King Fahd University of Petroleum and Minerals

Department of Physics

PHYS102-052

MAJOR 1 EXAM

Test Code: **018**

Sunday 26th March 2006

Exam Duration: 2hrs (from 6:00pm to 8:00pm)

Name:	
Student Number:	
Section Number:	

1. A pipe open at both ends has a fundamental frequency of 400 Hz. What will be the fundamental frequency if the pipe is closed at one end? (speed of sound is 340 m/s)
   A) 100 Hz.
   B) 200 Hz.
   C) 400 Hz.
   D) 800 Hz.
   E) 600 Hz.

2. One mole of an ideal gas is cooled at constant pressure process from 100 ^{o}C to 40 ^{o}C. Calculate the work done during the process.
   A) +300 J
   B) –300 J
   C) +500 J
   D) +600 J
   E) –500 J

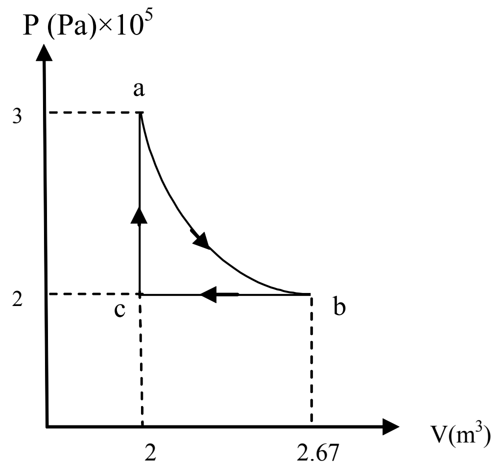
3. A 1000 W Carnot engine operates between two reservoirs at temperatures of 200 ^{o}C and 100 ^{o}C. Find the rate at which energy is TAKEN IN by the engine as heat.
   A) 1250 W
   B) 2320 W
   C) 7000 W
   D) 3740 W
   E) 4730 W

4. The sound level of a certain sound source is increased by 40 dB. By what factor is the displacement amplitude increased?
   A) 200
   B) 10,000
   C) 100
   D) 80
   E) 400

5. A 100 g of ice at -10 ^{o}C is placed in a lake whose temperature is 20 ^{o}C. Calculate the change in entropy of the lake.
   A) +250 J/K.
   B) –150 J/K.
   C) –200 J/K.
   D) –100 J/K.
   E) +150 J/K.

6. A 2.0-cm diameter cylinder contains 50 mL of water at 10.0 ^{o}C. What is the change in the water level when the temperature rises to 80 ^{o}C? Ignore the change in the volume of the tube. The coefficient of volume expansion of water is 2.1×10^{-4} /^{o}C, and 1 mL = 1 cm^3.
A) 0.05 cm
B) 0.60 cm
C) 0.13 cm
D) 0.53 cm
E) 0.23 cm

7. Consider one mole of a monatomic gas taken through the cycle shown in the figure. Find the change in internal energy for the adiabatic process a $\rightarrow$ b.



A) –200 kJ
B) +200 kJ
C) +150 kJ
D) +100 kJ
E) –100 kJ

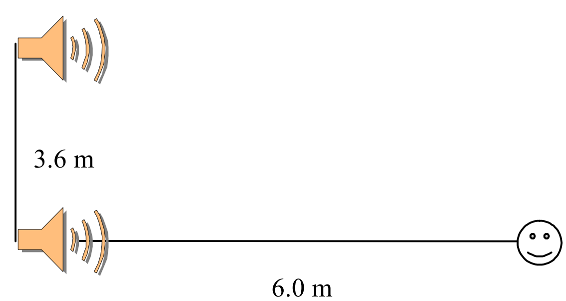
8. 500 g of steam at 100 ^{o}C lose 1.180×10^{6} J of heat. Calculate the final temperature? Heat of vaporization of water is 2.256×10^{6} J/kg, heat of fusion is 333 kJ/kg, and the specific heat of water = 4.19 kJ/kg K.
A) 25 ^{o}C
B) 0 ^{o}C
C) 75 ^{o}C
D) 100 ^{o}C
E) 150 ^{o}C

9. Equations 1-5 describes five sinusoidal waves traveling on five different strings.
   1. $y(x, t) = 2 \sin(2x - 4t)$
   2. $y(x, t) = 2 \sin(4x - 10t)$
   3. $y(x, t) = 2 \sin(6x - 12t)$
   4. $y(x, t) = 2 \sin(8x - 16t)$
   5. $y(x, t) = 2 \sin(10x - 20t)$

