

Exam

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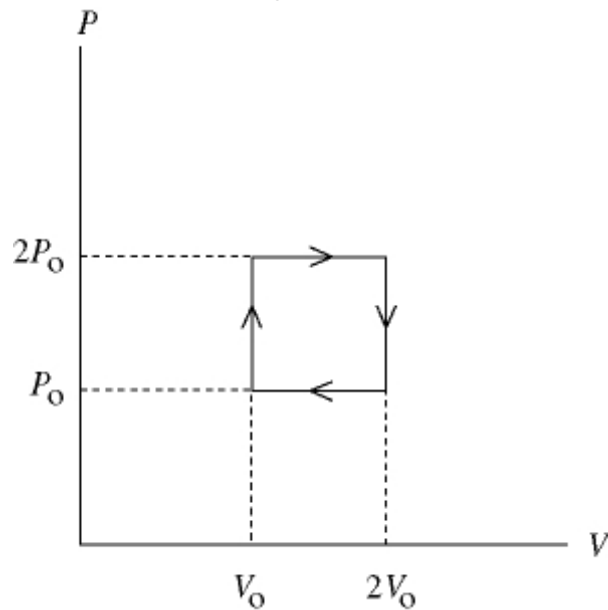
Remember to write all work in your Bluebook as well as put the answer on your Scantron

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

- 1) A transverse wave is propagated in a string stretched along the x -axis. The equation of the wave, in SI units, is given by: $y = 0.006 \cos \pi(46t - 12x)$. The frequency of the wave, in SI units, is closest to: 1) _____
A) 46 B) 100 C) 140 D) 23 E) 69
- 2) A transverse wave is propagated in a string stretched along the x -axis. The equation of the wave, in SI units, is given by: $y = 0.002 \cos \pi(52t - 15x)$. The maximum velocity of a particle on the string, in SI units, is closest to: 2) _____
A) 0.64 B) 0.53 C) 0.74 D) 0.33 E) 0.43
- 3) The equation $y(x,t) = 0.015 \cos(13.4x + 488t)$, where all quantities are in SI units, represents a traveling wave having: 3) _____
A) wavelength = 0.469 m and period = 12.9 ms
B) wavelength = 13.4 m and frequency = 488 Hz
C) frequency = 488 Hz and period = 12.9 ms
D) wavelength = 0.469 m and frequency = 3060 s
E) wavelength = 0.0746 m and period = 0.00205 s
- 4) A 8.0-g string, 0.87 m long, is under tension. The string produces a 900-Hz tone when it vibrates in the third harmonic. The speed of sound in air is 344 m/s. The wavelength of the tone in air, in SI units, is closest to: 4) _____
A) 0.71 B) 0.87 C) 0.54 D) 0.38 E) 0.58
- 5) A 380-Hz tone has an intensity level of 64 dB. The velocity of sound in air is 345 m/s. The bulk modulus of air is 142 kPa. The displacement amplitude of the sound waves, in SI units, is closest to: 5) _____
A) 9.3×10^{-8} B) 9.3×10^{-7} C) 4.6×10^{-8} D) 2.3×10^{-7} E) 4.6×10^{-7}
- 6) The howler monkey is the loudest land animal and can be heard up to a distance of 5.0 km. Assume the acoustic output of a howler to be uniform in all directions. The acoustic power emitted by the howler, in mW, is closest to: 6) _____
A) 0.11 B) 1.1 C) 11 D) 3.2 E) 0.32
- 7) A glass window is installed in the window space and the intensity level of the sound entering through the window is reduced from 84 dB to 71 dB. The factor, by which the acoustic power entering the chamber is reduced by the glass window, is closest to: 7) _____
A) 5.0×10^{-2} B) 3.0×10^{-1} C) 2.2×10^{-1} D) 1.4×10^{-1} E) 3.7×10^{-1}

