Instructor(s): *Profs. D. Acosta, H. B. Chan, P. Hirschfeld*
PHYSICS DEPARTMENT
PHY 2053   Exam 1   February 17, 2010
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 <u>blue</u> or <u>black</u> 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.
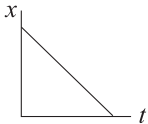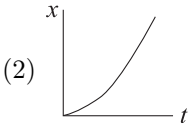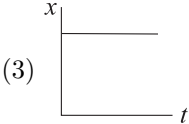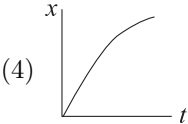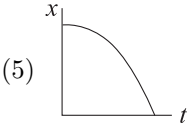(6) **Hand in the answer sheet separately.**

Constants
$g = 9.80$ m/s^2

1. A book with mass 1.0 kg is initially at rest on a rough horizontal table. It is set into motion when a constant horizontal force of 3.0 N is applied to it. If the coefficient of kinetic friction between the book and the table is 0.2, find the distance traveled by the book in 2.0 seconds.

   (1) 2.1 m   (2) 6.0 m   (3) 3.9 m   (4) 1.0 m   (5) 9.8 m

2. A book with mass 1.0 kg is initially at rest on a rough horizontal table. It is set into motion when a constant horizontal force of 4.0 N is applied to it. If the coefficient of kinetic friction between the book and the table is 0.3, find the distance traveled by the book in 2.0 seconds.

   (1) 2.1 m   (2) 8.0 m   (3) 5.9 m   (4) 1.0 m   (5) 9.8 m

3. A book with mass 2.0 kg is initially at rest on a rough horizontal table. It is set into motion when a constant horizontal force of 3.0 N is applied to it. If the coefficient of kinetic friction between the book and the table is 0.1, find the distance traveled by the book in 2.0 seconds.

   (1) 1.0 m   (2) 3.0 m   (3) 2.0 m   (4) 0.52 m   (5) 9.8 m

4. A plane flies at an altitude of 400 meters above the ground at a velocity of 50 m/s in the horizontal direction. The pilot releases a parcel when the plane is directly above a camper. How far does the camper need to walk from his initial position to retrieve the parcel?

   (1) 450 m   (2) 400 m   (3) 81 m   (4) 6.4 m   (5) 9.0 m

5. A plane flies at an altitude of 200 meters above the ground at a velocity of 50 m/s in the horizontal direction. The pilot releases a parcel when the plane is directly above a camper. How far does the camper need to walk from his initial position to retrieve the parcel?

   (1) 319 m   (2) 200 m   (3) 41 m   (4) 4.5 m   (5) 6.4 m

6. A plane flies at an altitude of 600 meters above the ground at a velocity of 50 m/s in the horizontal direction. The pilot releases a parcel when the plane is directly above a camper. How far does the camper need to walk from his initial position to retrieve the parcel?

   (1) 550 m   (2) 600 m   (3) 122 m   (4) 7.8 m   (5) 11.0 m

7. A 18.0 kg child on a 0.80 m long swing is released from rest when the ropes of the swing make an angle of 30.0° with the vertical. Neglect friction. Find the speed of the child at the lowest position.

(1) 1.4 m/s   (2) 4.0 m/s   (3) 3.7 m/s   (4) 2.8 m/s   (5) 2.1 m/s

8. A 18.0 kg child on a 1.1 m long swing is released from rest when the ropes of the swing make an angle of 30.0° with the vertical. Neglect friction. Find the speed of the child at the lowest position.

(1) 1.7 m/s   (2) 4.6 m/s   (3) 4.3 m/s   (4) 3.3 m/s   (5) 2.9 m/s

9. A 18.0 kg child on a 1.3 m long swing is released from rest when the ropes of the swing make an angle of 30.0° with the vertical. Neglect friction. Find the speed of the child at the lowest position.

