Version A

Name (print neatly):______________________________Section #:_____

Physics 111 Exam 2

First, write your name on this sheet and on the Scantron Card.

The Physics faculty would like to help you do well:

1. Budget your time: 80 minutes/20 questions=4 min each.
2. Questions vary in difficulty. Look for ones you can do first.
3. If you get stuck on a question, move on.
4. All answers are in standard units of m, s, kg and J.
5. If you show your work on the exam sheet you will do better and the work will improve your ability to study the exam afterward.
6. If any question is unclear, ask a tutor to clarify it immediately.
7. Use a calculator.
8. Answers are approximate. Select the closest one.

Since the NJIT Student Council asks for scrupulous fairness in exams, we remind you that you have pledged to comply with the provisions of the NJIT Academic Honor Code. The tutors will help by allowing no devices with internet access.

Signature: ____

1. Two blocks are on a horizontal, frictionless table. A force of 2.0 N pulls a block that has m=3.0 kg. The block is connected to a second block, M=4.0 kg, by a wire. What is the tension, in N, in the wire?
    a. **1.1**
    b. 0.86
    c. 0.29
    d. 2.0
    e. 1.0

2. A beam is tilted up by 0.02 m at one end, and it is 1m long. Friction is insignificant. Mass of the glider is 1 kg. What is the magnitude of the component of net force, in N, acting on the glider along the beam.
    a. 100
    b. 2
    c. 5
    d. 0.02
    e. **0.2**

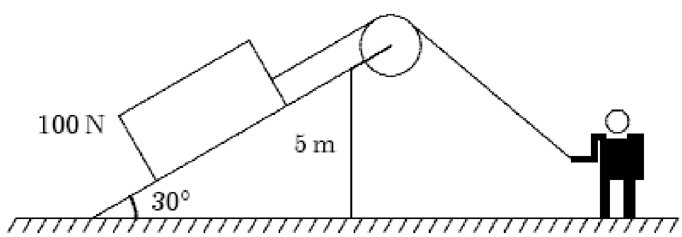
3. An elevator of mass 1000 kg pulls down on one side of a cable that goes over a pulley that has no friction. A counter weight of 900 kg pulls on the other side. The elevator starts to fall with no friction. What is the net force on the system, in N? Take the elevator's direction of motion as positive.
    a. 50
    b. **980**
    c. 100
    d. 460
    e. 20

4. On a Force table, forces are applied to a small ring near the center. If the forces are *F1*=-0.9 **i** +0 **j** and F2=0 **i** -0.75 **j** , what is the magnitude, in N, of a third force which will keep the ring in equilibrium without touching the pin at the center?

a. **1.2**
b. 1.6
c. 1.4
d. 0.9
e. 0.6

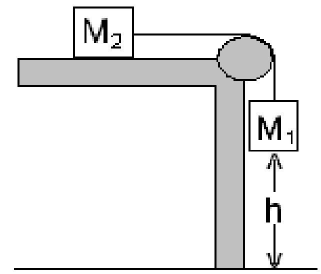
5. A crate of weight 100-N is sitting on a ramp with a 30 degree slope, as shown. The playful man lets go and the crate slides down with no friction and an acceleration a1. He then places another crate of half the weight on the ramp. Again, he lets go and the second crate slides down with acceleration a2. What are values of a1 and a2 in m/s^2?

a. 9.8, 4.9
b. 4.9, 2.5
c. 9.8, 9.8
d. 4.9, 9.8
e. 4.9, 4.9



6. The man lets go of the rope attached to the 100-N crate. It starts from rest and slides down the 30-degree slope with no friction. The crate's velocity increases to 9.8 m/s at a time t. What is t in s?
   a. 9.8
   b. 0.01
   c. 0.3
   d. 2.0
   e. 9.8

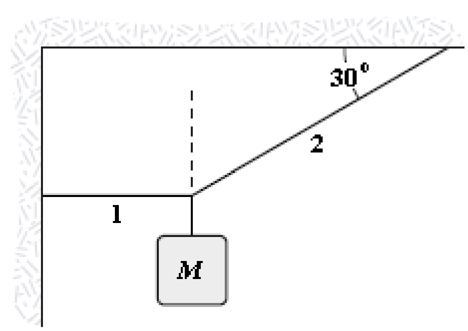
7. Two masses M_1 = 2 kg and M_2 = 4 kg are attached by a string as shown. They start from rest and move with no friction until they reach a velocity of 6.5 m/s. When do they reach that speed, in s ?



   a. 0.68
   b. 4.3
   c. 2.0
   d. 1.4
   e. 3.3

8. "A light fixture of mass 3.55 kg hangs by two wires (arranged like a "Y"), each of which makes an angle of 10 degrees with the ceiling. What is the tension, in N, in one of the wires?
   a. 200
   b. 100
   c. 25
   d. 20
   e. 10

9. A light fixture is suspended from a wall and a ceiling by wires, as shown. The tension, T1 in wire 1 is 3.5 N. What is the mass, M, in kg?

