Exam

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) The three common phases of matter are 1) _____
A) condensate, plasma, and gas. B) solid, liquid, and vapor.
C) solid, liquid, and gas. D) solid, plasma, and gas.
Answer: C

2) Density is 2) _____
A) inversely proportional to both mass and volume.
B) proportional to both mass and volume.
C) proportional to mass and inversely proportional to volume.
D) inversely proportional to mass and proportional to volume.
Answer: C

3) Substance A has a density of 3.0 g/cm^3 and substance B has a density of 4.0 g/cm^3. In order to obtain equal masses of these two substances, the ratio of the volume of A to the volume of B will be equal to 3) _____
A) 1:4. B) 3:4. C) 4:3. D) 1:3.
Answer: C

4) Pressure is 4) _____
A) proportional to both force and area.
B) inversely proportional to both force and area.
C) inversely proportional to force and proportional to area.
D) proportional to force and inversely proportional to area.
Answer: D

5) Which of the following is not a unit of pressure? 5) _____
A) N/m B) Pascal C) atmosphere D) mm of mercury
Answer: A

6) Consider three drinking glasses. All three have the same area base, and all three are filled to the same depth with water. Glass A is cylindrical. Glass B is wider at the top than at the bottom, and so holds more water than A. Glass C is narrower at the top than at the bottom, and so holds less water than A. Which glass has the greatest liquid pressure at the bottom? 6) _____
A) Glass A B) Glass B
C) Glass C D) All three have equal pressure.
Answer: D

7) What is the difference between the pressures inside and outside a tire called? 7) _____
A) gauge pressure B) N/m^2
C) atmospheric pressure D) absolute pressure
Answer: A

8) When atmospheric pressure changes, what happens to the absolute pressure at the bottom of a pool? 8) _____

A) It increases by a lesser amount.
B) It increases by the same amount.
C) It increases by a greater amount.
D) It does not change.

Answer: B

9) You are originally 1.0 m beneath the surface of a pool. If you dive to 2.0 m beneath the surface, what happens to the absolute pressure on you? 9) _____

A) It quadruples.
B) It less than doubles.
C) It doubles.
D) It more than doubles.

Answer: B

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

10) State Pascal's principle.

Answer: If an external pressure is applied to a confined fluid, the pressure at every point within the fluid increases by that amount.

11) State Archimedes' principle.

Answer: The buoyant force on an object immersed in a fluid is equal to the weight of the fluid displaced by that object.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

12) 50 cm^3 of wood is floating on water, and 50 cm^3 of iron is totally submerged. Which has the greater buoyant force on it? 12) _____

A) the wood
B) the iron
C) Both have the same buoyant force.
D) cannot be determined without knowing their densities

Answer: B

13) As a rock sinks deeper and deeper into water of constant density, what happens to the buoyant force on it? 13) _____

A) It remains constant.
B) It may increase or decrease, depending on the shape of the rock.
C) It decreases.
D) It increases.

Answer: A

14) Salt water has greater density than fresh water. A boat floats in both fresh water and in salt water. Where is the buoyant force greater on the boat? 14) _____

A) fresh water
B) salt water
C) Buoyant force is the same in both.
D) impossible to determine from the information given

Answer: C

15) Salt water is more dense than fresh water. A ship floats in both fresh water and salt water. Compared to the fresh water, the volume of water displaced in the salt water is 15) _____
A) the same.
B) more.
C) less.
D) cannot be determined from the information given

Answer: C

16) A steel ball sinks in water but floats in a pool of mercury. Where is the buoyant force on the ball greater? 16) _____
A) submerged in the water
B) floating on the mercury
C) It is the same in both cases.
D) cannot be determined from the information given

Answer: B

17) A 10-kg piece of aluminum sits at the bottom of a lake, right next to a 10-kg piece of lead. Which has the greater buoyant force on it? 17) _____
A) the lead
B) the aluminum
C) Both have the same buoyant force.
D) cannot be determined without knowing their volumes

Answer: B

18) A piece of iron rests on top of a piece of wood floating in a bathtub. If the iron is removed from the wood, what happens to the water level in the tub? 18) _____
A) It goes up.
B) It does not change.
C) It goes down.
D) impossible to determine from the information given