(1) 1.8 m/s   (2) 5.0 m/s   (3) 4.7 m/s   (4) 3.6 m/s   (5) 3.4 m/s

10. A trash can with mass 20 kg is initially at rest on the ground. The coefficient of static friction between the trash can and the ground is 0.6. A child pushes the trash can with a horizontal force of 15 N. Find the friction force on the can when the child is pushing.

(1) 15 N   (2) 118 N   (3) 103 N   (4) 196 N   (5) 0 N

11. A trash can with mass 15 kg is initially at rest on the ground. The coefficient of static friction between the trash can and the ground is 0.6. A child pushes the trash can with a horizontal force of 10 N. Find the friction force on the can when the child is pushing.

(1) 10 N   (2) 88 N   (3) 78 N   (4) 147 N   (5) 0 N

12. A trash can with mass 25 kg is initially at rest on the ground. The coefficient of static friction between the trash can and the ground is 0.6. A child pushes the trash can with a horizontal force of 22 N. Find the friction force on the can when the child is pushing.

(1) 22 N   (2) 147 N   (3) 125 N   (4) 245 N   (5) 0 N

13. A particle starts from the origin in the x-y plane. It first travels 15 meters at an angle of 80 degrees with the positive x axis to point A. From point A, it travels another 25 meters at an angle of 20 degrees with the positive x axis to arrive at point B. Find the distance of point B from the origin.

(1) 35 m   (2) 40 m   (3) 23 m   (4) 26 m   (5) 10 m

14. A particle starts from the origin in the x-y plane. It first travels 20 meters at an angle of 80 degrees with the positive x axis to point A. From point A, it travels another 30 meters at an angle of 20 degrees with the positive x axis to arrive at point B. Find the distance of point B from the origin.

(1) 44 m   (2) 50 m   (3) 31 m   (4) 35 m   (5) 10 m

15. A particle starts from the origin in the x-y plane. It first travels 30 meters at an angle of 80 degrees with the positive x axis to point A. From point A, it travels another 50 meters at an angle of 20 degrees with the positive x axis to arrive at point B. Find the distance of point B from the origin.

(1) 70 m   (2) 80 m   (3) 52 m   (4) 46 m   (5) 20 m

16. A stone is thrown with an initial speed of 15 m/s at an angle of 50 degrees above the horizontal from the top of a 50 m building. If air resistance is negligible, what is the magnitude of the horizontal displacement of the stone when it hits the ground?

(1) 44 m   (2) 50 m   (3) 38 m   (4) 56 m   (5) 32 m

17. A stone is thrown with an initial speed of 10 m/s at an angle of 55 degrees above the horizontal from the top of a 50 m building. If air resistance is negligible, what is the magnitude of the horizontal displacement of the stone when it hits the ground?

(1) 24 m   (2) 50 m   (3) 30 m   (4) 36 m   (5) 42 m

18. A stone is thrown with an initial speed of 20 m/s at an angle of 40 degrees above the horizontal from the top of a 50 m building. If air resistance is negligible, what is the magnitude of the horizontal displacement of the stone when it hits the ground?

(1) 73 m   (2) 50 m   (3) 66 m   (4) 59 m   (5) 79 m

19. A 800-kg elevator moves upwards with a constant speed of 1.5 m/s. Find the power supplied by the elevator motor.

(1) 11800 W   (2) 1200 W   (3) 800 W   (4) 5400 W   (5) 9600 W

20. A 700-kg elevator moves upwards with a constant speed of 1.5 m/s. Find the power supplied by the elevator motor.

(1) 10300 W   (2) 1000 W   (3) 700 W   (4) 5400 W   (5) 9200 W

21. A 900-kg elevator moves upwards with a constant speed of 1.5 m/s. Find the power supplied by the elevator motor.

(1) 13200 W   (2) 1300 W   (3) 900 W   (4) 5400 W   (5) 10000 W

22. A truck carries a package with mass 20 kg on an inclined uphill road at an angle of 10 degrees to the horizontal. The truck travels along this road for 1 minute with a constant velocity of 4 m/s. What is the work done by gravity on the package during this interval?