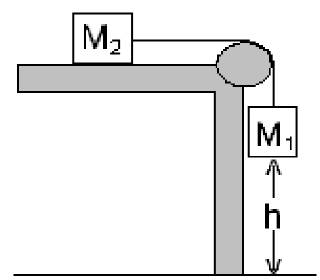


   a. 3.4;
   b. 2.0
   c. 1.7
   d. 0.64
   e. 0.21

10. A block sits on a horizontal surface with a coefficient of static friction of 0.2 between them. A horizontal force of 14 N is just able to move the block parallel to the surface.
What is the mass, in kg, of the block?

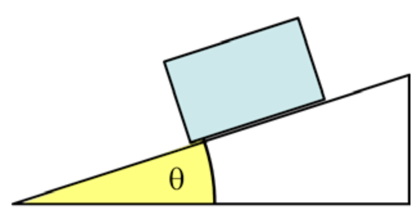
a. **7.1**
b. 14
c. 70
d. 1.4
e. 3.5

11. Two masses are attached by a string as shown. The mass, M_2, is 4 kg and the coefficient of friction is 0.5. What is the maximum mass M_1, in kg, that allows the system to stay at rest?



a. 0.3
b. **2**
c. 4
d. 0.5
e. 8

12. The block is at rest. Then, the ramp is gradually tilted. At at an angle of 14 degrees, the block begins to slide. What is the coefficient of static friction between the block of unknown mass, m, and the ramp?



a. Can't tell; need m
b. 0.87
c. 0.61
d. 0.55
e. **0.25**

13. A woman pulls a block along a horizontal surface at a constant speed with a 15-N force acting 20° above the horizontal. She does 85 J of work. How many meters does the block move?

a. 5.6

b. 90

c. 6.0

d. 0.16

e. 3

14. A person does 200 J work lifting an object from the bottom of a well at a constant speed of 2.0 m/s in a time of 5.1 s. What is the object's mass? (Neglect friction.)

a. 20

b. 2.0

c. 6.2

d. 2.1

e. 4.0

15. A woman throws a 2.0-kg ball from the origin to a point at (20 **i** + 3 **j** + h k) meters, where **k** is the upward unit vector. The work done by the gravitational force on the ball is -290J. What is the height, h?

a. 19

b. 15

c. 39

d. 7

e. 150

16. Suddenly, the driver of a fast car travelling 50 m/s sees a deer and slams on the brakes. The car travels for 10 s before it stops. What is the coefficient of kinetic friction between the tires and the road?

a. 0.13
b. 0.26
c. 0.32
d. 0.41
e. 0.51

17. An object falls vertically downward in water at a constant speed. The viscosity of the water does work of -20 J as the object falls 0.80 m. What is the mass, in kg, of the object?

a. 2.0
b. 20
c. 3.7
d. 2.6
e. 1.7

18. A constant force of (2 **i** -15 **j + 2 k**) N acts on a particle as it moves from the origin to a point (4 **i** + 3 **j + 5 k**) m. How much work, in J, does the force do during this displacement?

a. +30
b. –27
c. +45
d. –45
e. +37

19. A CONSTANT force acts on an object and increases its kinetic energy, by 24 J. The object moves from (7 **i** -8 **j** +4 k)m to (11 **i** – 5 **j** + 4 **k**) m. The net force acting on the object is equal to (Fx **i** + 4 **j** + 5 **k**) N. What is Fx, in N.

a. 1

b. -4

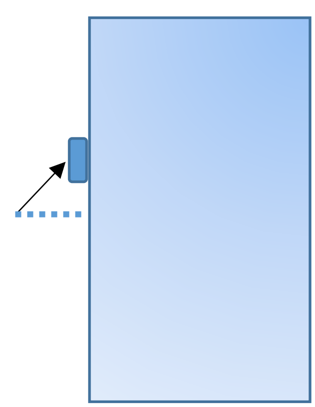
c. 4

d. 3

e. -3

20. As shown in the figure, a block is pushed up against a vertical wall by a force 20 N. The force is at an angle of 40 degrees from horizontal. The coefficient of static friction between the block and the wall is 0.50. Find the maximum mass, in kg, that the force can prevent from sliding down.

a. Infinite
b. 0.92
c. 2.1
d. 0.52
e. 10



Constants: 1 inch = 2.54 cm; 1 mi =1.61 km; 1 cm=10^{-2}m; 1 mm= 10^{-3} m; 1 gram=10^{-3} kg;
$g = 9.8$ m/s^2 ; $G = 6.674\times10^{-11}$ N m^2/kg^2 ; $M_{Earth} = 5.97\times10^{24}$ kg ; $R_{Earth} = 6.37\times10^{6}$ m

1D and 2D motion: $x=x_i+vt$ (constant v);
$x = x_i + v_i t + \frac{1}{2}at^2$; $v = v_i + at$; $v^2 = v_i^2 + 2a(x - x_i)$; $\vec{r} = \vec{r}_i + \vec{v}_i t + \frac{1}{2}\vec{a}t^2$; $\vec{v} = \vec{v}_i + \vec{a}t$