- 8) Which one of the following statements is true? 8) _____
- A) If the intensity level (in decibels) of sound *A* is twice the intensity level of sound *B*, then the intensity of *A* is twice the intensity of *B*.
 - B) If two sound waves have the same intensity level (in decibels), they must have the same intensity.
 - C) If two different sound waves have the same displacement amplitude, then they must have the same intensity level (in decibels).
 - D) If two different sound waves have the same displacement amplitude, then they must have the same intensity.
 - E) If the intensity of sound *A* is twice the intensity of sound *B*, then the intensity level (in decibels) of *A* is twice the intensity level of *B*.
- 9) A compression, at a constant pressure of 120 kPa, is performed on 8.0 moles of an ideal monatomic gas ($C_V = 3/2 R$). The compression reduces the volume of the gas from 0.23 m³ to 0.12 m³. The work done by the gas, in kJ, is closest to: 9) _____
- A) -13
 - B) -33
 - C) 13
 - D) 33
 - E) zero
- 10) An expansion process on a diatomic ideal gas ($C_V = 5/2 R$), has a linear path between the initial and final coordinates on a pV diagram. The coordinates of the initial state are: the pressure is 300 kPa, the volume is 0.05 m³, and the temperature is 390 K. The final pressure is 180 kPa and the final temperature is 340 K. The work done by the gas, in SI units, is closest to: 10) _____
- A) 6800
 - B) 5400
 - C) 8200
 - D) 2700
 - E) 4100
- 11) An expansion process on a diatomic ideal gas ($C_V = 5/2 R$), has a linear path between the initial and final coordinates on a pV diagram. The coordinates of the initial state are: the pressure is 300 kPa, the volume is 0.05 m³, and the temperature is 390 K. The final pressure is 140 kPa and the final temperature is 310 K. The change in the internal energy of the gas, in SI units, is closest to: 11) _____
- A) 4600
 - B) -4600
 - C) -7700
 - D) 7700
 - E) zero

Figure 19.2



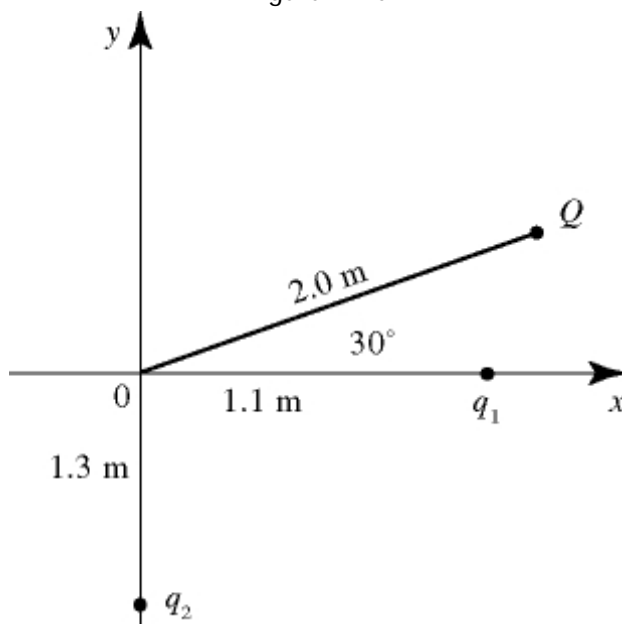
- 12) In Fig. 19.2, an ideal gas is carried around the cyclic process. How much work is done in one cycle if $P_0 = 7 \text{ atm.}$ and $V_0 = 6.00 \text{ liters?}$ 12) _____
 A) 4240 J B) 17,000 J C) 8480 J D) 1700 J E) 7980 J
- 13) A Carnot engine is operated as an air conditioner to cool a house in the summer. The air conditioner removes 20 kJ of heat per second from the house, and maintains the inside temperature at 293 K, while the outside temperature is 366 K. The power required for the air conditioner under these operating conditions, in SI units, is closest to: 13) _____
 A) 6000 B) 9000 C) 8000 D) 7000 E) 5000
- 14) A real (non-Carnot) heat engine, operating between heat reservoirs at temperatures of 740 K and 270 K, performs 2.7 kJ of net work and rejects 8.2 kJ of heat in a single cycle. The thermal efficiency of this heat engine is closest to: 14) _____
 A) 0.27 B) 0.25 C) 0.30 D) 0.22 E) 0.20
- 15) A 2.00-kg block of ice at 0.00°C is dropped into a very large lake at 25.0°C and completely melts. For water, the heat of fusion is $3.35 \times 10^5 \text{ J/kg}$, the heat of vaporization is $2.25 \times 10^5 \text{ J/kg}$, and the specific heat is $4190 \text{ J/kg} \cdot \text{K}$. The net change in entropy of the system consisting of the ice and the lake during this melting process is closest to: 15) _____
 A) $2.24 \times 10^3 \text{ J/K}$
 B) $-2.45 \times 10^3 \text{ J/K}$
 C) $2.45 \times 10^3 \text{ J/K}$
 D) $-2.06 \times 10^2 \text{ J/K}$
 E) $2.06 \times 10^2 \text{ J/K}$

