# Quest Chapter 25

| # | Problem | Hint |
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| 1 | (part 1 of 2)<br>Jim and Gina are swinging on adjacent, equal length swings at the school playground. Jim weights about twice as much as Gina<br>Who, if either, will take less time to swing back and forth?<br>1. Same for both<br>2. Jim<br>3. Gina | What determines how long it takes for a swing to complete a full cycle? Mass? Length?<br>If mass, then would more mass take less time? If so, then Jim. If not, then Gina.<br>If length, well the is the same so the time would be the same. |
| 2 | (part 2 of 2)<br>What, if anything, will change if Jim swings while standing on the seat of his swing?<br>1. No change to the periods<br>2. Jim's period will decrease.<br>3. Gina's period will decrease. | What would standing do the the determining factor of a pendulum? How would that affect the time (period)? |
| 3 | A child in a swing oscillates with a certain frequency of oscillation (the child is sitting still). Another child sits next to the first child.<br>How does the swing's frequency of oscillation change when the second child sits next to the first child?<br>1. more information is needed<br>2. stays the same<br>3. decreases<br>4. increases | What is changing in the problem? Length or mass?<br><br>Refer to question 1 for the rest of the hint. |
| 4 | You are designing a pendulum clock to have a period of 1.35 s.<br>The acceleration of gravity is 9.81 $m/s^2$ .<br>How long should the pendulum be? | $T_{pendulum} = 2\pi$ sqrt($L/a_g$)<br><br>Substitute and solve for L. |
| 5 | What is the period that corresponds to a frequency of 56.9 Hz? | How are period and frequency related? |
| 6 | What is the frequency corresponding to a period of 5.81 s? | How are period and frequency related? |

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| 7 | A nylon guitar string vibrates in a standing wave pattern shown below.<br>What is the wavelength of the wave? | Remember that symmetrical sections of a wave have the same length and the same time. Break the time down by section and add up enough sections to cover a full cycle. |
| 8 | Andrea asked her brother to take a 8 ft floating raft out of the water near the wave-swept shore. Using this raft as a measuring tool, she estimated that the wavelengths of these particular ocean waves were about 12 ft.<br>How fast are these surface ocean waves if the frequency remains 1/3Hz? | Remember: $v = \lambda f$.<br><br>Substitute and solve. |
| 9 | Two waves have the same speed. The first has twice the frequency of the second.<br>Compare the wavelength of the two waves.<br>1. They have the same wavelength.<br>2. The second has one third the wavelength of the first.<br>3. The second has half the wavelength of the first.<br>4. The first has half the wavelength of the second.<br>5. The first has one third the wavelength of the second. | Remember: $v = \lambda f$.<br><br>So, $\lambda_2 f_2 = v = \lambda_1 f_1$<br><br>Use your algebra skills to modify this to agree with the problem. Then, solve for wavelengths. |
| 10 | (part 1 of 2)<br>A piano emits frequencies that range from a low of about 25 Hz to a high of about 4300 Hz.<br>Find the maximum wavelength in air attained by this instrument when the speed of sound in air is 344 m/s. | Do you want the low frequency or the high one?<br><br>Remember: $v = \lambda f$.<br>Solve for $\lambda$. |
| 11 | (part 2 of 2)<br>Find the minimum wavelength in air attained by this instrument. | Find $\lambda$ for the other frequency. |
| 12 | “Doing the wave” is a common activity in large football stadiums.<br>What type of wave is this?<br>1. Cannot be determined from the information.<br>2. Transverse wave.<br>3. Longitudinal wave. | What are the definitions for transerve and logitudinal waves?<br>How does this behavior align? |

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| 13 | How many antinodes are in the standing wave pattern shown? | What is an antinode?<br>Where is it found?<br>Count. |
| 14 | (part 1 of 2)<br>The length of a string is 856 cm. The string is held fixed at each end. The string vibrates in eight sections; i.e., the string has eight antinodes, and the string vibrates at 135 Hz. Find the wavelength. | Remember: $\lambda = 2L/N$<br>where L = length, and<br>N = #antinodes<br>Answer in meters. |
| 15 | (part 2 of 2)<br>What is the fundamental frequency? | Remember: The fundamental frequency is also called the first harmonic frequency ($f_1$).<br><br>f = frequency of vibration (from problem 14), and<br>N = # antinodes (from problem 14), then $f_1 = f/N$ . |
| 16 | Consider standing waves on a string of length 23.7 cm.<br>Which wave has a wavelength 14.8 cm? | How many wavelengths occur along the string? ($L/\lambda$)<br><br>Which diagram displays that many wavelengths? |
| 17 | The four figures below represent sound waves emitted by a moving source.<br>Which picture represents a source moving at a speed greater than zero but less than the speed of sound? Waves emitted later than the original wave have smaller radii. | Which Check your notes.<br>What will be the spread on leading side of the speed is less than $v_{sound}$?<br>What will be the spread on the trailing side if the speed is less than $v_{sound}$? |

