Quiz 3 Version B

1) A partially full soda bottle with interior diameter 5.2 cm is floating upright in water. A drinker takes a swig and puts the bottle back into the water thereafter. It now floats 20 mm higher than before. How much soda did the drinker drink?

   a) 30 gram
   b) 40 gram
   c) 50 gram
   d) 60 gram
   e) 70 gram

2) A 5.0 mol sample of an ideal diatomic gas (C_V = 5/2 R) is initially at 1.0 atm pressure and 300 K. What is the entropy change if the gas is heated to 500 K at (i) constant volume (ii) constant pressure (iii) adiabatically ?

   A) (i) 50 J/K   (ii) 70 J/K   (iii) zero
   B) (i) 70 J/K   (ii) 50 J/K   (iii) zero
   C) (i) zero   (ii) zero   (iii) zero
   D) (i) 100 J/K   (ii) 100 J/K   (iii) 100 J/K
   E) (i) 60 J/K   (ii) 90 J/K   (iii) zero

B) $-nR\ln2$

C) nR

D) depends on the temperature of the ideal gas

E) 2nR

3) A typical mass flow rate for the Mississippi River is 1.8×10^7 kg/s. What is the flow speed in a region where the river is 2.0 km wide and 6.1m deep?

A) 0.5 m/s   B) 1.5 m/s   C) 2.5 m/s   D) 3.5 m/s   E) 4.5 m/s

5) An engine with a mechanical power output of 17kW extracts heat from a source at 420K and rejects it to a 2000kg block of ice at it's melting point. How long can the engine operate at its efficiency? (Lf=334kJ/kg)

A) for ever   B) 1 day   C) 12 hours   D) 6 hours   E) 3 hours

6) A Carnot engine operates between a high temperature reservoir at 463K and a river with water at 285K. If it absorbs 3200J of heat each cycle, how much work per cycle does it do?

A) 1230 J   B) 1981 J   C) 1219 J   D) 1970 J

4) A 200.0-kg flat-bottomed boat floats in fresh water, which has a density of 1000.0 kg/m³. Assuming that the base of the boat is 1.42 m wide and 4.55 m long, how much of the boat is submerged when it carries three passengers whose total mass is 209 kg?

A) 9.73 cm   B) 8.16 cm   C) 7.29 cm   D) 8.75 cm

7) Two mols of an ideal gas undergo a reversible isothermal expansion from 0.0280 cubic meters to 0.0420 cubic meters at a temperature of 25 degree Celsius. What is the change of entrpy of the gas?

A) 0.6 J/K   B) 6 J/K   C) 60 J/K   D) 600 J/K   E) zero

5) Two kilogram of ice at zero degree Celsius is melted and converted to water at zero degree Celsius. Compute its change in entropy, assuming the melting is done reversibly. The heat of fusion of water is Lf=334 kJ/kg.

A) 0 kJ/K   B) 1 kJ/K   C) 2 kJ/K   D) 4 kJ/K   E) 8 kJ/K

6) On land, the most massive concrete block you can carry is 25 kg. How massive a block could you carry under water, if the density of concrete is 2300 kg/m³. (Density of water = 1000 kg/m³)

A) 10 kg   B) 30 kg   C) 50 kg   D) 70 kg   E) 90 kg

D) One of the two processes is not possible as it can't get you back to the starting point.
E) In both cases, the gas does the same amount of work.

7) A pump is submerged at the bottom of a 100 meter deep well. Does it take less power to pump water the 100m to the surface when the well is full or half empty?   10)

A) full   B) half empty

7) A sealed tank containing water (density 1g/cubic-cm) to a height of 11m also contains air   7)
above the water at a pressure of 3atm (1atm = 100,000Pa). Water flows out at the bottom
through a small hole. What's the speed of the water flowing out?

C) doesn't matter   D) depends on the diameter of the pump

A) 20m/s   B) 25m/s   C) 30m/s   D) 35m/s   E) 40m/s

8) An engine with a mechanical power output of 17kW extracts heat from a source at 420K and   8)
rejects it to a 2000kg block of ice at it's melting point. How long can the engine operate at its
efficiency? (Lf=334kJ/kg)

A) 1 day   B) 3 hours   C) for ever   D) 12 hours   E) 6 hours

8) Advertisement for a certain small car claim that it floats in water. The car's mass is 900kg and   9)
its interior volume is 3.0 cubic meters. Water gradually leaks in and displaces the air in the car.
What fraction of the interior volume is filled with water when the car sinks?

A) 30%   B) 50%   C) 70%   D) 90%   E) 10%

10) A wooden plank is placed over a pit that is 5.00m wide. A physics student stands in the middle   10)
of the plank and begins to jump up and down such that she jumps upward from the plank two
times a second. The plank oscillates with a large amplitude because its fundamental frequency
is excited. What is the speed of transverse waves on the plank?

A) 10m/s   B) 20m/s   C) 30m/s   D) 40m/s   E) 50m/s

11) You are some distance away from the source of a spherical wave. How much further do you   11)
have to walk away for the wave intensity to drop by 3 decibel?

A) 50% further

4) An ideal gas goes through a free expansion from a volume of 3 cubic meters to a volume of 9 cubic meters. What's the change in entropy?

A) nRln2

B) −nRln2

C) nR

D) depends on the temperature of the ideal gas

E) 2nR

(overlapping: C) 5.2cm   D) 3.8cm   E) never floats)

9) A garage lift has 45cm diameter piston supporting the load. Compressed air with a maximum pressure of 500kPa is applied to a small piston at the other end of the hydraulic system. What is the maximum mass the lift can support?

A) 100kg

B) 1000kg

C) 2000kg

D) 4000kg

E) more than any of the above

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Assume the gas has 3 degrees of freedom.