16) Which of the following is an accurate statement?

16) _____

- A) An important distinction between the Diesel cycle and the Otto cycle is that for the Diesel cycle high efficiencies may be obtained with low compression ratios.
- B) Because a Diesel engine requires no fuel ignition system, Diesel engines tend to be lighter and easier to start than a comparable gasoline engine.
- C) The efficiency of the Otto cycle does not depend on the compression ratio.
- D) A typical gasoline engine has an efficiency of about 2%.
- E) An important distinction between the Diesel cycle and the Otto cycle is that there is no fuel in the cylinder at the beginning of the compression stroke and no spark plug is used.

Figure 21.1b

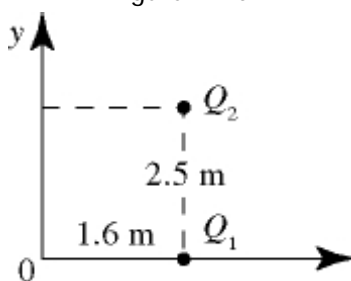


17) A point charge $Q = -500 \text{ nC}$ and two unknown point charges, q_1 and q_2 , are placed as shown. The electric field at the origin O , due to charges Q , q_1 , and q_2 , is equal to zero. In Fig. 21.1b, the charge q_1 , in nC, is closest to:

17) _____

- A) 120
- B) 250
- C) -120
- D) 210
- E) -210

Figure 21.2d



18) Two point charges, $Q_1 = -4.0 \mu\text{C}$ and $Q_2 = +2.0 \mu\text{C}$, are placed as shown. In Fig. 21.2d, the magnitude of the electric force on either charge is closest to:

18) _____

- A) 0.071 N
- B) 0.052 N
- C) 0.033 N
- D) 0.062 N
- E) 0.043 N

- 19) If you rub a balloon on your sweater and then press it to a wall, it will often stick there. Why does this happen? 19) _____
- A) Rubbing the balloon charges it electrostatically, and this charge on the balloon induces an opposite charge on the wall. The attraction between the induced charge and the charge on the balloon holds the balloon to the wall.
 - B) Rubbing removes a surface layer of grease, allowing the rubber to come in sufficiently close contact with the wall so that air pressure holds it there.
 - C) A wall typically has a net electric charge on it, and rubbing the balloon charges it electrostatically. If the wall happens to have opposite charge to that on the balloon, the balloon will stick.
 - D) Rubbing the balloon surface causes it to become slightly conducting. When the balloon is touched to the wall, electrons flow from the balloon to the wall. This sets up an electric field that bonds the balloon weakly to the wall.
 - E) Rubbing the balloon causes moisture to condense on it, and surface tension causes the balloon to stick to the wall.

- 20) When two point charges are a distance d apart, the electric force that each one feels from the other has magnitude F . In order to make this force twice as strong, the distance would have to be changed to: 20) _____
- A) $d/\sqrt{2}$ B) $d/4$ C) $\sqrt{2}d$ D) $2d$ E) $d/2$