(1) −8200 J   (2) −46000 J   (3) 784 J   (4) 46000 J   (5) 8200 J

23. A truck carries a package with mass 30 kg on an inclined uphill road at an angle of 10 degrees to the horizontal. The truck travels along this road for 1 minute with a constant velocity of 4 m/s. What is the work done by gravity on the package during this interval?

(1) −12300 J   (2) −70000 J   (3) 1176 J   (4) 70000 J   (5) 12300 J

24. A truck carries a package with mass 15 kg on an inclined uphill road at an angle of 10 degrees to the horizontal. The truck travels along this road for 1 minute with a constant velocity of 4 m/s. What is the work done by gravity on the package during this interval?

(1) −4600 J   (2) −26000 J   (3) 440 J   (4) 26000 J   (5) 4600 J

25. A box with mass 3 kg is pressed against a spring of negligible mass on a frictionless horizontal table. The spring is compressed by 10 cm and then the box is let go. Given that the spring constant is 2500 N/m, find the kinetic energy of the box when it moves to the equilibrium position of the spring.

(1) 13 J   (2) 250 J   (3) 0.015 J   (4) 7500 J   (5) 3.0 J

26. A box with mass 4 kg is pressed against a spring of negligible mass on a frictionless horizontal table. The spring is compressed by 10 cm and then the box is let go. Given that the spring constant is 3000 N/m, find the kinetic energy of the box when it moves to the equilibrium position of the spring.

(1) 15 J   (2) 300 J   (3) 0.02 J   (4) 12000 J   (5) 3.9 J

27. A box with mass 5 kg is pressed against a spring of negligible mass on a frictionless horizontal table. The spring is compressed by 10 cm and then the box is let go. Given that the spring constant is 1500 N/m, find the kinetic energy of the box when it moves to the equilibrium position of the spring.

(1) 7.5 J   (2) 150 J   (3) 0.025 J   (4) 7500 J   (5) 4.9 J

28. A uniform solid sphere has a radius of 21 cm and a mass of 1.9 kg. Given that the volume of a sphere is $\frac{4}{3}\pi R^3$, the mass density of the sphere is about:

(1) 49 kg/m^3 (2) 2.0×10^{-6} kg/m^3 (3) 2.0×10^{-2} kg/m^3 (4) 1.4 kg/m^3 (5) 14 kg/m^3

29. A uniform solid sphere has a radius of 12 cm and a mass of 1.9 kg. Given that the volume of a sphere is $\frac{4}{3}\pi R^3$, the mass density of the sphere is about:

(1) 260 kg/m^3 (2) 2.3×10^{-6} kg/m^3 (3) 4.0×10^{-2} kg/m^3 (4) 1.4 kg/m^3 (5) 3.1 kg/m^3

30. A uniform solid sphere has a radius of 31 cm and a mass of 1.9 kg. Given that the volume of a sphere is $\frac{4}{3}\pi R^3$, the mass density of the sphere is about:

(1) 15 kg/m^3 (2) 2.9×10^{-6} kg/m^3 (3) 7.6×10^{-2} kg/m^3 (4) 0.3 kg/m^3 (5) 9.1 kg/m^3

31. Which of the five graphs of position, x, versus time, t, represents the motion of an object moving with a constant nonzero speed?

(1)   (2)   (3)   (4)   (5)

32. Two trains are headed toward each other on the same straight track. At $t = 0$, the two trains are 200 meters apart and both have a speed of 30 m/s. If one train is traveling at a constant speed and the speed of the other train is increasing at a rate of 10 m/s^2, when do the two trains collide?

