Physics 111, Spring 2014, Common Exam 2

1. **C**
2. **E**
3. **B**
4. **C**
5. **D**
6. **D**
7. **E**
8. **D**
9. **C**
10. **B**
11. **A**
12. **E**
13. **D**
14. **A**
15. **B**
16. **D**
17. **B**
18. **E**

$M_E g - m_E a - m_S g \mu_k = m_S a$

Physics 111 Common Exam 2, Spring 2014, Version A

Name (P [redacted] **4 Digit ID:_____ Section: _____**

Honors [redacted] easons all students are pledged to comply with the provision ust answer the exam questions entirely by yourself. **Turn off unication devices.** Use only your own calculator.

Instruc

- First he Scantron card and this exam sheet.
- Use no other materials.
- Budg ems.
- For r t will be difficult to arrive at the correct answer without showing your wever, partial credit will **not** be awarded on the multiple choice prob
- Answ pencil. Also circle your answers on question papers.
- Do n uestion, if needed, from your proctor or Professor.

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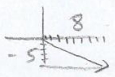
1. If the only forces acting on a 2.0-kg mass are $\vec{F}_1 = (3\hat{i} - 8\hat{j})$ N and $\vec{F}_2 = (5\hat{i} + 3\hat{j})$ N, what is the magnitude of the acceleration of the particle?

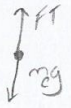
A) 1.5 m/s^2
B) 6.5 m/s^2
C) 4.7 m/s^2
D) 9.4 m/s^2
E) 7.2 m/s2

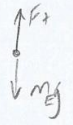
$F_1 + F_2 = ma$ $\quad (3i + 5i) \quad -8 + 3j$ $\quad (8i, -5j)$

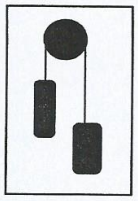


2. An elevator is built with a counterweight for safety. The elevator hangs from a cable on one side of a pulley and the counterweight hangs on the other side with no significant friction. The counter weight is 90% of the elevator weight. If the motor fails and the elevator falls, pulling the counterweight, what is the approximate downward acceleration of the elevator (in m/s^2)?

A) can't tell
B) 10
C) 15
D) 1
E) 0.5





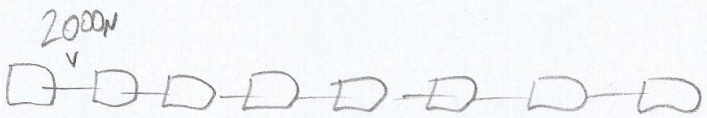


$g\frac{(M_E g - m_C g)}{m_C + m_E}$ $\quad FT - mg = ma$ $\quad \Sigma F_y = M_E g - FT = m_E a$

$g(M_E g - m_C g) = a(m_C + m_E)$

3. An NJ Transit train with 8 cars is pulled by its first car. The tension in the coupling to the last car is 2000N. Each of the cars has the same mass and we can neglect friction. What is the approximate force (in N) exerted by the wheels of the first car to pull all 8 cars?

A) 32,000
B) 16,000
C) 4,000
D) 2,000
E) Not enough information



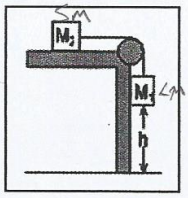
$f = 8m \cdot a$

$\Sigma F_y = m_2 g - F_T = m_2 a$ al

$m_2 g - m_L a$

S $\Sigma F_x = F_T - m_s g u_k = m_s a$

4. A large weight hangs over the side of a building from a cable. The cable goes over a pulley to a horizontal roof and is attached to a small weight of half the mass. The coefficient of sliding friction between roof and the small weight is 0.5. What is the approximate acceleration of the small mass (in m/s?



A) Not enough information
B) 10
C) 5
D) 3.3
E) 1

LM

FT

mg

SM

NF

FF FT

mg

$\Sigma F_y = mg - FT = m_2 a$

$\Sigma F_x = F_T - F_F = m_s a$

$\frac{(m_2 g - m_s g u_k) g}{m_s + m_L}$

$F_T - m_s g u_k = m_s a$

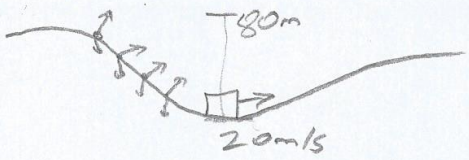
$\Sigma F_y = N_f - mg = 0$

$m_2 g - m_s g u_k = (m_s + m_L a) a$

$F_f = m g u_k$

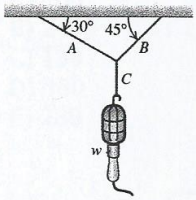
5. A man is sitting on a scale in the back of a truck. The truck goes at a speed of 20m/s through the bottom of a valley of circular radius of curvature 80m. At the bottom of the valley the scale reads 1000N. What is the approximate mass (kg) of the man?

