Instructor(s): *C. Parks*

PHYSICS DEPARTMENT
PHY2053, Summer 2015   Final Exam   August 6, 2015

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. If you
   believe that no listed answer is correct, leave the form blank.**
(6) Hand in the answer sheet separately.

Given Information:

$g = 9.80$ m/s^2 1 atmosphere $= 1.01 \times 10^5$ Pa   Density of water $= 1000$ kg/m^3
1 m $= 100$ cm   1 minute $= 60$ seconds

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1. Your dog runs away from you. She runs 27 m at 35° North of East and then runs an additional 39 m at 57° North of
   East. Assuming that your dog does not move any more (very unlikely), how far and in what direction do you have to
   go to catch your dog?

   (1) 65 m at 48° North of East
   (2) 47 m at 55° North of East
   (3) 66 m at 92° North of East
   (4) 65 m at 42° North of East
   (5) None of these.

2. Your dog runs away from you. He runs 54 m at 35° North of East and then runs an additional 78 m at 57° North of
   East. Assuming that your dog does not move any more (very unlikely), how far and in what direction do you have to
   go to catch your dog?

   (1) 130 m at 48° North of East
   (2) 95 m at 55° North of East
   (3) 130 m at 92° North of East
   (4) 130 m at 42° North of East
   (5) None of these.
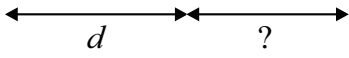
3. Starting from rest, your car accelerates uniformly and travels $d = 50$ m in 5.0
   seconds. If the car continues with the same acceleration, how far will it travel
   after another 5.0 seconds?

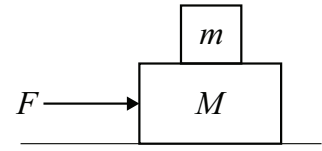   (1) 150 m   (2) 100 m   (3) 50 m   (4) 200 m   (5) None of these.

4. Starting from rest, your car accelerates uniformly and travels $d = 75$ m in 5.0
   seconds. If the car continues with the same acceleration, how far will it travel
   after another 5.0 seconds?

   (1) 225 m   (2) 150 m   (3) 75 m   (4) 300 m   (5) None of these.
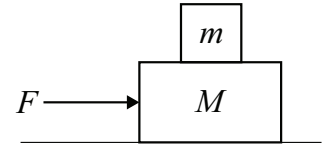
5. A $m = 2.0$-kg block sits on a $M = 4.0$-kg block. There is no friction between m and M. There is no friction between M and the surface below it. If $F = 12$ N, which blocks move and what is their acceleration?

(1) M moves with $a = 3.0$ m/s^2
(2) m and M move with $a = 2.0$ m/s^2
(3) m moves with $a = 6.0$ m/s^2
(4) M moves with $a = 2.0$ m/s^2
(5) None of these.

6. A $m = 2.0$-kg block sits on a $M = 6.0$-kg block. There is no friction between m and M. There is no friction between M and the surface below it. If $F = 48$ N, which blocks move and what is their acceleration?
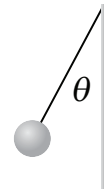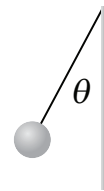
(1) M moves with $a = 8.0$ m/s^2
(2) m and M move with $a = 6.0$ m/s^2
(3) m moves with $a = 24$ m/s^2
(4) M moves with $a = 6.0$ m/s^2
(5) None of these.

7. The tetherball is spinning around the pole. The mass of the ball is 1.5 kg, the length of the rope is 3.0 m, and $\theta = 40°$. What constant speed is needed to maintain θ?

(1) 4.0 m/s
(2) 5.0 m/s
(3) 4.3 m/s
(4) 5.4 m/s
(5) None of these.

8. The tetherball is spinning around the pole. The mass of the ball is 1.5 kg, the length of the rope is 4.0 m, and $\theta = 40°$. What constant speed is needed to maintain θ?
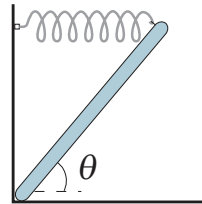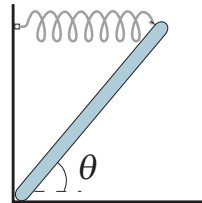
(1) 4.6 m/s
(2) 5.7 m/s
(3) 5.0 m/s
(4) 6.3 m/s
(5) None of these.

9. A projectile is shot from the ground towards a very tall vertical wall. The initial velocity of the projectile is 30 m/s at 55° above the horizontal. The wall is 60 m away and the ground is level. Does the projectile reach the wall? If it does, how high above the ground will it hit the wall?

(1) 26 m   (2) 30 m   (3) 60 m   (4) 45 m   (5) It does not hit the wall.