(1) $t = 2.7$ s   (2) $t = 3.3$ s   (3) $t = 1.5$ s   (4) $t = 6.6$ s   (5) $t = 5.4$ s

33. Two trains are headed toward each other on the same straight track. At $t = 0$, the two trains are 100 meters apart and both have a speed of 30 m/s. If one train is traveling at a constant speed and the speed of the other train is increasing at a rate of 10 m/s^2, when do the two trains collide?

(1) $t = 1.5$ s   (2) $t = 2.7$ s   (3) $t = 3.9$ s   (4) $t = 6.6$ s   (5) $t = 5.4$ s

34. Two trains are headed toward each other on the same straight track. At $t = 0$, the two trains are 200 meters apart and both have a speed of 20 m/s. If one train is traveling at a constant speed and the speed of the other train is increasing at a rate of 10 m/s^2, when do the two trains collide?

(1) $t = 3.5$ s   (2) $t = 1.7$ s   (3) $t = 4.3$ s   (4) $t = 6.6$ s   (5) $t = 5.4$ s

35. There are two forces on the 5.0 kg box in the overhead view of the figure. If $\vec{F}_1$ points in the positive x-direction and if $|\vec{F}_1| = 10N$, $|\vec{a}| = 12$ m/s^2, and $\theta = 30°$ as shown, what is the magnitude of $\vec{F}_2$?
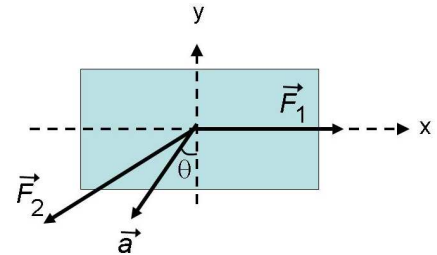
(1) 65.5 N
(2) 40.0 N
(3) 50.0 N
(4) 13.2 N
(5) 73.2 N
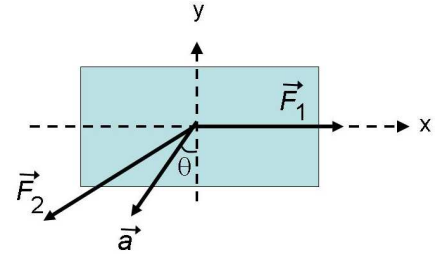
36. There are two forces on the 5.0 kg box in the overhead view of the figure. If $\vec{F}_1$ points in the positive x-direction and if $|\vec{F}_1| = 20N$, $|\vec{a}| = 12$ m/s^2, and $\theta = 30°$ as shown, what is the magnitude of $\vec{F}_2$?
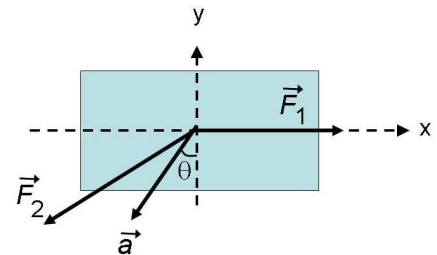
(1) 72.1 N
(2) 40.0 N
(3) 33.0 N
(4) 13.2 N
(5) 93.2 N

37. There are two forces on the 10.0 kg box in the overhead view of the figure. If $\vec{F}_1$ points in the positive x-direction and if $|\vec{F}_1| = 10N$, $|\vec{a}| = 12$ m/s^2, and $\theta = 30°$ as shown, what is the magnitude of $\vec{F}_2$?

(1) 125 N
(2) 40.3 N
(3) 63.0 N
(4) 13.2 N
(5) 73.2 N

38. The figure shows two blocks with masses m_1 and m_2 connected by a cord (of negligible mass) that passes over a frictionless pulley (also of negligible mass). If when released from rest block 2 accelerates upward at g/2, what is the mass of block 1?

