KEY CODE is B D E A C

1. The decibel intensity level of a jackhammer is 130 dB. Determine the decibel level if two jackhammers operate side by side.

    ___ A.   65 dB

    ___ B.   130 dB

    X C.   133 dB

    ___ D.   144 dB

    ___ E.   260 dB

    $10 \log \left(\text{INTENSITY} \right) = 130 \, dB$ so

    $10 \log \left(2 \times \text{INTENSITY} \right) = 10 \log 2 + 10 \log \left(\text{INTENSITY} \right)$

    $= 3 + 130$

2. A certain string on a piano is tuned to produce middle C ($f = 261.63$ Hz) by carefully adjusting the tension in the string. For a fixed wavelength, what is the frequency when this tension is doubled?
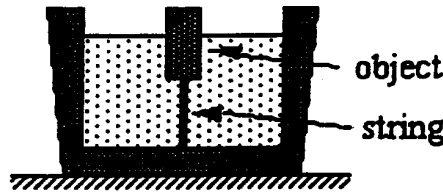
    ___ A.   130.08 Hz

    ___ B.   185.00 Hz

    X C.   370.00 Hz

    ___ D.   446.63 Hz

    ___ E.   523.26 Hz

    $f_1 = \dfrac{m}{2L} \sqrt{\dfrac{F}{\mu}}$ $f_2 = \dfrac{m}{2L} \sqrt{\dfrac{2F}{\mu}} = \sqrt{2} f_1$

    $f_2 = \sqrt{2} \cdot 261.63 =$

    m STAYS THE SAME FOR THE SAME WAVELENGTH

3. A 2-kg block with density less than water is tied down as shown in the figure. It displaces 5 kg of water in this situation.   What is the tension in the string?

    ___ A.   10 N

    ___ B.   20 N

    X C.   30 N

    ___ D.   70 N

    ___ E.   100 N

    GRAVITY ON BLOCK $= mg \downarrow = 2(9.8) \downarrow$

    BUOYANT FORCE $= m_w g \uparrow = 5(9.8) \uparrow$

    TENSION $= 5(9.8) - 2(9.8) = 3(9.8) = 30 \, N$

4. A rope of length L is clamped at both ends. Which one of the following is not a possible wavelength for standing waves on this rope?

    ___ A.   L/2

    ___ B.   2L/3

    ___ C.   L

    ___ D.   2L

    X E.   4L ⟵ ONLY ONE QUARTER WAVELENGTH FITS ON L,
    MUST BE AN INTEGER NUMBER OF
    HALF WAVELENGTHS FOR STRING
    CLAMPED AT BOTH ENDS

5. The two dams are identical with the exception that the water reservoir behind dam **A** extends twice the horizontal distance behind it as that of dam **B**. Which one of the following statements regarding these dams is correct?

  __ A. The force exerted by the water on dam **A** is greater than that on dam **B**.

  __ B. The force exerted by the water on dam **B** is greater than that on dam **A**.

  __ C. Dam **A** is more likely to collapse than dam **B** if the water level rises.

  __ D. Dam **B** is more likely to collapse than dam **A** if the water level rises.

  X E. The horizontal distance of the water behind the two dams does not determine the force on them. *(BEEN THERE, DONE THAT)*

6. Which one of the following statements is true concerning an object executing simple harmonic motion?

  __ A. Its velocity is never zero.

  __ B. Its acceleration is never zero.

  __ C. Its velocity and acceleration are simultaneously zero.

  X D. Its velocity is zero when its acceleration is a maximum. *(AT MAXIMUM DISTANCE)*

  __ E. Its maximum acceleration is equal to its maximum velocity.

7. Pipe **A** is 0.50 m long and open at both ends. Pipe **B** is open at one end and closed at the other end. Determine the length of **B** so that it has the same fundamental frequency as **A**.