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| 18 | (part 1 of 3)<br>At what point in its motion is the KE of a pendulum bob a maximum?<br>1. at the lowest point<br>2. midway between the highest and lowest points<br>3. at the highest point<br>4. The KE does not change. | Check you notes.<br>KE is at its maximum when velocity is what?<br>Where does that occur in the motion of a pendulum? |
| 19 | (part 2 of 3)<br>At what point is its PE a maximum?<br>1. at the lowest point<br>2. The PE does not change.<br>3. midway between the highest and lowest points<br>4. at the highest point | Check you notes.<br>PE is at its maximum when velocity is what?<br>Where does that occur in the motion of a pendulum? |
| 20 | (part 3 of 3)<br>When its KE is half of its maximum value, how much PE does it have?<br>1. half of its maximum value<br>2. its minimum value<br>3. the same as its PE at any other point.<br>4. its maximum value | How does PE and KE change in the motion of a pendulum.<br>(Think 1$^{st}$ Law of Thermo.) |

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| 21 | A block is placed on the top of a ramp as shown in the figure below. The block is released from rest on the frictionless incline. When the block reaches the flat portion of the table it begins to feel a frictional force with the table characterized by a coefficient of kinetic friction $\mu_k$.<br>Which of the following statements about the energy and work of the system could NOT be correct?<br>1. On the table, friction does work on the block causing it to slow down.<br>2. The block's gravitational potential energy loss is equal to kinetic energy gain as it descends.<br>3. The normal force from the incline does no work on the block.<br>4. Along the incline, the potential energy of the system decreases from its initial value.<br>5. The sum of the potential energy and the kinetic energy of the block at any point along the entire path of travel is conserved.<br>6. When the block reaches the bottom of the incline, its kinetic energy reaches a maximum.<br>7. Along the incline, gravity does work on the block causing it to speed up. | Analyze the problem.<br>Break the motion into two events: The descent and the horizontal motion.<br><br>What does "frictionless" mean?<br>Are there any losses in a frictionless situation? No.<br>While frictionless, is energy conserved? Yes.<br><br>What changes when friction occurs?<br>Are there any losses in a frictionless situation? Yes.<br>With friction, is energy conserved? Yes.<br><br>Be careful. You are asked to find the statement that is **NOT** correct. So, cross off answers that ARE correct. The one that remains must be the answer. |
| 22 | (part 1 of 2)<br>A heat engine absorbs 530 J of thermal energy and performs 17.6 J of work in each cycle.<br>Find the efficiency of the engine. | Remember:<br>eff = work done/energy used |
| 23 | (part 2 of 2)<br>Find the thermal energy expelled in each cycle.<br>Answer in units of J | "expelled" Did this energy do any work? |

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| 24 | A heat engine operates between two reservoirs at 27.2°C and 243°C.<br>What is the maximum efficiency possible for this engine? | Check you notes about ideal or Carnot efficiency. |
| 25 | A 2000 kg car experiences a constant braking force of 10,000 N, and comes to a stop in 6 sec.<br>What would have been the speed of the car just before the brakes were applied?<br>1. 15 m/s<br>2. None of these<br>3. 30 m/s<br>4. 12 m/s<br>5. 40 m/s<br>6. 45 m/s<br>7. 50 m/s | A car has a mass and a speed.<br>It stops in a certain amount of time.<br>Two things have changed for the car.<br>Check page 87. |
| 26 | The pressure exerted on the ground by a man is greatest when<br>1. he stands with both feet flat on the ground.<br>2. his pressure on the ground is the same, however he stands, sits or lies.<br>3. he lies down on his back.<br>4. he sits on his butt.<br>5. he stands flat on one foot.<br>6. he stands on the toes of one foot. | What is the definition of pressure?<br>Does the fellow's weight change?<br>What is changing? |
| 27 | (part 1 of 2)<br>A 4.3 kg mass weighs 39.56 N on the surface of a planet similar to Earth. The radius of this planet is roughly $6.1 \times 10^6$ m.<br>Calculate the mass of of this planet. The value of the universal gravitational constant is $6.67259 \times 10^{-11}$ N · m²/kg².<br>Answer in units of kg | Use Newton's Universal Law of Gravitation:<br><br>$F_g = Gm_1m_2/r^2$ |
| 28 | (part 2 of 2)<br>Calculate the average density of this planet.<br>Answer in units of kg/m³ | $V_{sphere} = (4/3)\pi r^3$ |
| 29 | (part 1 of 2)<br>A pedestrian moves 4.7 km east and then 13 km north.<br>Find the magnitude of the resultant displacement vector.<br>Answer in units of km | What is the angle between east and north?<br>Hmmm…Who was that Greek guy whose theorem we use for this? |

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| 30 | (part 2 of 2)<br>What is the direction of the displacement vector (using the counter-clockwise angular direction to be positive, within the limits of $-180^{\circ}$ to $+180^{\circ}$)?<br>Answer in units of $^{\circ}$ | Do you remember the inverse trig functions?<br>Which would you use for this if you have north and east? |
| 31 | A gas is initially inside an insulated vessel at a volume $V_1$, a temperature $T_1$, and a pressure $P_1$. The gas then expands adiabatically to a volume $V_2$.<br>Which statement best describes what occurs?<br>1. $T_2 > T_1$.<br>2. All of these are true.<br>3. None of these is true.<br>4. The pressure $P_2$ is greater than $P_1$.<br>5. Work is done by the gas. | “Adiabatically”<br>Does heat move in or out in this process?<br>So, can the temperature increase? The pressure?<br><br>To expand, what must the volume of gas do? |