Answer: C

19) A piece of wood is floating in a bathtub. A second piece of wood sits on top of the first piece, and does not touch the water. If the top piece is taken off and placed in the water, what happens to the water level in the tub? 19) _____
A) It goes down.
B) It does not change.
C) It goes up.
D) cannot be determined from the information given

Answer: B

20) Water flows through a pipe. The diameter of the pipe at point B is larger than at point A. Where is the speed of the water greater? 20) _____
A) point A
B) point B
C) same at both A and B
D) cannot be determined from the information given

Answer: A

21) An ideal fluid flows at 12 m/s in a horizontal pipe. If the pipe widens to twice its original radius, what is the flow speed in the wider section? 21) _____

A) 4.0 m/s B) 6.0 m/s C) 12 m/s D) 3.0 m/s

Answer: D

22) An ideal fluid flows at 12 m/s in a horizontal pipe. If the pipe narrows to half its original radius, what is the flow speed in the narrower section? 22) _____

A) 48 m/s B) 12 m/s C) 36 m/s D) 24 m/s

Answer: A

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

23) State Bernoulli's principle.

Answer: Where the velocity of fluid is high, the pressure is low; and where the velocity is low, the pressure is high.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

24) Which one of the following is associated with the law of conservation of energy in fluids? 24) _____

A) Archimedes' principle B) Bernoulli's principle
C) equation of continuity D) Pascal's principle

Answer: B

25) As the speed of a moving fluid increases, the pressure in the fluid 25) _____

A) decreases.
B) remains constant.
C) may increase or decrease, depending on the viscosity.
D) increases.

Answer: A

26) Water flows through a pipe. The diameter of the pipe at point B is larger than at point A. Where is the water pressure greatest? 26) _____

A) point A
B) point B
C) same at both A and B
D) cannot be determined from the information given

Answer: B

27) When you blow some air above a paper strip, the paper rises. This is because 27) _____

A) the air above the paper moves faster and the pressure is lower.
B) the air above the paper moves faster and the pressure is higher.
C) the air above the paper moves slower and the pressure is higher.
D) the air above the paper moves slower and the pressure is lower.

Answer: A

28) A sky diver falls through the air at terminal velocity. The force of air resistance on him is 28) _____

A) equal to his weight.
B) half his weight.
C) twice his weight.
D) cannot be determined from the information given

Answer: A

29) Two Styrofoam balls, of radii R and 2R, are released simultaneously from a tall tower. Which will reach the ground first? 29) _____

A) Both will reach the ground simultaneously.
B) the smaller one
C) the larger one
D) The result will depend on the atmospheric pressure.

Answer: C

30) When a small spherical rock of radius r falls through water, it experiences a drag force arv, where "v" is its velocity and "a" is a constant proportional to the viscosity of water. From this, one can deduce that if a rock of diameter 2.0 mm falls with terminal velocity, "v", then a rock of diameter 4.0 mm will fall with terminal velocity _____. 30) _____

A) 1.4v B) 4.0v C) v D) 2.0v

Answer: B

31) Which has the greatest effect on the flow of fluid through a narrow pipe? That is, if you made a 10% change in each of the quantities below, which would cause the greatest change in the flow rate? 31) _____

A) the fluid viscosity B) the length of the pipe
C) the pressure difference D) the radius of the pipe

Answer: D

32) Two horizontal pipes are the same length, but pipe B has twice the diameter of pipe A. Water undergoes viscous flow in both pipes, subject to the same pressure difference across the lengths of the pipes. If the flow rate in pipe A is Q, what is the flow rate in pipe B? 32) _____

A) 16Q B) 4Q C) 2Q D) 8Q

Answer: A

33) Two horizontal pipes have the same diameter, but pipe B is twice as long as pipe A. Water undergoes viscous flow in both pipes, subject to the same pressure difference across the lengths of the pipes. If the flow rate in pipe B is Q, what is the flow rate in pipe A? 33) _____

A) 2Q B) 8Q C) 4Q D) Q

Answer: A

34) When soup gets cold, it often tastes greasy. This "greasy" taste seems to be associated with oil spreading out all over the surface of the soup, instead of staying in little globules. To us "physikers", this is readily explained in terms of 34) _____

A) the Bernoulli effect.
B) the increase in the surface tension of water with increasing temperature.
C) the decrease in the surface tension of water with increasing temperature.
D) Archimedes Principle.