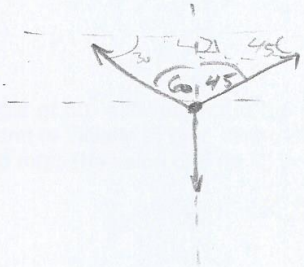
A) 1000
B) 500
C) 200
D) 67
E) 10



6. A lamp of weight w=10 N is suspended by cables as shown in the figure. The tension in cable A (in N) is

A) 5.1
B) 8.5
C) 9.2
D) 7.3
E) 4.7



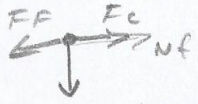


$\Sigma F_x = \sin(45) \cdot B - \sin 60 \cdot A = 0$

$\Sigma F_y = \cos(45) B + \cos 60 A - 10 = 0$

7. You are standing on a bathroom scale in an elevator in a small building. The elevator starts from rest and moves with a velocity given by $v(t) = (3\ m/s^2)t + (0.2\ m/s^3)t^2$. If your mass is 64 kg what is your weight at t=4.0 s as recorded by the scale (in N).

A) 627
B) 1254
C) 333
D) 124
E) 922



$U_{ST} + K_1 = K_2 + U_{S2}$

$\frac{1}{2}mv^2 = \frac{1}{2}kd^2$

$50 = k$

8. An amusement park ride consists of a large vertical cylinder (tube) that spins about its axis so that a person inside is held against the wall when the floor drops away? If the radius of the cylinder is 4 m and μ_s is 0.400, what must be the period of revolution (in s) to keep the person form falling.

A) 1.5
B) 5.0
C) 12
D) 2.5
E) 7.3

$\Sigma F_x = F_c + N_f - F_F = m\frac{v^2}{R}$

$N_f - F_T$

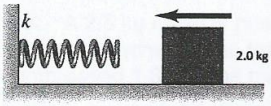
$N_f - \mu_S N_f$

$F_c - F_F = ma$

$-24 = K_2 - K_1$ $\quad -24 = k_2 - 25$

9. A mass 2.0 kg with an initial velocity, v_i = 5.0 m/s slides on a horizontal surface losing 24 joules of energy. It then slides on a frictionless surface and collides with a massless spring lying horizontally on the surface. It is known that a weight of 5 N suspended vertically from the spring elongates it 10 cm. The maximum distance (in cm) that the spring is compressed is

A) 10
B) 30
C) 20
D) 40
E) 140



$1 = k_2$

$V_i = 1\ m/s$

$-24 = k_2 - k_1$

$-24 = \frac{1}{2}mv^2 - 25$

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

$\sqrt{\frac{2k_1}{k}}$

$U_{spring} = \Delta KE$

$U_{S1} - U_{S2} = K_2 - K_1$

$k_1 = \frac{1}{2}kx^2$

$K_1 + U_{ST} = k_2 + U_{S2}$

$K_1 + 0$

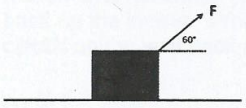
10. A force F (constant) at an angle of 60° with respect to the horizontal is applied to a mass of 80 kg which lies on a horizontal surface and is initially at rest. When the body moves 10 m, the work done by friction is 200 J and its velocity is 5.0 m/s. The value of F (in N) is:

A) 100
B) 240
C) 139
D) 160
E) 280

$W_{TOT} = KE$ $\quad K_2 - K_1$

$W_P + W_F = K_2$

$\cos 10 \cdot F_P - 200 = \frac{1}{2}mv^2$



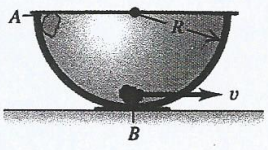
11. A vertical (-y direction, down) force F = 100 N is applied to a 50 kg mass which lies on a horizontal surface and is moving with a velocity of 10 m/s in the (+ x) horizontal direction. The work done (in joules) by F when the body has moved 5 m in the + x direction is:

A) 0
B) 500
C) 1000
D) 2450
E) 2500

12. A 72 kg man walks a vertical distance of 30 m up the stairs of a building in 3.0 minutes, rests for 1.0 minutes and then proceeds 20 m vertically up the stairs in another 2.0 minutes. His average power output (in watts) is:

A) 10
B) 64
C) 588
D) 1167
E) 98

13. A small rock with mass 0.10-kg is released from rest at point *A*, which is at the top edge of a large, hemispherical bowl with radius *R* = 0.5 m (the figure). Assume that size of the rock is small compared to *R*, so that the rock can be treated as a particle, assume that the rock slides rather than rolls. The work done by friction on the rock when it moves from point *A* to point *B* at the bottom of the bowl has magnitude 0.29 J. The speed (in m/s) of the rock as it reaches point *B* is:

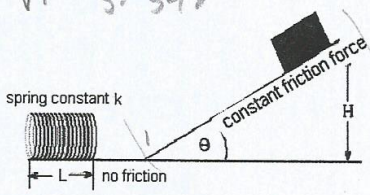


A) 0.5
B) 1
C) 1.5
D) 2
E) 2.5

14. A 2.5 kg mass is pushed against a horizontal spring of force constant k = 1930 N/m on a frictionless air table. The spring is attached to the tabletop, and the mass is not attached to the spring in any way. When the spring has been compressed 1.8 cm, the mass is suddenly released from rest. Find the greatest speed the mass reaches (in m/s):