   (x and y are in centimeters and t is in seconds). All strings have the same tension and all have the same linear mass density, except one. The string with the different linear mass density is:
   A) 1
   B) 3
   C) 2
   D) 5
   E) 4

10. A sample of argon gas (M_{Ar} = 40 g/mole) is at four times the absolute temperature of hydrogen gas (M_H = 2 g/mole). The ratio of the rms speed of the argon atoms to that of hydrogen molecules is:
    A) 0.65
    B) 4.00
    C) 0.45
    D) 0.25
    E) 1.25

11. Two speakers are separated by a distance of 3.6 m. A listener is standing in front of one speaker at a distance of 6 m. The transmitted sound waves by both speakers are in phase and are in the audible range. What is lowest frequency at which a listener will hear a minimum intensity (speed of sound in air is 340 m/sec)?

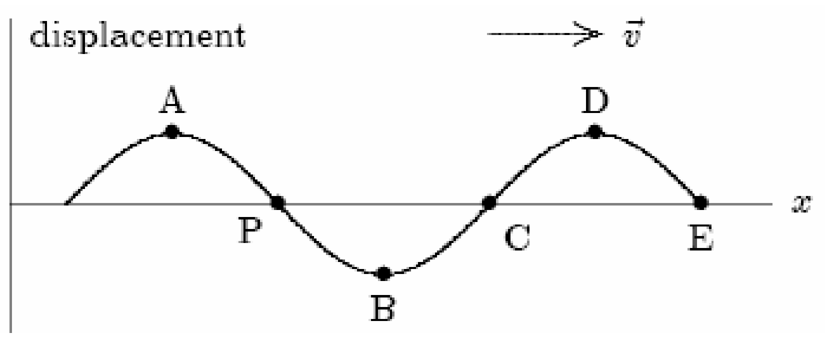


    A) 340 Hz
    B) 170 Hz
    C) 240 Hz
    D) 460 Hz
    E) 120 Hz

12. The temperature of one side of 8.0-mm thick glass window is maintained at 45 ^oC while the other side is maintained at 25 ^oC. If the area of the window is 2.0 m^2, how much energy is transferred through the window in 5 hours? The thermal conductivity of glass is 1.0 W/m·K.
    A) 1.5×10^6 J
    B) 1.5×10^9 J
    C) 1.5×10^3 J
    D) 25×10^3 J
    E) 90×10^6 J

13. A stationary person hears a frequency of 800 Hz of an ambulance siren moving at a speed of 60 m/s towards him. What frequency will he hear when the ambulance is moving away from him with the same speed. [speed of sound in air is 340 m/s].
    A) 560 Hz.
    B) 800 Hz.
    C) 640 Hz.
    D) 760 Hz.
    E) 460 Hz.

14. A traveling sinusoidal wave is shown in the figure. At which point is the motion 180$^?$ out of phase with the motion at point P?



    A) B
    B) C
    C) A
    D) E
    E) D

15. Two different materials have the same mass and are at the same initial temperature. Equal quantities of energy are absorbed as heat by each. Their final temperatures may be different because they have different:
    A) Coefficients of expansion.
    B) Densities.
    C) Thermal conductivities.
    D) Volumes.
    E) Specific heat.

16. A string is vibrating in its fifth-harmonic standing wave pattern described by the equation : $y(x,t) = 0.25 \sin(\pi x) \times \cos(15t)$ m. Find the length of the string.
   A) 5 m
   B) 1 m
   C) 2 m
   D) 3 m
   E) 4 m

17. The temperature of 2.0 mole of a monatomic ideal gas is raised reversibly from 100 K to 300 K, with its volume kept constant. The entropy change for the gas is:
   A) 64 J/K
   B) 10 J/K
   C) 15 J/K
   D) 38 J/K
   E) 27 J/K

18. Choose the correct answer: If a process occurs in a closed system, the entropy of the system:
   A) Increases for an irreversible process.
   B) Decreases for a reversible process.
   C) Remains constant for an irreversible process.
   D) Increases for a reversible process.
   E) Decreases for an irreversible process.