Answer: B

35) When a tube of diameter d is placed in water, the water rises to a height h. If the diameter were half as great, how high would the water rise? 35) _____

A) 4h B) h/2 C) h D) 2h

Answer: D

36) Certain insects, such as the water bug, are sufficiently lightweight that they can run on top of water without breaking the surface tension. Water bug A has weight W. Water bug B is twice as big as bug A, in all dimensions. That is, bug B is twice as long, twice as wide, etc. What is the weight of bug B? 36) _____

A) 1.3W B) 8.0W C) 2.0W D) 4.0W

Answer: B

37) Certain insects, such as the water bug, are sufficiently lightweight that they can run on top of water without breaking the surface tension. This is possible because the water, due to surface tension, exerts an upward force on the bottom of the bug's feet. Suppose that the maximum possible upward force on the feet of water bug A is F. Now suppose that water bug B is twice as big as bug A in every dimension. That is, bug B is twice as long, twice as wide, etc. What is the maximum upward force on the feet of bug B? 37) _____

A) 4.0F B) 8.0F C) 2.0F D) 1.4F

Answer: A

38) A plastic block of dimensions 2.00 cm × 3.00 cm × 4.00 cm has a mass of 30.0 g. What is its density? 38) _____

A) 1.60 g/cm^3 B) 0.80 g/cm^3 C) 1.25 g/cm^3 D) 1.20 g/cm^3

Answer: C

39) A liquid has a specific gravity of 0.357. What is its density? 39) _____

A) 357 kg/m^3 B) 1000 kg/m^3 C) 643 kg/m^3 D) 3570 kg/m^3

Answer: A

40) A brick weighs 50.0 N, and measures 30.0 cm × 10.0 cm × 4.00 cm. What is the maximum pressure it can exert on a horizontal surface? 40) _____

A) 12.5 Pa B) 12.5 kPa C) 1.25 kPa D) 1.25 Pa

Answer: B

41) A person weighing 900 N is standing on snowshoes. Each snowshoe has area 2500 cm^2. What is the pressure on the snow? 41) _____

A) 1800 N/m^2 B) 3600 N/m^2 C) 0.18 N/m^2 D) 0.36 N/m^2

Answer: A

42) How much pressure (absolute) must a submarine withstand at a depth of 120.0 m in the ocean? 42) _____

A) 1310 N/m^2 B) 1200 N/m^2 C) 1310 kPa D) 1200 kPa

Answer: C

43) A circular window of 30 cm diameter in a submarine can withstand a maximum force of 5.20 × 10^5 N. What is the maximum depth in a lake to which the submarine can go without damaging the window? 43) _____

A) 750 m B) 680 m C) 1200 m D) 1327 m

Answer: A

44) What is the gauge pressure if the absolute pressure is 300 kPa? 44) _____

A) 300 kPa B) 97 kPa C) 199 kPa D) 101 kPa

Answer: C

45) What is the gauge pressure at a location 15.0 m below the surface of sea? (The density of seawater is 1.03×10^3 kg/m^3.) 45) _____

A) 1.47×10^5 N/m^2 B) 1.51×10^5 N/m^2
C) 2.52×10^5 N/m^2 D) 1.01×10^5 N/m^2

Answer: B

46) What is the absolute pressure at a location 15.0 m below the surface of sea? (The density of seawater is 1.03×10^3 kg/m^3.) 46) _____

A) 2.48×10^5 N/m^2 B) 2.52×10^5 N/m^2
C) 1.51×10^5 N/m^2 D) 1.01×10^5 N/m^2

Answer: B

47) A 500-N weight sits on the small piston of a hydraulic machine. The small piston has area 2.0 cm^2. If the large piston has area 40 cm^2, how much weight can the large piston support? 47) _____

