Instructor(s): *C. Parks*

PHYSICS DEPARTMENT

PHY2053, Summer 2014 EXAM 3 August 1, 2014

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

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

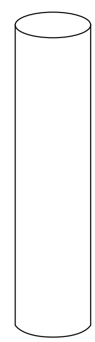
YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.

(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.

Given Information:

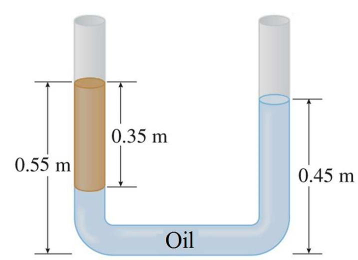
$g = 9.80$ m/s^2	1 foot = 12 inches	1 m = 100 cm	1 inch = 2.54×10^{-2} m
density of water = 1000 kg/m^3		density of oil = 800 kg/m^3	
density of steel = 7860 kg/m^3		1 atmosphere = 1.01×10^5 Pa	
speed of sound in air = 340 m/s		area of a circle = πr^2	

1. A 0.3-m diameter tube is 15 m long and oriented vertically as shown. The bottom of the tube is sealed and the pipe is filled with water. After filling the tube, a piston is placed at the top of the pipe to plug the pipe. Next, 100 kg is placed on the piston. While the piston fits the pipe snuggly, there is no friction between the piston and the pipe. What is the pressure at the bottom of the pipe after the 100 kg was added. (Hint: Don't forget the Earth's atmosphere.)



(1) 2.6×10^5 Pa
(2) 1.6×10^5 Pa
(3) 1.4×10^4 Pa
(4) 1.01×10^5 Pa
(5) None of these.

2. Given the dimensions in the diagram. Both ends of the manometer are open to the atmosphere. What is the density of the fluid in the left arm, if the other fluid is oil?



(1) 570 kg/m^3 Pa
(2) 710 kg/m^3 Pa
(3) 1300 kg/m^3 Pa
(4) 650 kg/m^3 Pa
(5) None of these.

3. What is the apparent weight of 125 cm^3 of steel submerged in water?

(1) 8.4 N (2) 9.6 N (3) 1.2 N (4) 0.86 N (5) None of these.

4. Water flows in a horizontal pipe with changing cross-sectional area. In the left side, water flows with at 3.9 m/s and its pressure is 13,500 Pa. In the right side, the pressure is 17,700 Pa. What is the ratio of the cross-sectional area of the left side to the area of the right side?

(1) $A_L/A_R = 0.67$ (2) $A_L/A_R = 0.33$ (3) $A_L/A_R = 0.50$ (4) $A_L/A_R = 0.60$ (5) None of these.

5. A viscous fluid flows through a pipe of length L and cross-sectional area A. What happens to the volume flow rate if the same fluid flows in a pipe of length $2L$ and area $2A$. The pressure difference across the two pipes remains the same.

   (1) The volume flow rate increases 2 times.
   (2) The volume flow rate increases 4 times.
   (3) The volume flow rate increases 8 times.
   (4) The volume flow rate remains the same.
   (5) None of these.

6. A steel wire (Young's modulus $= 2.0 \times 10^{11}$ Pa) of diameter 0.15 cm and length 3.5 m supports a 150-kg mass. What is Young's modulus if the mass is changed to 250 kg?

   (1) 2.0×10^{11} Pa (2) 4.0×10^{11} Pa (3) 1.0×10^{11} Pa (4) 8.0×10^{11} Pa (5) None of these.

7. An iron block is compressed by a pressure of 1.8×10^{8} Pa. What is the fractional change in the volume of the iron block? The bulk modulus for iron is 90×10^{9} Pa.

   (1) -0.2% (2) -0.1% (3) -0.3% (4) -0.4% (5) None of these.

8. A 0.051-kg mass attached to a spring oscillates vertically at 2.49 Hz. How far did the spring stretch when the mass was first attached?

   (1) 0.040 m (2) 1.6 m (3) 0.63 m (4) 0.13 m (5) None of these.