  X A. 0.25 m

  __ B. 0.50 m

  __ C. 0.75 m

  __ D. 1.0 m

  __ E. 2.0 m

  A ← OPEN

  $\lambda = 2L_A$

  ← CLOSED

  B

  $\lambda = 4L_B = 2L_A$
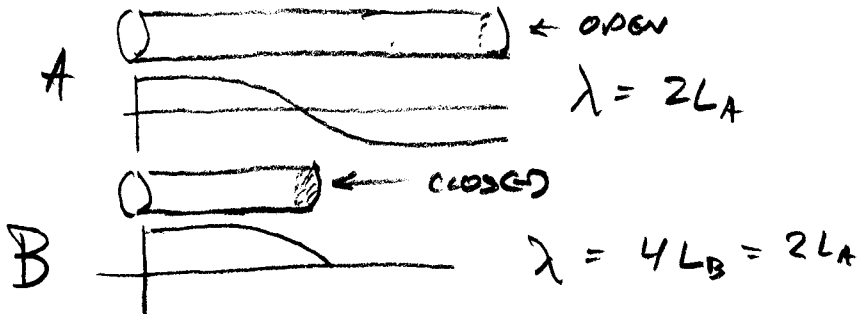
8. A guitar string produces 4 beats/s when sounded with a 250 Hz tuning fork and 9 beats per second when sounded with a 255 Hz tuning fork. What is the vibrational frequency of the string?

  __ A. 240 Hz

  X B. 246 Hz

  __ C. 254 Hz

  __ D. 259 Hz

  __ E. 263 Hz

  $250 - 246 = 4$

  $255 - 246 = 9$

9. A spring required a force of 1.0 N to compress it 0.1 m. How much work is required to stretch the spring 0.4 m?

  __ A. 0.4 J

  __ B. 0.6 J

  X C. 0.8 J

  __ D. 2 J

  __ E. 4 J

  $k = \dfrac{1.0 \ N}{0.1 \ M} = 10 \ N/M$

  P.E. IF STRETCHED 0.4 M IS

  $\frac{1}{2} kx^2 = \frac{1}{2}(10)(0.4)^2 = 0.8 \ J$

10. A bell produces sound energy at a rate of 4.0×10^{-3} W and radiates it uniformly in all directions. What is the intensity of the wave at a distance of 100 m from the bell?

X A. 3.18×10^{-8} W/m²

___ B. 3.14×10^{-7} W/m²

___ C. 5.02×10^{-2} W/m²

___ D. 5.02×10^{2} W/m²

___ E. 6.28×10^{7} W/m²

AREA OF SPHERE OF RADIUS 100 M IS

$4\pi r^2 = 4\pi (100)^2 = 1.2566 \times 10^5$ M²

$\dfrac{4.0 \times 10^{-3} W}{1.2566 \times 10^5 M^2} = 3.183 \times 10^{-8}$ W/M²

11. Water flows through a pipe of diameter 8.0 cm with a speed of 10.0 m/s. It then enters a smaller pipe of diameter 3.0 cm. What is the speed of the water as it flows through the smaller pipe?

___ A. 1.4 m/s

___ B. 2.8 m/s

___ C. 27 m/s

___ D. 54 m/s

X E. 71 m/s

$A = \pi r^2$ SO $\dfrac{A_1}{A_2} = \dfrac{\pi 8^2}{\pi 3^2} = \dfrac{64}{9}$

$V_1 A_1 = V_2 A_2$ SO

$V_2 = V_1 \dfrac{A_1}{A_2} = (10.0)\dfrac{64}{9} = 71.1$ M/S

12. A cable stretches by an amount d when a crate of mass M hangs from it. The cable is replaced by another cable of the same material having the same length but twice the cross sectional area. What is the mass of the load that can be supported by the thicker cable if it stretches by an amount d?