(1) $3m_2$
(2) $4m_2$
(3) $6m_2$
(4) $2m_2$
(5) $5m_2$
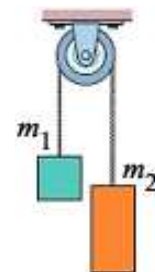
39. A 1000-kg elevator is rising and its speed is increasing at 3 m/s^2. The tension in the elevator cable is:

(1) 12800 N (2) 6800 N (3) 9800 N (4) 3000 N (5) 1000 N

40. A 1000-kg elevator is rising and its speed is increasing at 4 m/s^2. The tension in the elevator cable is:

(1) 13800 N (2) 6800 N (3) 9800 N (4) 3000 N (5) 1000 N

41. A 2000-kg elevator is rising and its speed is increasing at 3 m/s^2. The tension in the elevator cable is:

(1) 25600 N (2) 12800 N (3) 9800 N (4) 3000 N (5) 13800 N

42. Two blocks with masses m and M are pushed along a horizontal friction-less surface by a horizontal applied force $\vec{F}$ as shown. The magnitude of the force of either of these blocks on the other is:
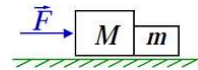
(1) $mF/(m+M)$ (2) mF/M (3) $mF/(M-m)$ (4) $MF/(M+m)$ (5) MF/m

43. A 10 kg bucket with water is suspended midway between two walls 10 m apart by a rope under tension which passes through the handle of the bucket. Each section of the rope makes an angle of 30° with the horizontal. Find the tension in the rope.

(1) 98 N (2) 78 N (3) 72 N (4) 48 N (5) 64 N

44. A 5 kg bucket with water is suspended midway between two walls 10 m apart by a rope under tension which passes through the handle of the bucket. Each section of the rope makes an angle of 30° with the horizontal. Find the tension in the rope.

(1) 49 N (2) 78 N (3) 72 N (4) 98 N (5) 64 N

45. A 10 kg bucket with water is suspended midway between two walls 10 m apart by a rope under tension which passes through the handle of the bucket. Each section of the rope makes an angle of 10° with the horizontal. Find the tension in the rope.

(1) 280 N (2) 78 N (3) 172 N (4) 98 N (5) 64 N

46. The figure shows three blocks of masses m, $2m$, and $3m$, respectively from the left. These are connected with 2 massless strings, as shown. The middle block is on a frictionless table, and the other two hang over the edge by means of frictionless pulleys. What is the magnitude of the acceleration of the middle block?
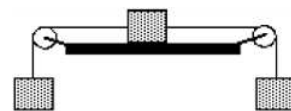
(1) $g/3$ (2) g (3) $g/2$ (4) $g/6$ (5) $2g/3$

47. Identical guns fire identical bullets horizontally at the same speed from the same height above level planes, one on the Earth and one on the Moon. Which of the following three statements is/are true?
   I. The horizontal distance traveled by the bullet is greater for the Moon.
   II. The flight time is less for the bullet on the Earth.
   III. The velocities of the bullets at impact are the same.

   (1) I and II only   (2) III only   (3) I and III only   (4) II and III only   (5) I, II, III

48. In order to receive credit for this problem, you must correctly code ("bubble in") your UFID and your 5-digit test number (located at the top left and right hand corners of this test) onto your scan sheet and also select the correct response below. Please check now that you have correctly coded your exam number on the scan sheet.

   (1) I have correctly bubbled my UFID number and 5-digit test code.
   (2) I won't do this because I don't need really the credit.
   (3) I don't know what my UFID number is.
   (4) I can't read my test code.
   (5) I don't understand what is being asked.

FOLLOWING GROUPS OF QUESTIONS WILL BE SELECTED AS ONE GROUP FROM EACH TYPE
TYPE 1
Q# S 1
Q# S 2
Q# S 3
TYPE 2
Q# S 4
Q# S 5
Q# S 6
TYPE 3
Q# S 7
Q# S 8
Q# S 9
TYPE 4
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Q# S 11
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TYPE 12
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TYPE 13
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Q# S 41
TYPE 14
Q# S 43
Q# S 44
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