A) 10000 N B) 40000 N C) 25 N D) 500 N

Answer: A

48) In a hydraulic garage lift, the small piston has a radius of 5.0 cm and the large piston has a radius of 15 cm. What force must be applied on the small piston in order to lift a car weighing 20,000 N on the large piston? 48) _____

A) 2.2×10^3 N B) 2.9×10^3 N C) 6.7×10^3 N D) 5.0×10^3 N

Answer: A

49) A 13,000 N vehicle is to be lifted by a 25 cm diameter hydraulic piston. What force needs to be applied to a 5.0 cm diameter piston to accomplish this? 49) _____

A) 260 N B) 2600 N C) 520 N D) 5200 N

Answer: C

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

50) The small piston of a hydraulic lift has a diameter of 8.0 cm, and its large piston has a diameter of 40 cm. The lift raises a load of 15,000 N.
(a) Determine the force that must be applied to the small piston.
(b) Determine the pressure applied to the fluid in the lift.

Answer: (a) 600 N
(b) 1.2×10^5 Pa

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

51) A block of metal weighs 40 N in air and 30 N in water. What is the buoyant force of the water? 51) _____

A) 70 N B) 10 N C) 40 N D) 30 N

Answer: B

52) An object has a volume of 4.0 m^3 and weighs 40,000 N. What will its weight be in water? 52) _____

A) 9,800 N B) 40,000 N C) 800 N D) 39,200 N

Answer: C

53) A 4.00-kg cylinder of solid iron is supported by a string while submerged in water. What is the tension in the string? (The specific gravity of iron is 7.86.) 53) _____

A) 19.6 N B) 34.2 N C) 23.7 N D) 2.50 N

Answer: B

54) If the density of gold is 19.3×10^3 kg/m^3, what buoyant force does a 0.60-kg gold crown experience when it is immersed in water? 54) _____

A) 3.0×10^{-5} N B) 3.0×10^{-4} N C) 0.30 N D) 3.0×10^{-2} N

Answer: C

55) A crane lifts a steel submarine (density = 7.8×10^3 kg/m^3) of mass 20,000 kg. What is the tension in the lifting cable (1) when the submarine is submerged, and (2) when it is entirely out of the water? 55) _____

A) (1) 1.7×10^5 N (2) 2.0×10^5 N B) (1) 2.0×10^5 N (2) 2.6×10^3 N

C) (1) 2.0×10^5 N (2) 1.7×10^5 N D) (1) 2.6×10^3 N (2) 2.0×10^5 N

Answer: A

56) An object weighs 7.84 N when it is in air and 6.86 N when it is immersed in water. What is the specific gravity of the object? 56) _____

A) 6.0 B) 9.0 C) 8.0 D) 7.0

Answer: C

57) A container of water is placed on a scale, and the scale reads 120 g. Now a 20-g piece of copper (specific gravity = 8.9) is suspended from a thread and lowered into the water, not touching the bottom of the container. What will the scale now read? 57) _____

A) 120 g B) 140 g C) 138 g D) 122 g

Answer: D

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

58) A piece of aluminum with a mass of 1.0 kg and density of 2700 kg/m^3 is suspended from a string and then completely immersed in a container of water. The density of water is 1000 kg/m^3.
(a) Determine the volume of the piece of aluminum.
(b) Determine the tension in the string after the metal is immersed in the container of water.

Answer: (a) 3.7×10^{-4} m^3
(b) 6.2 N

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

59) A cylindrical rod of length 12 cm and diameter 2.0 cm will just barely float in water. What is its mass? 59) _____

A) 150 g B) 38 g C) 75 g D) 300 g

Answer: B

60) A rectangular box of negligible mass measures 5.0 m long, 1.0 m wide, and 0.50 m high. How many kilograms of mass can be loaded onto the box before it sinks in a lake? 60) _____

A) 1.5×10^3 kg B) 0.5×10^3 kg C) 2.5×10^3 kg D) 3.5×10^3 kg

Answer: C

61) A 1.0-m^3 object floats in water with 20% of it above the waterline. What does the object weigh out of the water? 61) _____