19. A string, under a tension of 100 N, is observed to oscillate at two adjacent resonant frequencies of 300 Hz and 400 Hz. Then tension in the string is changed and the string is observed to oscillate at resonant frequencies of 400 Hz and 480 Hz with no intermediate frequencies. Find the new tension in the string.
   A) 164 N
   B) 104 N
   C) 84 N
   D) 40 N
   E) 64 N

20. A monatomic ideal gas is compressed adiabatically from an initial pressure of 1 atm and volume of 800 cm^3 to a volume of 400 cm^3. If the initial temperature of the gas is 20 ^oC, what is the final temperature of the gas? (Take γ=1.67)
   A) 587 K
   B) 664 K
   C) 231 K
   D) 466 K.
   E) 398 K

Answer Key

1. B
2. E
3. E
4. C
5. B
6. E
7. E
8. C
9. C
10. C
11. B
12. E
13. A
14. B
15. E
16. A
17. E
18. A
19. E
20. D

Physics 102 Major1
Formula sheet
Spring Semester 2005-2006 (Term 052)

$v = \lambda f = \frac{\omega}{k}$

$v = \sqrt{\frac{\tau}{\mu}} \qquad v = \sqrt{\frac{B}{\rho}}$

$y = y_m \sin(kx - \omega t + \varphi)$

$P = \frac{1}{2}\mu\omega^2 y_m{}^2 v$

$S = S_m \cos(kx - \omega t)$

$\Delta P = \Delta P_m \sin(kx - \omega t)$

$\Delta P_m = \rho v \omega S_m$

$I = \frac{1}{2}\rho(\omega S_m)^2 v$

$\beta = 10\log\left(\frac{I}{I_o}\right)$

$I = \frac{\text{Power}}{\text{Area}}$

$f' = f\left(\frac{v \pm v_D}{v \mp v_s}\right)$

$y = \left(2y_m \cos\frac{\varphi}{2}\right)\sin\left(kx - \omega t + \frac{\varphi}{2}\right)$

$y = (2y_m \sin kx)\cos\omega t$

$f_n = \frac{nv}{2L}, \qquad n = 1,2,3,...$

$f_n = \frac{nv}{4L}, \qquad n = 1,3,5...$

$\Delta L = \alpha L \Delta T$

$PV = nRT = NkT$

$\Delta L = \frac{\lambda}{2\pi}\varphi$

$\Delta L = m\lambda \qquad m = 0,1,2,....$

$\Delta L = \left(m + \frac{1}{2}\right)\lambda, \qquad m = 0,1,2,.....$

$PV^{\gamma} = \text{constant}$

$TV^{\gamma-1} = \text{constant}$

$T_F = \frac{9}{5}T_C + 32$

$Q = mL \qquad Q = mc\Delta T$

$\Delta E_{int} = Q - W \qquad \Delta E_{int} = nC_V\Delta T$

$C_p - C_v = R \qquad W = \int PdV$

$H = \frac{Q}{t} = \kappa A\frac{T_H - T_C}{L}$

$P = \sigma\varepsilon AT^4 \qquad \frac{m\overline{v^2}}{2} = (3/2)kT$

$v_{rms} = \sqrt{\frac{3RT}{M}}$

$Q = nc_p\Delta T, \quad Q = nc_v\Delta T$

$W = Q_h - Q_c \qquad \varepsilon = \frac{W}{Q_h} = 1 - \frac{Q_c}{Q_h}$

$K = \frac{Q_c}{W} \qquad \frac{Q_c}{Q_h} = \frac{T_c}{T_h} \qquad \Delta S = \int\frac{dQ}{T}$

$c_v = \frac{3}{2}R \quad \textit{for monatomic gases.}$

$= \frac{5}{2}R \quad \textit{for diaatomic gases.}$

$\Delta S = nc_v \ln\frac{T_f}{T_i} + nR\ln\frac{V_f}{V_i}$

Constants:

Pi = π
1 Liter = 10^{-3} m^3
R = 8.31 J/mol K
N_A = 6.02 x 10^{23} molecules/mole
1 atm = 1.01 x 10^5 N/m^2
k = 1.38 x 10^{-23} J/K
I_o = 10^{-12} W/m^2
1 calorie = 4.186 Joule
$\sigma = 5.67x10^{-8}\, W/(m^2K^4)$
micro = 10^{-6}
for water: L_f = 80 cal/g
L_v = 540 cal/g
c = 1 cal/g.K
c_{ice} = 0.53 cal/g.K