Circular motion: $T = 2\pi R / v$; $T = 2\pi / \omega$; $a_c = v^2 / R$

Force: $\sum \vec{F} = m\vec{a}$; $\vec{F}_{12} = -\vec{F}_{21}$; **Friction:** $f_s \le \mu_s N$; $f_k = \mu_k N$

Energies: $K = \frac{1}{2}mv^2$; $U_g = mgy$; $U_s = \frac{1}{2}kx^2$; $W = -\int \vec{F}\cdot d\vec{r} = -\vec{F}\cdot\Delta\vec{r}$
$E_{total} = K + U_g + U_S$; $\Delta E_{mech} = \Delta K + \Delta U_g + \Delta U_s = -f_s d$; $P = dW/dt = \vec{F}\cdot\vec{v}$; $\Delta K = W$

Momentum and Impulse: $\vec{p} = m\vec{v}$; $\vec{I} = \int \vec{F}dt = \Delta\vec{p}$

Center of mass: $\vec{r}_{cm} = \sum_i m_i\vec{r}_i / \sum_i m_i$; $\vec{v}_{cm} = \sum_i m_i\vec{v}_i / \sum_i m_i$

Collisions: $\vec{p}$ = const and E$\neq$ const (inelastic) or $\vec{p}$ = const and E= const (elastic)

Rotational motion: $\omega = 2\pi / T$; $\omega = d\theta / dt$; $\alpha = d\omega / dt$; $v_t = r\omega$; $a_t = r\alpha$
$a_c = a_r = v_t^2 / r = \omega^2 r$; $a_{tot}^2 = a_r^2 + a_t^2$; $v_{cm} = r\omega$ (rolling, no slipping) ; $a_{cm} = r\alpha$
$\omega = \omega_o + \alpha t$; $\theta_f = \theta_i + \omega_o t + \alpha t^2 / 2$; $\omega_f^2 = \omega_i^2 + 2\alpha(\theta_f - \theta_i)$
$I_{point} = MR^2$; $I_{hoop} = MR^2$; $I_{disk} = MR^2/2$; $I_{sphere} = 2MR^2/5$; $I_{shell} = 2MR^2/3$;
$I_{rod\,(center)} = \left\langle ML^2/12 \right\rangle$
$I_{rod\,(end)} = ML^2/3$; $I = \sum_i m_i r_i^2$; $I = I_{cm} + Mh^2$; $\vec{\tau} = \vec{r}\times\vec{F}$; $\sum\tau = I\alpha$; $\vec{L} = \vec{r}\times\vec{p}$; $\vec{L} = I\vec{\omega}$

Energy: $K_{rot} = I\omega^2/2$; $K = K_{rot} + K_{cm}$; $\Delta K + \Delta U = 0$; $W = \tau\,\Delta\theta$; $P_{inst} = \tau\omega$

Fluid: $\rho = \frac{M}{V}$; $P = P_o + \rho gh$; $A_1v_1 = A_2v_2$; $P_1 + \rho g y_1 + \frac{1}{2}\rho v_1 = P_2 + \rho g y_2 + \frac{1}{2}\rho v_2$; $B = \rho_{fluid}V^{object}g$

Gravitation: $\vec{F}_g = -\frac{Gm_1m_2}{r^2}\hat{r}_{12}$; $g(r) = GM/r^2$; $U = -Gm_1m_2/r$; $T^2 = \frac{4\pi^2}{GM}a^3$

Math: 360° = 2π rad = 1 rev; Arc: $s = r\theta$; $V_{sphere} = 4\pi R^3/3$; $A_{sphere} = 4\pi R^2$; $A_{circle} = \pi R^2$

quadratic formula to solve $ax^2 + bx + c = 0$: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Vectors: $\vec{A} = A_x\hat{i} + A_y\hat{j}$; $A_x = |\vec{A}|\cos(\theta)$; $A_y = |\vec{A}|\sin(\theta)$; $|\vec{A}| = \sqrt{A_x^2 + A_y^2}$; $\tan\theta = \frac{A_y}{A_x}$
$\vec{C} = \vec{A} + \vec{B}$ => $C_x = A_x + B_x$; $C_y = A_y + B_y$;
$\vec{A}\cdot\vec{B} = |\vec{A}||\vec{B}|\cos\theta = A_xB_x + A_yB_y + A_zB_z$; $\hat{\imath}\cdot\hat{\imath} = \hat{\jmath}\cdot\hat{\jmath} = \hat{k}\cdot\hat{k} = 1$; $\hat{\imath}\cdot\hat{\jmath} = \hat{\imath}\cdot\hat{k} = \hat{\jmath}\cdot\hat{k} = 0$
$|\vec{A}\times\vec{B}| = |\vec{A}||\vec{B}|\sin\theta$; $\vec{A}\times\vec{B} = \hat{i}(A_yB_z - A_zB_y) + \hat{j}(A_zB_x - A_xB_z) + \hat{k}(A_xB_y - A_yB_x)$
$\hat{i}\times\hat{i} = \hat{j}\times\hat{j} = \hat{k}\times\hat{k} = 0$; $\hat{i}\times\hat{j} = \hat{k}$; $\hat{j}\times\hat{k} = \hat{i}$; $\hat{k}\times\hat{i} = \hat{j}$