A) 9,800 N B) 7,840 N C) 11,800 N D) 1,960 N

Answer: B

62) An object floats with half its volume beneath the surface of the water. The weight of the displaced water is 2000 N. What is the weight of the object? 62) _____

A) 4000 N
B) 2000 N
C) 1000 N
D) cannot be determined from the information given

Answer: B

63) A solid object floats in water with three-fourths of its volume beneath the surface. What is the object's density? 63) _____

A) 750 kg/m^3 B) 1000 kg/m^3 C) 250 kg/m^3 D) 1333 kg/m^3

Answer: A

64) A 200-N object floats with three-fourths of its volume beneath the surface of the water. What is the buoyant force on the object? 64) _____

A) 200 N B) 50 N C) 150 N D) 267 N

Answer: A

65) A polar bear of mass 200 kg stands on an ice floe 100 cm thick. What is the minimum area of the floe that will just support the bear in saltwater of specific gravity 1.03? The specific gravity of ice is 0.98. 65) _____

A) 4.0 m^2 B) 2.0 m^2 C) 3.0 m^2 D) 1.0 m^2

Answer: A

66) Liquid flows through a pipe of diameter 3.0 cm at 2.0 m/s. Find the flow rate. 66) _____

A) 1.4×10^{-3} m^3/s B) 57 m^3/s C) 14 m^3/s D) 5.7×10^{-3} m^3/s

Answer: A

67) Liquid flows through a 4.0 cm diameter pipe at 1.0 m/s. There is a 2.0 cm diameter restriction in the line. What is the velocity in this restriction? 67) _____

A) 4.0 m/s B) 2.0 m/s C) 0.50 m/s D) 0.25 m/s

Answer: A

68) Water flows at 12 m/s in a horizontal pipe with a pressure of 3.0×10^4 N/m^2. If the pipe widens to twice its original radius, what is the pressure in the wider section? 68) _____

A) 9.8×10^4 N/m^2 B) 3.0×10^4 N/m^2 C) 7.4×10^4 N/m^2 D) 4.9×10^4 N/m^2

Answer: A

69) How much pressure does it take for a pump to supply a drinking fountain with 300 kPa, if the fountain is 30.0 m above the pump? 69) _____

A) 594 kPa B) 294 kPa C) 300 kPa D) 675 kPa

Answer: A

70) A hole of radius 1.0 mm occurs in the bottom of a water storage tank that holds water at a depth of 15 m. At what rate will water flow out of the hole? 70) _____

A) 5.4×10^{-6} m^3/s B) 5.4×10^{-7} m^3/s C) 5.4×10^{-4} m^3/s D) 5.4×10^{-5} m^3/s

Answer: D

71) Water flows through a horizontal pipe of cross-sectional area 10.0 cm^2 at a pressure of 0.250 atm. The flow rate is 1.00×10^{-3} m^3/s. At a valve, the effective cross-sectional area of the pipe is reduced to 5.00 cm^2. What is the pressure at the valve? 71) _____

A) 0.112 atm B) 0.200 atm C) 0.235 atm D) 0.157 atm

Answer: C

72) SAE No. 10 oil has a viscosity of 0.20 Pa-s. How long would it take to pour 4.0 L of oil through a funnel with a neck 15 cm long and 2.0 cm in diameter? Assume the surface of the oil is kept 6 cm above the top of the neck, and neglect any drag effects due to the upper part of the funnel. 72) _____

A) 105 s B) 84 s C) 52 s D) 46 s

Answer: C

73) Suppose that the build-up of fatty tissue on the wall of an artery decreased the radius by 10%. By how much would the pressure provided by the heart have to be increased to maintain a constant blood flow? 73) _____

A) 52% B) 46% C) 48% D) 54%

Answer: A

74) Two narrow tubes are placed in a pan of water. Tube A has twice the diameter of tube B. If water rises 24 cm in tube A, how high will it rise in tube B? 74) _____

A) 24 cm B) 96 cm C) 48 cm D) 12 cm

Answer: C

75) The surface tension of water is 0.073 N/m. How high will water rise in a capillary tube of diameter 1.2 mm? 75) _____

