King Fahd University of Petroleum and Minerals

Department of Physics

PHYS102-053
MAJOR 1 EXAM
Test Code: **100**

12 July 2006
Exam Duration: 2hrs (from 7:00am to 10:00am)

Name:	
Student Number:	
Section Number:	

1. A string is put under tension and then two different sinusoidal waves *A* and *B* are separately sent along it. Fig. 1 gives plots of the displacement versus time for a point on the string. Which of the following statements regarding the two waves is true?
   A) Wave *A* has the same frequency as wave *B*
   B) Wave *A* has a lower frequency than wave *B*
   C) Wave *A* has a larger wavelength than wave *B*
   D) Wave *A* has the same speed as wave *B*
   E) Wave *A* has the same wave length as wave *B*

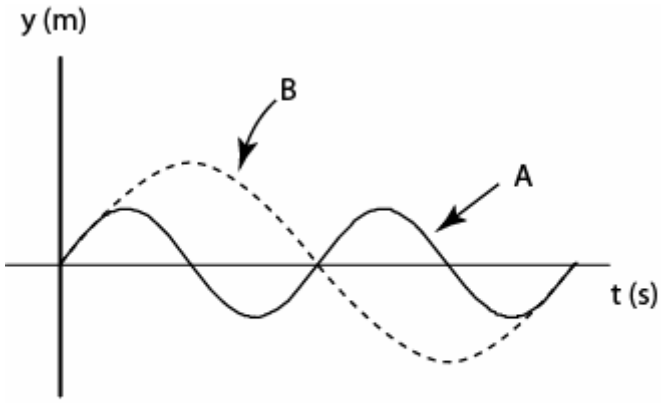

Figure 1

2. Which of the following CANNOT be a traveling wave?
   A) $\cos(kx)\sin(\omega t)$
   B) $2\sin(kx+\omega t)$
   C) $2\cos(kx+\omega t)$
   D) $2\cos(\phi/2)\sin(kx+\omega t+\phi/2)$
   E) $2\sin k(x\text{-v } t)$

3. Two waves with the same amplitude y_m and wavelength λ are moving on a string. One of the waves is shifted relative to the other by a distance of 5.5 λ. The amplitude of the resultant wave is:
   A) $2\,y_m$
   B) 0
   C) $0.50\,y_m$
   D) $2\,y_m \cos 30$
   E) $2\,y_m \cos 15$

4. Two waves *A* and *B* are generated on a string of length 4.0 m to produce a four-loop standing wave. The wave speed is 1000 m/s. What is the frequency of each of the two waves *A* and *B*?
   A) 600 Hz
   B) 350 Hz
   C) 1200 Hz
   D) 1000 Hz
   E) 500 Hz

5. A certain sound source is increased in sound level by 60 dB. By what multiple is its intensity increased?
   A) 10^7
   B) 10^3
   C) 10^2
   D) 10^6
   E) 10

6. Two trains are traveling toward each other at 30.5 m/s relative to the ground. One train is blowing a whistle at 500 Hz. What frequency is heard on the other train? (Speed of sound is 343 m/s).
   A) 500 Hz
   B) 354 Hz
   C) 825 Hz
   D) 400 Hz
   E) 598 Hz

7. Tube *A* (open at both ends) has the same length as tube *B* (open at one end). The ratio of their fundamental frequencies (f_{1A}/f_{1B}) is:
   A) 2
   B) 1
   C) 4
   D) 3
   E) 5

8. Two small identical speakers *A* and *B* are connected (in phase) to the same source as shown in Fig. 2. A man starts walking from speaker *A* toward speaker *B*. He hears the second minimum sound at point *P* which is 3 m from speaker *A* and 9 m from speaker *B*. What is the wavelength of the emitted sound wave?
   A) 6 m
   B) 8 m
   C) 4 m
   D) 3 m
   E) 14 m

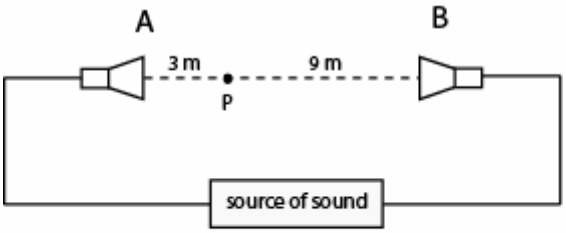

Figure 2

9. In which one of the following quantities, does the change in that quantity depend on the process that takes a gas from an initial *state* ***i*** to a final *state* ***f***?
   A) T
   B) Q-W
   C) Q+W
   D) P
   E) V

10. A glass container of volume 200 cm^3 is completely filled with mercury. Taking into account the expansions of the mercury and the glass, find how much of the mercury will overflow the vessel if the temperature is raised by 30° C (β_{Hg} = 0.18 x 10^{-3}/C°, α_{glass} = 9.0 x 10^{-6}/C°)
   A) 0.16 cm^3
   B) 0.92 cm^3
   C) 1.08 cm^3
   D) 1.24 cm^3
   E) 82 cm^3

