NYU General Physics 1—Term Exam 3

1. — [from lecture 2011-11-08] If you stretched a guitar string by a distance $\Delta L$, how much work did you do? In these equations, $E$ is the elastic modulus, $A$ is the cross-sectional area of the string, $L$ is the length of the string, and $M$ is the mass of the string.

   A: $\frac{1}{2} \sqrt{\frac{EA}{ML}} (\Delta L)^2$  
   B: $\frac{1}{2} \sqrt{\frac{EA}{L}} (\Delta L)^2$  
   C: $\frac{1}{2} \frac{EA}{ML} (\Delta L)^2$  
   D: $\frac{1}{2} \frac{EA}{L} (\Delta L)^2$  
   E: none of these

2. — [from lecture 2011-11-08] If you want to lower the fundamental frequency of a piano string of fixed length, you can change the tension or the mass. Which gives the options that lower the fundamental frequency?

   A: lower the tension or lower the mass  
   B: raise the tension or lower the mass  
   C: lower the tension or raise the mass  
   D: raise the tension or raise the mass

3. — [from lecture 2011-11-10] The length $\ell$ of a pendulum (a mass $M$ on the end of a light string of length $\ell$ that ticks off seconds (that is, has a two-second period) is about

   A: 0.1 m  
   B: 1 m  
   C: 10 m  
   D: 100 m  
   E: depends on the mass $M$

4. — [from lecture 2011-11-10] The sine of the very small angle 0.01 radians is

   A: much less than 0.01  
   B: very slightly less than 0.01  
   C: exactly 0.01  
   D: very slightly more than 0.01  
   E: much more than 0.01

5. — [from lecture 2011-11-15] A wave has wavelength $\lambda$, frequency $f$, and wave speed $v$. These are related by

   A: $v = \frac{1}{\lambda f}$  
   B: $v = \frac{\lambda}{f}$  
   C: $v = \frac{f}{\lambda}$  
   D: $v = \lambda f$  
   E: none of these
6. [from lecture 2011-11-17] The figure shows a standing wave ringing on a string at various different times as it is ringing. At the time marked Q, in what form is the energy?

A: potential    B: kinetic    C: heat
D: there is no energy; it is in equilibrium    E: none of these

7. [from lecture 2011-11-22] Consider two points in a glass of water separated by a vertical distance \( \Delta h \). What is the pressure difference \( \Delta P \) between those two points? In these equations, \( \rho \) is the density of water and \( g \) is the acceleration due to gravity.

A: \( \Delta P = \frac{1}{\rho g} \Delta h \)    B: \( \Delta P = \frac{\rho g}{\Delta h} \)    C: \( \Delta P = \frac{g}{\rho} \Delta h \)
D: \( \Delta P = \rho g \Delta h \)    E: it depends on the shape of the glass
8.— [from lecture 2011-11-29] A helium balloon is floating in an accelerating bus. Think of the bus as being a closed tank of air. What is the direction of the buoyant force on the balloon?
A: in the direction of decreasing pressure
B: in the direction of increasing pressure    C: in the down direction
D: in the up direction    E: none of these

9.— [from lecture 2011-12-01] Fluid is flowing through a pipe that has a large cross-sectional area at the input end, and a small cross-sectional area at the output end. The fluid velocity increases from input to output because
A: the pressure is higher at the output end
B: the volume per unit time varies along the pipe
C: all the fluid that enters the pipe must leave
D: none of these is true

10.— [from lecture 2011-12-06] Water flows out of a small hole in the vertical wall of a large water tank. If water surface is a height $h$ above the hole, the velocity $v$ of the water shooting out of the hole is roughly
A: $v = \sqrt{\frac{1}{gh}}$    B: $v = \sqrt{\frac{g}{h}}$    C: $v = \sqrt{\frac{h}{g}}$
D: $v = \sqrt{gh}$    E: none of these

11.— [from problem set 9, problem 1] Which is the higher frequency? The frequency of oscillation of a femur bone if you hit it so it “rings” like a bell because of its own elasticity and mass, or the frequency if you swing it like a pendulum in gravity?
A: rings at higher frequency
B: rings and swings at similar frequencies
C: swings at higher frequency
D: there is no way to answer this question