A) 2.2 cm B) 1.2 cm C) 2.5 cm D) 1.5 cm

Answer: C

76) To what height would water at 0 degree Celsius rise in a glass capillary tube with a diameter of 0.50 mm? 76) _____

A) zero B) 9.3 cm C) 6.2 cm D) 3.1 cm

Answer: C

77) A narrow tube is placed vertically in a pan of water, and the water rises in the tube to 4.0 cm above the level of the pan. The surface tension in the liquid is lowered to one-half its original value by the addition of some soap. What happens to the height of the liquid column in the tube? 77) _____

A) It drops or rises, but the height cannot be calculated from the information given.
B) It drops to 1.0 cm.
C) It remains at the same height.
D) It drops to 2.0 cm.

Answer: D

78) Consider a rectangular frame of length 0.120 m and width 0.600 m with a soap film formed within its confined area. If the surface tension of soapy water is 0.0260 N/m, how much force does the soap film exert on the 0.600 m side? 78) _____

A) 1.56×10^{-3} N B) 6.24×10^{-3} N

C) 3.12×10^{-3} N D) none of the above

Answer: C

79) An adjustable rectangular frame has length 12 cm and width 5 cm, and is built in such a way that one of the longer sides can be moved without bursting the soap film contained in the frame. Soapy water has surface tension 0.026 N/m. How much work is required to move the adjustable long side so that the frame is 12 cm square? 79) _____

A) 2.2 J B) 4.4×10^{-4} J C) 2.2×10^{-4} J D) 4.4 J

Answer: B

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

80) Consider what happens when you push both a pin and the blunt end of a pen against your skin with the same force. Decide what determines whether your skin is cut—the net force applied to it or the pressure.

Answer: The sharp end of the pin (with a smaller area) will pierce the skin when pushed with a certain minimum force, while the same force applied in pushing the blunt end of the pen (with a larger area) into the skin does not pierce the skin. Thus it is pressure (force per unit area) that determines whether or not the skin is pierced.

81) An ice cube floats in a glass of water filled to the brim. What can you say about the density of ice? As the ice melts, will the glass overflow? Explain.

Answer: Since the ice floats, the density of ice must be less than that of the water. The mass of the ice displaces a water volume equal to its weight, whether it is solid or liquid. Thus as the ice melts, the level in the glass stays the same. The ice displaces its melted volume.

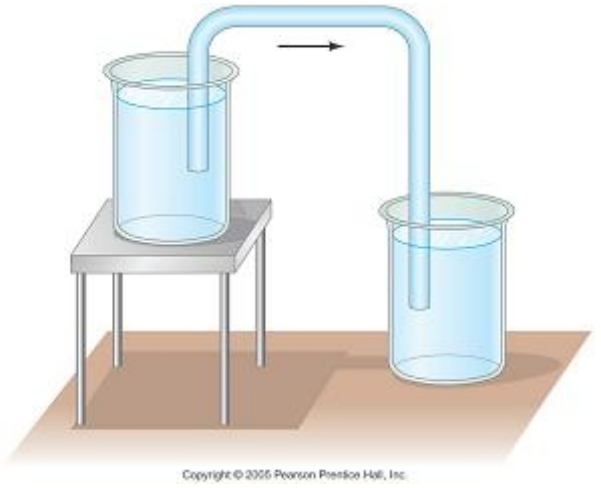

FIGURE 10-45

82) Explain how the tube in Fig. 10-45, known as a siphon, can transfer liquid from one container to a lower one even though the liquid must flow uphill for part of its journey. (Note that the tube must be filled with liquid to start with.)

Answer: The pressure at the surface of both containers of liquid is atmospheric pressure. The pressure in each tube would thus be atmospheric pressure at the level of the surface of the liquid in each container. The pressure in each tube will decrease with height by an amount . Since the portion of the tube going into the lower container is longer than the portion of the tube going into the higher container, the pressure at the highest point on the right side is lower than the pressure at the highest point on the left side. This pressure difference causes liquid to flow from the left side of the tube to the right side of the tube. And as noted in the question, the tube must be filled with liquid before this argument can be made.