11. A gas within a closed chamber is taken through the cycle as shown in the P-V diagram of Fig. 3. Calculate the net energy added as heat and the change in the internal energy of the gas per cycle.
   A) Q= +120 J, ΔE_{int}=0
   B) Q= -120 J, ΔE_{int}=0
   C) Q = -30 J, ΔE_{int}=120 J
   D) Q =-360 J, ΔE_{int}=0
   E) Q =120 J, ΔE_{int}=-120 J

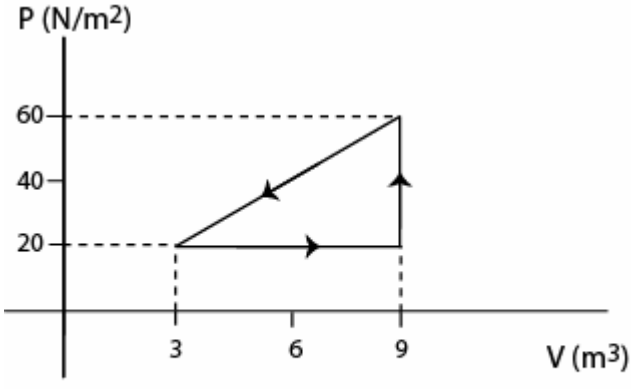

Figure 3

12. Calculate how much heat is lost in 24 hours through a glass window 2.0 m x 1.5 m in area and thickness of 3.2mm, if the temperatures at the inner and outer surfaces are 15° C and 14° C, respectively. Coefficient of thermal conductivity of the glass is equal to 0.84 W/m.K
    A) 68 MJ
    B) 102 MJ
    C) 25 MJ
    D) 8 MJ
    E) 60 MJ

13. Ten moles of an ideal gas expands isothermally at 50° C to four times its initial volume. What is the change in internal energy of the gas?
    A) 125 J
    B) 250 J
    C) 0 J
    D) 108 J
    E) -218 J

14. One mole of an ideal diatomic gas goes from ***a*** to ***c*** along the diagonal path in Fig. 4. How much heat energy is added to the gas in this process?
    A) -5000 J
    B) -2000 J
    C) 5000 J
    D) 2000 J
    E) 7000 J

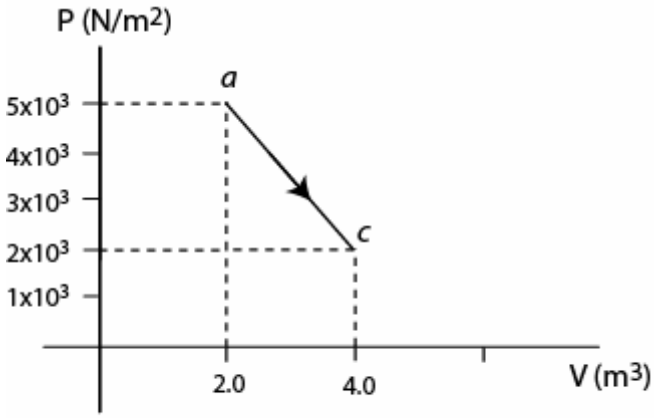

Figure 4

15. Container *A* has 5 moles of Helium at 100° C and container *B* has 5 moles of Xenon at 200° C. What is the ratio of the average kinetic energy of Helium atoms to that of Xenon atoms? (Both Helium and Xenon are ideal monoatomic gases)
    A) 2.11
    B) 0.500
    C) 0.231
    D) 1.00
    E) 0.789

16. Calculate the heat lost by one mole of an ideal gas during an isothermal compression from a volume of 22.4 L at 1.00 atm to a volume of 16.8 L.
    A) 651 J
    B) 1253 J
    C) 85 J
    D) 2561 J
    E) 0

17. 100 g ice at -20° C is placed in a lake whose temperature is at 10° C. Calculate the change in entropy of the lake as the ice cube comes to thermal equilibrium with the lake. [Specific heat of ice is 2220 J/kg.K; heat of fusion of ice = 3.33×10^5 J/kg; specific heat of water is 4186 J/kg.K].
    A) -211 J/K
    B) +148 J/K
    C) 211 J/K
    D) -148 J/K
    E) 31 J/K

18. A freezer has a coefficient of performance of 3.8 and uses 200 W of power. How long would it take to freeze 600 g of water at 0° C? [Heat of fusion of ice = 3.33×10^5 J/kg]
    A) 24 minutes
    B) 4.4 minutes
    C) 2.5 seconds
    D) 2.9 minutes
    E) 12 minutes

19. A car engine has an efficiency of 20% and produces an average of 23,000 J of mechanical work per second during operation. How much heat is discharged as waste heat per second?
    A) 10 kJ
    B) 115 kJ
    C) 207 kJ
    D) 45 kJ
    E) 92 kJ

20. Two sound waves have equal displacement amplitudes, but one has twice the frequency of the other. What is the ratio of their intensities?
    A) 0.45
    B) 2
    C) 4
    D) 9
    E) 0.50

Answer Key

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