (4) 130 rad/s (5) 210 rad/s

17. Three identical objects, each of mass M, are fastened to a massless rod of length L as shown. The rotational inertia about one end of this array is:



(1) $5ML^2/4$ (2) $ML^2/2$ (3) ML^2 (4) $3ML^2/2$ (5) $3ML^2$

18. A rod is pivoted about its center. A 5-N force is applied 4 m from the pivot and another 5-N force is applied 2 m from the pivot, as shown. The magnitude of the total torque about the pivot (in N·m) is:



(1) 15 (2) 0 (3) 8.7 (4) 5 (5) 26

19. A 8.0-cm radius disk with a rotational inertia of 0.12 kg·m^2 is free to rotate on a horizontal axis through its center o mass. A string is fastened to the surface of the disk and a 10-kg mass hangs from the other end. The mass is raised b using a crank to apply a 9.0-N·m torque to the disk. The acceleration of the mass, in m/s^2, is:

(1) 0.50 (2) 1.7 (3) 6.2 (4) 12 (5) 20

20. Where on the bubble sheet MUST you enter the 5 digit test code?

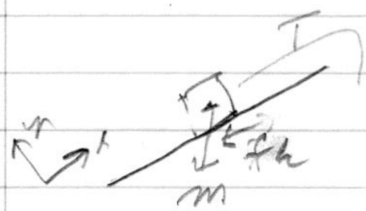
(1) Rows 76–80.
(2) It is already on every page of the question sheet.
(3) What is the test code?
(4) Oops, I thought this was the CHEM 2105 exam.
(5) Is it ok if I also omit my name and UFID number?

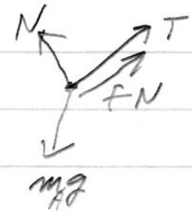
Exam #2 Fall 2011

1. 

$a = 0 \Rightarrow F_{net} = 0$

$F = T\cos\theta - f_k = 0 \quad f_k = T\cos\theta$

2. 

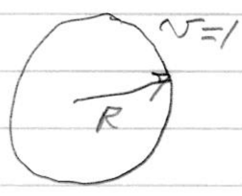


$T = m_B g$

$N = m_a g\cos\theta$

$T + f \cdot m_a g\cos\theta - m_a g\sin\theta = 0$

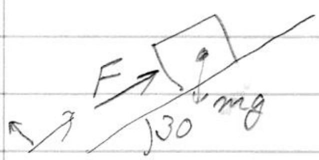
$m_B = -m_a\cos\theta \cdot f_s + m_a\sin\theta = 2.459$

3. 

$v_T = 1\ m/s \quad v_{cp} = \frac{v^2}{R}$

NO mass dependence

∴ a's are equal

4. 

$W = mgh + \Delta KE$

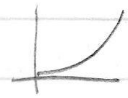
$= mg \cdot 5\sin\theta + KE = 200 + \Delta K$

$mg = 80 \quad m = 80/g = 8$

$\Delta K = W = F \cdot d = ma\,d = 8 \cdot 1.5 \cdot 5 = 60$

~~total~~ $W = 200 + 60 = 260\ J$

5 $W = \vec{F} \cdot \vec{d} = (4\hat{i} + 2\hat{j} - 4\hat{k}) \cdot 5\hat{i} = 20$

6. $W = \Delta K = \frac{1}{2} m v^2 - 0$  quadratic

7. $W = \Delta K = K_f - K_i = \frac{1}{2} m (v_f^2 - v_i^2)$
$= \frac{1}{2} \cdot 2 \, (3.6^2 - 5^2) = 13 - 25 = 12$

8 $W = \Delta U = mgh = .01 \cdot g \cdot 40$
$\approx 4 \, J$ (20)

9 total E is conserved so $E = U + K = \text{const}$

10 $W = \frac{1}{2} k x^2 = \frac{1}{2} m v^2$
$v = \left(\frac{k x^2}{m} \right)^{1/2} = \left(\frac{20 \cdot .07^2}{.015} \right)^{1/2} = 2.556 \text{ m/s}$

11. $mg(h_1 - h_2) = \frac{1}{2} m v^2$ $v = \left[2g(h_1 - h_2) \right]^{1/2}$

12. $F = ma = -\frac{dU}{dx}$ $a = -\frac{1}{m} \frac{dU}{dx} = -\frac{1}{m}(16x - 8x^3)$

$a = -\frac{1}{.2}(16 - 8) = -40$

13 $F_x = m a_{cm} \Rightarrow a_{cm} = 0 \Rightarrow F_x = 0$

14 B does not move, E is conserved since it is an elastic collision so $K_f = K_i$
$\Rightarrow |v_f| = |v_i|$

15 $\omega = \frac{2\pi}{60\,\text{min}/\text{hr} \cdot 60\,\text{sec}/\text{m}} = \frac{\pi}{1800}$

16. $\alpha(t) = 6t^2 \qquad d\omega = \alpha\, dt$

$$\int d\omega = \omega - \omega_0 = \int \alpha\, dt = 6\int t^2\, dt = 6 \cdot \tfrac{1}{3} t^3 + C \quad (C = 0)$$

$$= 2t^3$$

$$\theta = \int \omega\, dt = \tfrac{1}{2} t^4 \qquad \Delta\theta = 20\pi = \tfrac{1}{2} t^4 \quad t = 3.35$$

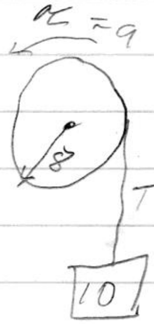
$$\omega = 2 \cdot 3.35^3 = 75\, s^{-1}$$

17 $I = \sum_i m_i r_i^2 = M\left(\frac{L}{2}\right)^2 + ML^2 = ML^2 \cdot \frac{5}{4}$

18 $\tau = \sum_i \vec{F} \cdot \vec{r} = 5 \cdot \sin 30 \cdot 2 + 5 \sin 30 \cdot 4$

$$= (5 \sin 30) 6 = 15$$

19



$I = .12 \qquad \tau = 9$

$a = \alpha r \qquad T - mg = ma$

$\tau = I\alpha = I\, a/r$

$\tau_{tot} = 9 - Tr = 9 - r(ma + mg)$

$$9 - rma - rmg = \frac{I}{R} \cdot a$$

$$a = \frac{9 - rmg}{\frac{I}{r} + rm} = \frac{9 - .08 \cdot 10 \cdot g}{.12/.08 + 10 \cdot .08} = \frac{1.16}{2.3}$$

$$= 1/2$$

20 —