10. A projectile is shot from the ground towards a very tall vertical wall. The initial velocity of the projectile is 40 m/s at 55° above the horizontal. The wall is 60 m away and the ground is level. Does the projectile reach the wall? If it does, how high above the ground will it hit the wall?

(1) 52 m   (2) 36 m   (3) 11 m   (4) 29 m   (5) It does not hit the wall.

11. A ball is thrown at 12 m/s from a 15-m tall tower. What is the speed of the ball just before it hits the ground if (a) air resistance is ignored and if (b) air resistance removes 1/4 of the total mechanical energy?

    (1) (a) 21 m/s (b) 18 m/s
    (2) (a) 21 m/s (b) 16 m/s
    (3) (a) 17 m/s (b) 15 m/s
    (4) (a) 29 m/s (b) 22 m/s
    (5) None of these.

12. A ball is thrown at 11 m/s from a 14-m tall tower. What is the speed of the ball just before it hits the ground if (a) air resistance is ignored and if (b) air resistance removes 1/4 of the total mechanical energy?

    (1) (a) 20 m/s (b) 17 m/s
    (2) (a) 20 m/s (b) 15 m/s
    (3) (a) 16 m/s (b) 14 m/s
    (4) (a) 28 m/s (b) 21 m/s
    (5) None of these.

13. A 35-kg cart is traveling to the right at 5.0 m/s and it collides with a 42-kg cart traveling to the left at 7.0 m/s. After the head on collision, the 42-kg cart rebounds to the right at 2.0 m/s. What is the velocity of the 35-kg cart?

    (1) 5.8 m/s left   (2) 11 m/s right   (3) 1.0 m/s left   (4) 2.5 m/s left   (5) None of these.

14. A 36-kg cart is traveling to the right at 5.0 m/s and it collides with a 24-kg cart traveling to the left at 7.0 m/s. After the head on collision, the 24-kg cart rebounds to the right at 2.0 m/s. What is the velocity of the 35-kg cart?

    (1) 1.0 m/s left   (2) 8.3 m/s right   (3) 0.50 m/s left   (4) 8.5 m/s left   (5) None of these.

15. A modern sculpture has a large horizontal spring, with a spring constant of 275 N/m, that is attached to a 53.0-kg piece of uniform metal at its end and holds the metal at an angle of $\theta = 50.0°$ above the horizontal direction. The other end of the metal is wedged into a corner as shown. By how much has the spring stretched?

    (1) 0.79 m   (2) 1.6 m   (3) 1.1 m   (4) 2.3 m   (5) None of these.

16. A modern sculpture has a large horizontal spring, with a spring constant of 275 N/m, that is attached to a 61.0-kg piece of uniform metal at its end and holds the metal at an angle of $\theta = 52.0°$ above the horizontal direction. The other end of the metal is wedged into a corner as shown. By how much has the spring stretched?

    (1) 0.85 m   (2) 1.7 m   (3) 1.4 m   (4) 2.8 m   (5) None of these.

17. A solid sphere $(I = 2MR^2/5)$ rolls without slipping down a plane inclined at 29° relative to horizontal. What type of friction acts and what is the coefficient of friction? The answers are rounded to two significant digits.

    (1) static, ≥ 0.16 (2) kinetic, 0.16   (3) static, ≥ 0.14 (4) kinetic, 0.14   (5) None of these.

18. A solid sphere ($I = 2MR^2/5$) rolls without slipping down a plane inclined at $35°$ relative to horizontal. What type of friction acts and what is the coefficient of friction? The answers are rounded to two significant digits.

(1) static, ≥ 0.20 (2) kinetic, 0.20   (3) static, ≥ 0.16 (4) kinetic, 0.16   (5) None of these.

19. Eager to impress Marge, Homer decides to take up figure skating. He begins his spin with his leg and arms extended. Pulling his leg and arms in, his rotational inertia is reduced by $1/3$. By what factor is his angular velocity changed?
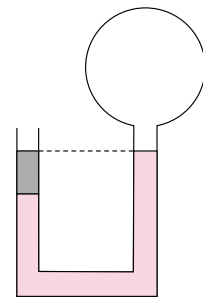
(1) 1.5   (2) 3.0   (3) 0.33   (4) 0.67   (5) None of these.

20. Eager to impress Marge, Homer decides to take up figure skating. He begins his spin with his leg and arms extended. Pulling his leg and arms in, his rotational inertia is reduced by $1/4$. By what factor is his angular velocity changed?

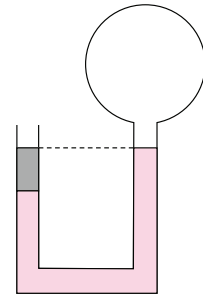(1) 1.33   (2) 4.0   (3) 0.25   (4) 0.50   (5) None of these.

21. The left side of the manometer is open to the atmosphere (1.01×10^5 Pa) and the right side contains a gas with a gauge pressure of -50 Pa. The left side has a fluid with density 950 kg/m^3. The remainder of the manometer has water (1000 kg/m^3). The top fluid level is the same on both sides. What is the height of the column of low density fluid?