12.— [from problem set 9, problem 2] A mass is oscillating on an ideal spring. Imagine a plot of the total energy $E$ in the oscillator as a function of time $t$.
A: The graph oscillates at the frequency of the oscillator.
B: The graph oscillates at twice the frequency of the oscillator.
C: The graph is constant with time.    D: none of these
13. — [from problem set 9, problem 3] What is the second derivative with respect to time $t$ of 
\[ A \cos(\omega t + \phi) \]
where $A$, $\omega$, and $\phi$ are all constants?
A: $-\omega^2 A \cos(\omega t + \phi)$  B: $-\omega A \sin(\omega t + \phi)$  C: $\omega^2 A \cos(\omega t + \phi)$
D: $\omega A \sin(\omega t + \phi)$  E: none of these

14. — [from problem set 10, problem 1] If you kept the room at constant temperature and pressure, but changed the air to helium gas, the mass density of the air would drop by a factor of about 4. The speed of sound in the room would
A: increase by factor of about 4  B: increase by factor of about 2
C: stay about the same  D: decrease by factor of about 2
E: decrease by factor of about 4

15. — [from problem set 10, problem 1] An organ pipe that plays middle C is about how long?
A: 100 feet  B: 10 feet  C: 1 foot  D: 1 inch  E: none of these

16. — [from problem set 10, problem 2] A transverse wave obeys the description
\[ y = A \cos \left( \frac{2\pi x}{\lambda} - \frac{2\pi t}{T} \right) \]
where $A$ is a constant, $\lambda$ is the wavelength, and $T$ is the period. Which way is the wave moving?
A: negative $x$ direction  B: positive $x$ direction
C: negative $y$ direction  D: positive $y$ direction  E: none of these

17. — [from problem set 10, problem 3] You hit a bell once with a hammer. It rings but the sound it makes decays—it gets softer and softer over time. Why does this happen?
A: Energy is not conserved.
B: It radiates energy to it’s surroundings (including your ears).
C: The energy has to return to the hammer.
D: Energy is changing from kinetic to potential and back.
E: none of these

18. — [from problem set 11, problem 1] A pressure difference of 50 mm of mercury corresponds to roughly how many atmospheres?
A: 0.07 atm  B: 0.7 atm  C: 1 atm  D: 10 atm  E: none of these
19. — [from problem set 11, problem 1] Airplanes fly at an altitude of about 10 km; what is true about this?
A: The density of air is lower at this altitude.
B: It is much hotter at this altitude.
C: The speed of sound is much higher at this altitude.
D: There is no atmosphere at all at this altitude.   E: none of these

20. — [from problem set 11, problem 2] For a submerged ice cube in cold water, the buoyant force is greater than the gravitational force. By what factor is it greater?
A: Infinitely   B: A factor of 10.8   C: A factor of 1.92
D: A factor of 1.08   E: nothing near any of these

21. — [from problem set 11, problem 3] Consider two cylindrical tubes, each carrying 5 liters per minute of blood. If the wide tube has cylindrical radius 1 cm and the narrow tube has cylindrical radius 0.5 cm, what is the ratio of velocities (wide tube velocity over narrow tube velocity)?
A: 1   B: 0.707   C: 0.5   D: 0.25   E: none of these

22. — [from Collisions in One Dimension lab] A glider of mass $m_1$ initially moves at speed $v_1$ in the positive $x$ direction. It collides elastically with a second glider of mass $m_2$ initially at rest. Under what condition will the first glider continue to move in the positive $x$ direction after the elastic collision?
A: $m_1 < m_2$   B: $m_1 > m_2$   C: $m_1 v_1 > m_2$   D: $m_1 v_1 < m_2$
E: none of these

23. — [from Ballistic Pendulum lab] A ball of mass $m$ hits a pendulum bob of mass $M$ and sticks. Immediately after it sticks to the bob, the kinetic energy of the bob+ball system is
A: greater than the initial kinetic energy of the ball
B: the same as the initial kinetic energy of the ball
C: less than the initial kinetic energy of the ball
D: there is not enough information to tell
24.— [from Work–Energy lab] You do work \( W \) on a mass \( m \) and all the work goes into increasing the kinetic energy of the mass. If the mass starts off at speed \( v_i \) and gains speed \( \Delta v \) (to end up at speed \( v_f = v_i + \Delta v \)), then

A: \( W = \frac{1}{2} m (\Delta v)^2 \)  
B: \( W = \frac{1}{2} m v_i^2 \)  
C: \( W = \frac{1}{2} m v_i (\Delta v) \)  
D: \( W = \frac{1}{2} m (v_i + \Delta v)^2 \)  
E: \( W = \frac{1}{2} m \left[ (v_i + \Delta v)^2 - v_i^2 \right] \)

25.— [from Oscillations of a String lab] At fixed string tension, as the wavelength of the standing waves gets shorter, the frequency of the waves

A: gets smaller  
B: stays the same  
C: gets higher  
D: there is not enough information to tell