___ A. M /4

___ B. M /2

___ C. M

X D. 2M
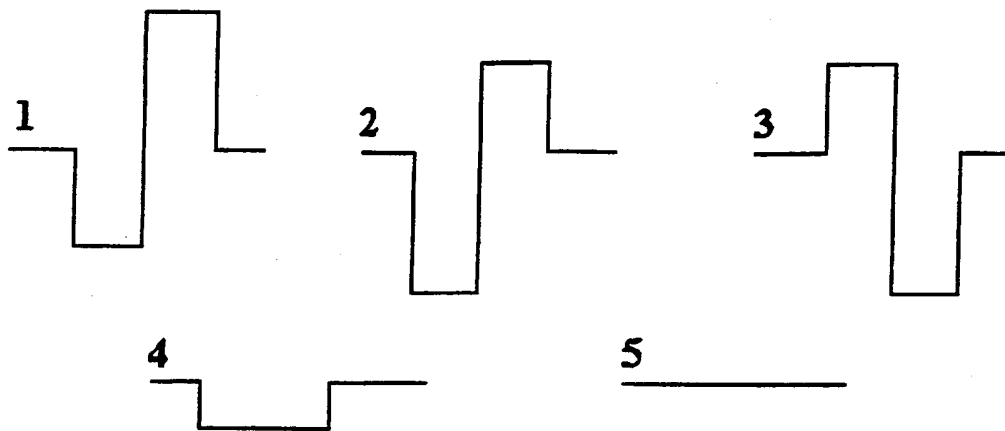
___ E. 4M

$Y = \dfrac{F L_0}{A \Delta L}$ SO

$d = \Delta L = \dfrac{F L_0}{A Y}$

$\Delta L = d$ STAYS SAME

L STAYS SAME

$A \times 2 \Rightarrow F \times 2$ $F = Mg$ SO

$M \times 2$

13. What is the wavelength of a wave with a speed of 12 m/s and a period of 0.25 s?

___ A. 0.25 m

___ B. 1.5 m

X C. 3.0 m

___ D. 24 m

___ E. 48 m

$\lambda = \dfrac{v}{f} = v\left(\dfrac{1}{f}\right) = vT$

$\lambda = \left(12 \dfrac{M}{S}\right)(0.25 s) = 3 M$

14. Which pulses must be superimposed to give the situation shown in 5.

   __ A.   1 and 2

   ✗ B.   1 and 3 (CANCEL EACH OTHER)

   __ C.   2 and 4

   __ D.   1, 2, and 4

   __ E.   2, 3, and 4.

15. A 0.2-kg block is held in place by a force F that results in a 0.10-m compression of a spring beneath the block. The spring constant is 100 N/m. Assuming the mass of the spring is negligible compared to that of the block, to what maximum height would the block rise if the force F were removed?
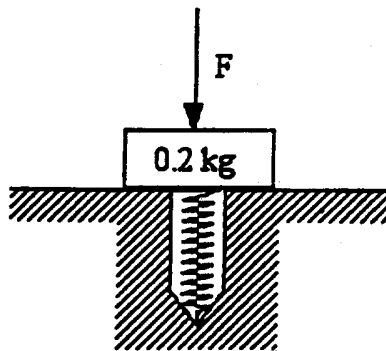

   ✗ A.   0.26 m

   __ B.   0.52 m

   __ C.   2.5 m

   __ D.   5 m

   __ E.   10 m

THIS IS ABOUT POTENTIAL ENERGY, IF WE REMOVE F, THE SPRING THROWS THE BLOCK UPWARD, IT RISES UNTIL ITS GRAVITATIONAL POTENTIAL ENERGY EQUALS THE POTENTIAL ENERGY STORED IN THE COMPRESSED SPRING!

$$mgh = \frac{1}{2}kx^2 \text{ so } h = \frac{kx^2}{2mg} = \frac{100(0.1)^2}{2(0.2)9.8} = 0.255 \text{ m}$$

4

16. A large tank is filled with water to a depth of 15 m. A spout located 10.0 m above the bottom of the tank is then opened as shown in the drawing. The tank is vented to the atmosphere at the top. With what speed will water emerge from the spout?
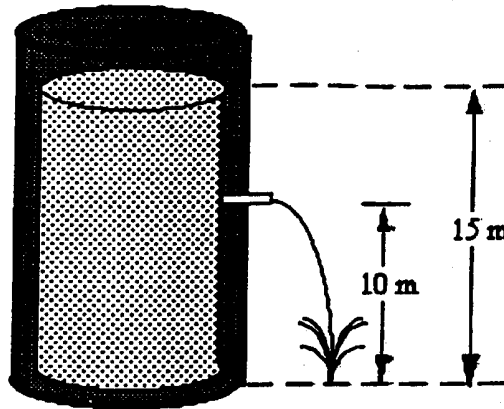
$$P_{TOP} + \rho g h_{TOP} + \rho \frac{V_{TOP}^2}{2} =$$

