

Physics 2 – Summer Session 2009

Quiz # 5

Question 1

An ideal gas is kept at constant pressure. If its temperature is changed from 40° to 80°C , its volume will change by a factor of

- (a) 0.500
- (b) 2.000
- (c) 0.887
- (d) 1.13
- (e) not enough information

$PV=nRT \rightarrow V = (nR/P) T \rightarrow V_1/V_2 = T_1/T_2 = (273+40)/(273+80) = 0.8867$
 $\rightarrow V_2 = V_1 / 0.8867 = 1.128 V_1 \rightarrow$ **correct naswer is (d)**

Question 2

A 180 g piece of ice at 0°C is placed in 400 g of water at 20°C . The system is in a container of negligible heat capacity and is insulated from its surroundings. The final equilibrium temperature of the system will be (specific heat of water $c = 4190 \text{ J}/(\text{kg K})$; heat of fusion of water $L = 334,000 \text{ J}/\text{Kg}$)

- (a) 10°C
- (b) 13.8°C
- (c) 0°C
- (d) not enough information is given to solve this problem
- (e) none of the answers is correct

First let's see if the water could give out enough heat to melt the ice. If it cannot, then the system will settle as a mixture of water and ice at zero degrees.

To melt 180 g = 0.180 Kg of ice at 0°C , it takes $0.180 * 334,000 = \underline{260,520 \text{ J}}$

400 g = 0.4 Kg of water cooling from 20°C to 0°C give out $0.4 * 4190 * 20 = \underline{33,520 \text{ J}}$

Thus, even if all the water cooled down to zero degrees, it would not give out enough heat to melt all of the ice. So the final state is a mixture of water and ice at zero degrees.

\rightarrow **correct answer is (c)**

Question 3

A diatomic gas does 500 J of work and absorbs 900 J of heat. The change of its internal energy is

- (a) 400 J
- (b) 1400 J
- (c) -400 J
- (d) -1400 J

If it does 500 J of work, it looses 500 J of internal energy.

If it absorbs 900 J of heat, its internal energy increases by 900 J

$-500 \text{ J} + 900 \text{ J} = + 400 \text{ J} \rightarrow$ **correct answer is (a)**

Question 4

An ideal gas at one atmosphere of pressure and 400 K is confined to $\frac{1}{2}$ of an insulated container by a thin partition. The other half of the container is at vacuum. The partition is then removed and equilibrium is established. At that point, which of the following is correct?

- (a) $P = \frac{1}{2}$ atm and $T = 200$ K
- (b) $P = 1$ atm and $T = 200$ K
- (c) $P = 1$ atm and $T = 400$ K
- (d) $P = \frac{1}{2}$ atm and $T = 400$ K

The gas does no work and no heat is transferred, therefore its internal energy is unchanged, therefore its temperature is unchanged $\rightarrow T=400$ K
 $PV = nRT$. If T is unchanged, and V doubles, P must be halved $\rightarrow P = \frac{1}{2}$ at,
 \rightarrow **correct answer is (d)**

Question 5

A diatomic gas of molar mass M is confined to a closed container of volume V and pressure P . The amount of heat Q that should be transferred to the gas in order to quadruple the pressure is

- (a) $\frac{1}{2} PV$
- (b) $(15/2) PV$
- (c) $15 PV$
- (d) $4PV$
- (e) $10PV$

$$Q = n C_v \Delta T = (5/2) nR\Delta T$$

$$\text{Also: } PV=nRT_1 \text{ and } 4PV=nRT_2 \rightarrow nR(T_2-T_1) = nR\Delta T = 3PV$$

$$\rightarrow Q = (5/2) (3PV) = (15/2) PV \rightarrow \text{correct answer is (b)}$$

Question 6

The height of three students is measured to be 1.850 m, 1.700 m and 1.730 m. The rms value of the height is

- (a) 1.760 m
- (b) 1.761 m
- (c) 3.050 m
- (d) 1.017 m
- (e) none of the above

$$\langle h^2 \rangle = (1.850^2 + 1.700^2 + 1.730^2) / 3 = 3.1018 \text{ m}^2.$$

$$h_{\text{rms}} = \text{sqrt}(3.1018) \text{ m} = 1.761 \text{ m} \rightarrow \text{correct answer is (b)}$$

Question 7

A molecule of mass m travelling horizontally with velocity $+V$ hits a vertical wall and rebounds along the original path at the same speed. What is the change in momentum of the molecule

- (a) -2mV
- (b) -mV
- (c) zero
- (d) mV
- (e) 2mV

$$P(\text{initial}) = mV \quad P(\text{final}) = -mV$$

$$\Delta P = P(\text{final}) - P(\text{initial}) = -mV - mV = -2mV \rightarrow \text{correct answer is (a)}$$