83) A small wooden boat floats in a swimming pool, and the level of the water at the edge of the pool is marked. Consider the following situations and explain whether the level of the water will rise, fall, or stay the same. (a) The boat is removed from the water. (b) The boat in the water holds an iron anchor which is removed from the boat and placed on the shore. (c) The iron anchor is removed from the boat and dropped in the pool.

Answer: (a) The boat displaces enough water to equal the weight of the boat. If the boat is removed from the water the water will no longer be displaced and thus the water level will lower.
(b) While the anchor is in the boat, the water displaced has a weight equal to that of the boat and the anchor together. If the anchor is placed on the shore, then less water will need to be displaced, and the water level will lower.
(c) While the anchor is in the boat, the water displaced has a weight equal to that of the boat and the anchor together. If the anchor is dropped into the pool, the water displaced is equal to the weight of the boat (which will float) and the weight of a volume of water equal to the volume of the anchor (which will sink). Since the anchor is more dense than the water, it takes more water displacement to hold up the anchor (while in the boat) than is displaced when the anchor is in the water. Thus the water level will lower when the anchor is thrown overboard.

84) Why do you float higher in salt water than in fresh?

Answer: Salt water has a higher density than fresh water. Thus you have to displace less salt water to equal your weight than you do in fresh water. You then float "higher" in the salt water.

85) Why does the canvas top of a convertible bulge out when the car is traveling at high speed?

Answer: As the car drives through the air, the air inside the car is stationary with respect to the top, but the outside air is moving with respect to the top. There is no appreciable change in height between the two sides of the canvas top. By Bernoulli's principle, the outside air pressure near the canvas top will be less than the inside air pressure. That difference in pressure results in a force that makes the top bulge outward.

86) A tall Styrofoam cup is filled with water. Two holes are punched in the cup near the bottom, and water begins rushing out. If the cup is dropped so it falls freely, will the water continue to flow from the holes? Explain.

Answer: Water will not flow from the holes when the cup and water are in free fall. The acceleration due to gravity is the same for all falling objects (ignoring friction), and so the cup and water would fall together. For the water to flow out of the holes while falling would mean that the water would have an acceleration larger than the acceleration due to gravity. Another way to consider the situation is that there will no longer be a pressure difference between the top and bottom of the cup of water, since the lower water molecules don't need to hold up the upper water molecules.

87) A bottle has a mass of 35.00 g when empty and 98.44 g when filled with water. When filled with another fluid, the mass is 88.78 g. What is the specific gravity of this other fluid?

Answer: 0.8477

88) If 5.0 L of antifreeze solution (specific gravity = 0.80) is added to 4.0 L of water to make a 9.0 L mixture, what is the specific gravity of the mixture?

Answer: 0.89

89) The gauge pressure in each of the four tires of an automobile is 240 kPa. If each tire has a "footprint" of 220 cm^2, estimate the mass of the car.

Answer: 2.2×10^3 kg

90) The maximum gauge pressure in a hydraulic lift is 17.0 atm. What is the largest size vehicle (kg) it can lift if the diameter of the output line is 28.0 cm?

Answer: 1.08×10^4 kg

91) (a) What are the total force and the absolute pressure on the bottom of a swimming pool 22.0 m by 8.5 m whose uniform depth is 2.0 m? (b) What will be the pressure against the *side* of the pool near the bottom?

Answer: (a) 2.3×10^7 N, 1.21×10^5 N/m^2
(b) 1.21×10^5 N/m^2

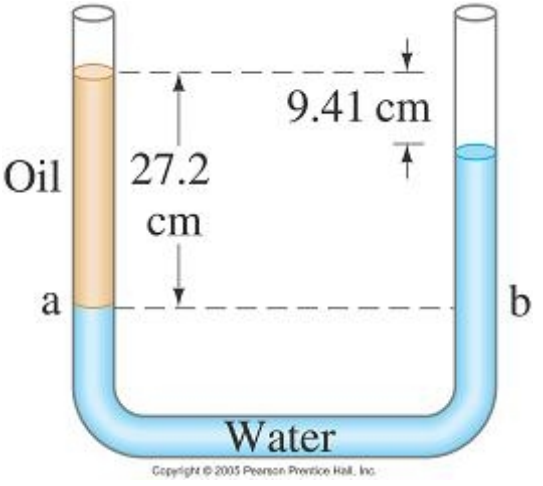

FIGURE 10-49

92) Water and then oil (which don't mix) are poured into a U-shaped tube, open at both ends. They come to equilibrium, as shown in Fig. 10-49. What is the density of the oil? [*Hint*: Pressures at points a and b are equal. Why?]