$$P_{SPOUT} + \rho g h_{SPOUT} + \rho \frac{V_{SPOUT}^2}{2}$$

$$P_{TOP} = P_{SPOUT} = 1 \; ATM$$

V_{TOP} IS VERY SMALL, SO NEGLECT IT. THEN

- A. 3.1 m/s
- X B. 9.9 m/s
- C. 14 m/s
- D. 17 m/s
- E. 31 m/s

$$\rho \frac{V_{SPOUT}^2}{2} = \rho g (h_{TOP} - h_{SPOUT})$$

$$V_{SPOUT} = \sqrt{2g(h_{TOP} - h_{SPOUT})} = \sqrt{98}$$

(SAME AS AFTER FREE-FALL OF 5M)

17. What is the period of pendulum consisting of a 6-kg object oscillating on a 4-m string?

- A. 0.25 s
- B. 0.50 s
- C. 1.0 s
- D. 2.0 s
- X E. 4.0 s

$$T = 2\pi \sqrt{\frac{\ell}{g}} \quad \text{INDEPENDENT OF MASS}$$

$$T = 2\pi \sqrt{\frac{4}{9.8}} = 4.01$$

18. Using the value of atmospheric pressure at sea level, 1×10^5 Pa, estimate the total mass of the earth's atmosphere above a 5-m² area.
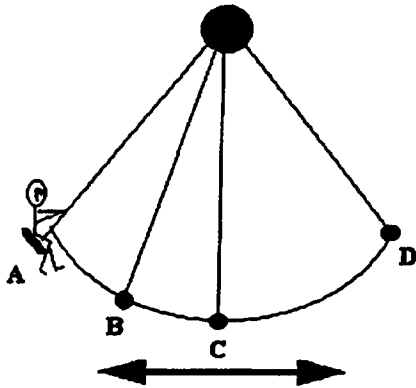
- X A. 5 x 10⁴ kg
- B. 9 x 10² kg
- C. 2 x 10⁻⁴ kg
- D. 4 x 10⁻² kg
- E. 3 x 10⁵ kg

THE PRESSURE IS THE WEIGHT OF THE AIR (mg) DIVIDED BY 5M² AREA IT RESTS ON: $(P = F/A)$

$$P = \frac{mg}{A} \quad SO \quad m = \frac{PA}{g}$$

$$m = \frac{10^5 P_a \times 5 m^2}{9.8 \, m/s^2} = \frac{5 \times 10^5 \frac{N}{m^2} m^2}{9.8 \, m/s^2} = 5 \times 10^4 \, kg \frac{m/s^2}{m/s^2}$$

5

The diagram shows the various positions of a child in motion on a swing. Somewhere in front of the child a stationary whistle is blowing.

Stationary
Whistle

19. At which position(s) will the child hear the highest frequency for the sound from the whistle?

___ A. at both A and D

___ B. at B when moving toward A

___ C. at B when moving toward C

___ D. at C when moving toward B

X E. at C when moving toward D

APPARENT FREQUENCY IS HIGHEST WHEN CHILD IS MOVING TOWARD THE WHISTLE WITH THE GREATEST SPEED

20. Young's modulus of nylon is 5 x 10⁹ N/m². A force of 5 x 10⁵ N is applied to a 2-m length of nylon of cross sectional area 0.1 m². By how much does the nylon stretch?

___ A. 2×10^{-1} m

___ B. 2×10^{-2} m

X C. 2×10^{-3} m

___ D. 2×10^{-4} m

___ E. 2×10^{-5} m

$$y = \frac{F L_o}{A \Delta L}$$

$$\Delta L = \frac{F L_o}{A Y} = \frac{5 \times 10^5 (2)}{0.1 (5 \times 10^9)}$$

$$\Delta L = 2 \times 10^{-3}$$