9. A simple pendulum has a 2.25 m long string. How much should be cut from the pendulum's string to reduce its period by 2.01 seconds?

   (1) 2.0 m (2) 0.25 m (3) 1.5 m (4) 0.5 m (5) None of these.

10. A 0.25-kg mass is oscillating from a spring ($k = 100$ N/m). When you see the mass displaced 0.345 m from equilibrium, its velocity is 4.05 m/s. The mass continues to oscillate. Because of viscous damping, it loses energy. After half of the energy is lost, what is the amplitude of the vibration?

    (1) 0.28 m (2) 0.40 m (3) 0.20 m (4) 0.36 m (5) None of these.

11. The velocity of a mass can be described by $v = v_m \cos(\omega t + \phi)$, where $v_m = 4$ m/s, $\omega = 6$ rad/s, and $\phi = 1.0$ rad. What is the mass' acceleration at $t = 3$ s?

    (1) -3.6 m/s^2 (2) -7.8 m/s^2 (3) -23 m/s^2 (4) -24 m/s^2 (5) None of these.

12. A jet engine emits sound energy at 30,000 J/s. How much energy enters the ear of a baggage handler 40 m from the engine. Assume that the effective area of the ears is 3.0 cm^2.

    (1) 4.5×10^{-4} J/s (2) 9.0 J/s (3) 1.8×10^{-3} J/s (4) 4.5 J/s (5) None of these.

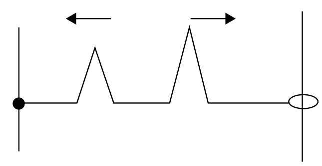
13. When the tension in a cord is 75 N, the wave speed is 140 m/s. If the cord is 5 m long, what is its mass?

    (1) 0.019 kg (2) 0.10 kg (3) 52 kg (4) 0.053 kg (5) None of these.

14. The equation of a wave is $y = A\cos((120 \text{ rad/s})t + (2.0 \text{ rad/m})x - 2.0 \text{ rad})$. What is the velocity of the wave?

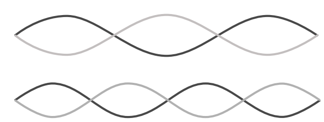
(1) 60 m/s in $-x$ direction
(2) 240 m/s in $-x$ direction
(3) 60 m/s in $+x$ direction
(4) 240 m/s in $-x$ direction
(5) None of these.

15. Two pulses are traveling down a rope as shown. The rope is tied at the left end making it a fixed point and looped around a rod at its right end making it a free point. The amplitude of the left pulse is 3 cm and the amplitude of the right pulse is 4 cm. After the pulses reach the ends of the rope, they reflect back and the two pulses overlap in the middle. What is the amplitude of the overlapping pulses?



(1) 1 cm (2) 7 cm (3) 5 cm (4) 4 cm (5) None of these.

16. What is the ratio of the frequency of the 4 antinode pattern to the frequency of the 3 antinode pattern? Both strings have the same length.



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

17. A decrease of 3 dB means

(1) the sound intensity changes by a factor of 1/2.
(2) the sound intensity changes by a factor of 1/10.
(3) the sound intensity changes by a factor of 1/3.
(4) the sound intensity changes by a factor of 1/6.
(5) None of these.

18. A signal of 440 Hz is needed. How long should a pipe open at both ends be to make the 440 Hz signal? What is the length of a pipe closed at one end and open at the other?

(1) 0.39 m, 0.19 m (2) 0.19 m, 0.39 m (3) 0.77 m, 0.39 m (4) 0.39 m, 0.77 m (5) None of these.

19. When tuning a piano, a beat frequency of 10 Hz is heard. The beats cease after loosening the string. If the tuning fork is marked as 440 Hz, what was the original (out of tune) frequency of the piano string?

(1) 450 Hz (2) 430 Hz (3) 460 Hz (4) 445 Hz (5) None of these.

20. When a jet plane approaches you hear the engine whine at 1200 Hz. When the jet moves away from you, the frequency is 400 Hz. What is the speed of the jet?

(1) 170 m/s (2) 110 m/s (3) 230 m/s (4) 200 m/s (5) None of these.