Answer: The pressure at points a and b are equal since they are the same height in the same fluid.
6.54×10^2 kg/m^3

93) A crane lifts the 18,000-kg steel hull of a ship out of the water. Determine (a) the tension in the crane's cable when the hull is submerged in the water, and (b) the tension when the hull is completely out of the water.

Answer: (a) 1.5×10^5 N
(b) 1.8×10^5 N

94) A spherical balloon has a radius of 7.35 m and is filled with helium. How large a cargo can it lift, assuming that the skin and structure of the balloon have a mass of 930 kg? Neglect the buoyant force on the cargo volume itself.

Answer: 920 kg

95) The specific gravity of ice is 0.917, whereas that of seawater is 1.025. What fraction of an iceberg is above the surface of the water?

Answer: 10.5%

96) A 5.25-kg piece of wood (SG =0.50) floats on water. What minimum mass of lead, hung from the wood by a string, will cause it to sink?

Answer: 5.76 kg

97) What gauge pressure in the water mains in necessary if a firehose is to spray water to a height of 15 m?

Answer: 1.5×10^5 N/m^2

98) A 6.0-cm diameter pipe gradually narrows to 4.0 cm. When water flows through this pipe at a certain rate, the gauge pressure in these two sections is 32.0 kPa and 24.0 kPa, respectively. What is the volume rate of flow?

Answer: 5.6×10^{-3} m^3/s

99) What is the lift (in newtons) due to Bernoulli's principle on a wing of area 78 m^2 if the air passes over the top and bottom surfaces at speeds of 260 m/s and 150 m/s, respectively?

Answer: 2.3×10^6 N

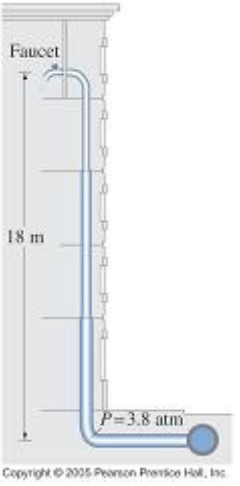

FIGURE 10-53

100) Water at a gauge pressure of 3.8 atm at street level flows into an office building at a speed of 0.60 m/s through a pipe 5.0 cm in diameter. The pipe tapers down to 2.6 cm in diameter by the top floor, 18 m above (Fig. 10-53), where the faucet has been left open. Calculate the flow velocity and the gauge pressure in such a pipe on the top floor. Assume no branch pipes and ignore viscosity.

Answer: 2.2 m/s, 2.0 atm

101) A *viscometer* consists of two concentric cylinders, 10.20 cm and 10.60 cm in diameter. A particular liquid fills the space between them to a depth of 12.0 cm. The outer cylinder is fixed, and a torque of 0.024 m·N keeps the inner cylinder turning at a steady rotational speed of 62 rev/min. What is the viscosity of the liquid?

Answer: 7.2×10^{-2} Pa·s

102) What must be the pressure difference between the two ends of a 1.9 km section of pipe, 29 cm in diameter, if it is to transport oil (ϱ = 950 kg/m^3, η = 0.20 Pa·s) at a rate of 450 cm^3/s?

Answer: 990 Pa

103) Assuming a constant pressure gradient, if blood flow is reduced by 75%, by what factor is a blood vessel decreased in radius?

Answer: 29%

104) If the base of an insect's leg has a radius of about 3.0×10^{-5} m and the insect's mass is 0.016 g, would you expect the six-legged insect to remain on top of the water? Why or why not?

Answer: The largest mass that can be supported by the surface tension of the water is 8.3×10^{-6} kg. Therefore, the insect will not remain on top of the water.