(1) 10 cm
(2) 5.0 cm
(3) 15 cm
(4) 20 cm
(5) None of these.

22. The left side of the manometer is open to the atmosphere (1.01×10^5 Pa) and the right side contains a gas with a gauge pressure of -50 Pa. The left side has a fluid with density 898 kg/m^3. The remainder of the manometer has water (1000 kg/m^3). The top fluid level is the same on both sides. What is the height of the column of low density fluid?

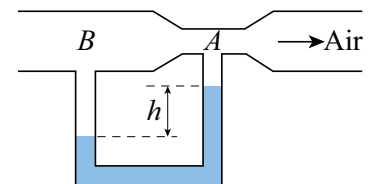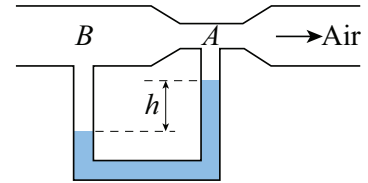(1) 5.0 cm
(2) 10 cm
(3) 15 cm
(4) 20 cm
(5) None of these.

23. Suppose air, with a density of 1.29 kg/m^3 is flowing into a Venturi meter. The narrow section of the pipe at point A has a diameter that is $1/3$ of the diameter of the larger section of the pipe at point B. The U-shaped tube is filled with water (density 1000 kg/m^3) and the difference in height between the two sections of pipe is 1.75 cm. In which section of the pipe is the air moving fastest?

(1) A   (2) B   (3) midway between A and B   (4) the speed is the same everywhere   (5) None of these.

24. Suppose air, with a density of 1.29 kg/m^3 is flowing into a Venturi meter. The narrow section of the pipe at point A has a diameter that is 1/3 of the diameter of the larger section of the pipe at point B. The U-shaped tube is filled with water (density 1000 kg/m^3) and the difference in height between the two sections of pipe is 1.75 cm. In which section of the pipe is the air moving slowest?

    (1) B   (2) A   (3) midway between B and A   (4) the speed is the same everywhere   (5) None of these.

25. The position of a simple harmonic oscillator is given as $x = A \cos \omega t$, where $A = 12$ cm and the period of the oscillator is 1.3 seconds. What is maximum acceleration of the oscillator?

    (1) 280 cm/s^2 (2) 58 cm/s^2 (3) 16 cm/s^2 (4) 110 cm/s^2 (5) None of these.

26. The position of a simple harmonic oscillator is given as $x = A \cos \omega t$, where $A = 11$ cm and the period of the oscillator is 1.2 seconds. What is maximum acceleration of the oscillator?

    (1) 300 cm/s^2 (2) 58 cm/s^2 (3) 13 cm/s^2 (4) 150 cm/s^2 (5) None of these.

27. A wave travels in a 14-m long string at 38 m/s. If the tension in the string is 40 N, what is the mass of the string?

    (1) 0.39 kg   (2) 0.028 kg   (3) 1.1 kg   (4) 0.67 kg   (5) None of these.

28. A wave travels in a 19-m long string at 51 m/s. If the tension in the string is 40 N, what is the mass of the string?

    (1) 0.29 kg   (2) 0.015 kg   (3) 0.78 kg   (4) 0.50 kg   (5) None of these.

29. Two tuning forks A and B, excite the next-to-lowest resonant frequencies in two air columns of the same length, but A's column is closed at one end and B's column is open at both ends. What is the ratio of A's frequency to B's frequency.

    (1) 3/4   (2) 4/3   (3) 1/2   (4) 2/1   (5) None of these.

30. Two tuning forks A and B, excite the next-to-lowest resonant frequencies in two air columns of the same length, but A's column is closed at one end and B's column is open at both ends. What is the ratio of B's frequency to A's frequency.

    (1) 4/3   (2) 3/4   (3) 1/2   (4) 2/1   (5) None of these.

FOLLOWING GROUPS OF QUESTIONS WILL BE SELECTED AS ONE GROUP FROM EACH TYPE
TYPE 1
Q# S 1
Q# S 2
TYPE 2
Q# S 3
Q# S 4
TYPE 3
Q# S 5
Q# S 6
TYPE 4
Q# S 7
Q# S 8
TYPE 5
Q# S 9
Q# S 10
TYPE 6
Q# S 11

Q# S 12
TYPE 7
Q# S 13
Q# S 14
TYPE 8
Q# S 15
Q# S 16
TYPE 9
Q# S 17
Q# S 18
TYPE 10
Q# S 19
Q# S 20
TYPE 11
Q# S 21
Q# S 22
TYPE 12
Q# S 23
Q# S 24
TYPE 13
Q# S 25
Q# S 26
TYPE 14
Q# S 27
Q# S 28
TYPE 15
Q# S 29
Q# S 30