A) 0.5
B) 1.0
C) 1.5
D) 2.0
E) 2.5

15. A 3.0 kg block A is initially kept at rest at height H = 1.8 m . It slides down a $\theta = 37^0$ incline with the friction force of 10 N. At the bottom of incline there is an L = 20 cm long spring with the spring constant k = 3200 N/m. There is no friction on a horizontal path (while compressing a spring). After compressing the spring the block rebounds and slides back up the incline. While moving up the incline it exerts the same friction force of 10 N. What is the maximum height it climbs on the way back (in m)?



A) 0.1
B) 0.5
C) 0.6
D) 0.4
E) 0.7

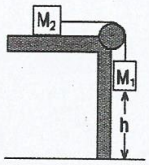
$\Sigma F_y = F_n - mg = 0$ 2 $\Sigma F_x = F_T = m_2 a$ $mg = (m_2 - m)a$

1 $\Sigma F_y = mg - F_T = m_1 a$ $F_T + mg = m_1 a$ $F_T = m_2 a$ $mg = (m_2 + m_1)a$

16. Two masses M_1 = 2.5 kg and M_2 = 4 kg are attached by a string as shown. M_1 falls vertically down and M_2 moves on a frictionless surface. Initially the system is at rest and the mass M_1 is 0.9 m above the ground. What is the speed of mass M_1 just before it touches the ground (in m/s)?

A) 2.9
B) 3.6
C) 3.9
D) 2.6
E) 4.3

$a = \frac{mg}{m}$ 3.769 15 $U_{g_1} + K_1 = K_2 + U_{g_2}$ $\sqrt{2gh_1} = \frac{1}{2}mv^2$

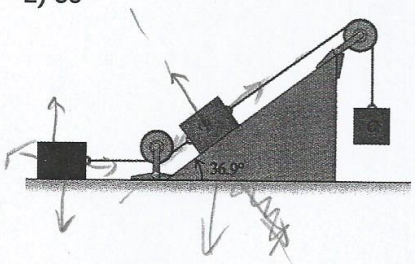


$mgh = \frac{1}{2}mv^2$ 2 $\Sigma F_x = F_T = m_2 a$ $mgh = \frac{1}{2}mv^2$

$\sqrt{2gh} = v$ 1 $\Sigma F_x = Mg - F_T = m_1 a$ $m_1 g = (m_1 + m_2)a$

17. Blocks A, B and C are placed as in the figure below and connected by a massless rope to massless pulleys. Both mass A and B weigh 25.0 N and the coefficient of kinetic friction between these masses (A and B) and the surface is 0.35. If block C descends with a constant velocity, what is the weight of block C (in N)?

A) 12
B) 31
C) 10
D) 15
E) 35



30

C $\Sigma F_y = F_T - mg = 0$

B $\Sigma F_x = F_{T_1} - F_{T_2} - \sin\theta\, mg - F_f = 0$

$\Sigma F_y = N_f - \cos\theta\, mg = 0$

$F_T - 8.75 - \sin\theta\, mg - F_f = 0$

A $\Sigma F_x = F_T - F_f = 0$

$F_T - 8.75 - 6.99724 - 15.0\cos 0$

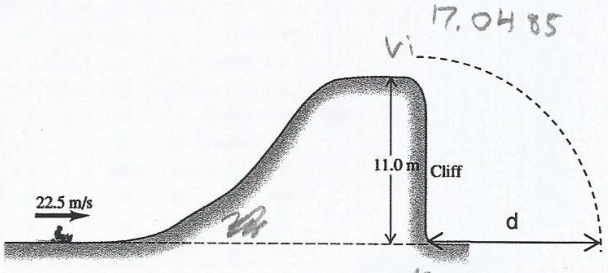
$F_T = 36$

$\Sigma F_y = -mg + N_f = 0$

$F_T = 8.75$ $4k \cdot mg$

18. A sled and rider having a combined mass of 125 kg travel on a perfectly smooth icy surface. The sled approaches an incline at 22.5 m/s. How far does the sled land from the base of the cliff at the right side of the figure (distance "d" in meters in the figure).

A) 15
B) 29
C) 33
D) 40
E) 26



$V_f = V_i + aT\Delta$

X	Y
$V_i = 17.04$	$\Delta d = 11$
$a = 0$	$a = 9.8$
$V_f = 17.04$	$\Delta T =$
$\Delta T =$	$V_i = 0$

17.04 85

V_i

$mgh_1 + K_1 = K_2 + mgh_2$

$\frac{1}{2}mv = \frac{1}{2}mv^2 + 13475$

31640.6

18165.6 =

$\Delta d = 0 + \frac{1}{2}aT^2$

$11 = \frac{1}{2}aT^2$

$1.4983 = \Delta T$