

ANSWERS AND EXPLANATIONS

1. The correct answer is B. This question involves centripetal force, which is sometimes confused with centrifugal force. Stock car drivers know that centripetal force increases when traveling around corners during acceleration or no braking. Racetracks are purposely elevated on the outside of the curve to counteract this force.
2. The correct answer is A. This question involves water density and resistance. The tug and ship combination in A will ride higher on the water because ocean water contains salt. Salt water is denser than fresh water therefore, the tug and ship will be more buoyant on the salt water than in the ones traveling in river water. Decreased buoyancy means the tug and ship in B will ride lower, have more of its surface below water, and greater drag to overcome.
3. The correct answer is B. The boiler heats water flowing through the pipe. Cooling occurs in the water the farther it is away from the boiler. Room A is furthest away from the heat source.
4. The correct answer is B. With the switch open as shown for A, the circuit is not complete. The circuit is only completed when the switch is closed at B, allowing flow of electricity through the alarm.
5. The correct answer is B. This question has to do with forces on springs and "simple harmonic motion". If the upward force is suddenly removed, the stored energy in the compressed spring transforms back and forth between kinetic and potential energy, pushing the lever down, then up, then down, then up until all the energy is transferred into some other form.
6. The correct answer is A. This question involves how gears work. The gear adjacent to gear Z must move counterclockwise for its indicator to point to X. Therefore, gear Z needs to rotate clockwise, toward A.
7. The correct answer is B. The object will hit the water with a greater rate of speed in picture B. This is because rollers provide the least resistance to an object in motion. The bigger splash associates with an object hitting water with greater force.
8. The correct answer is B. As the pinion gear inside Gear X moves counterclockwise, the internally configured teeth of the pinion gear also moves counterclockwise. Gear X is an "internal gear" meaning that its teeth point toward its center rather than away from its center. The shaft built into the pinion gear will move the same direction as the pinion gear, counterclockwise.
9. The correct answer is B. The pressure of a gas inside a container, such as a balloon, increases as its temperature increases. This means that the pressure exerted on the inside of the balloon is proportional to the temperature of the heated air. Since the temperature is greater for Hot Air Balloon B, it has the greatest internal pressure inside the balloon.
10. The correct answer is A. This question involves light rays and reflective surfaces. Imagine an identical lamp mirrored on the opposite side of the reflective surface from the lamp shown. Imaginary light from the imaginary lamp would also hit the surface between points X and Y. This path identifies the direction of the path that the real reflected light will travel.
11. The correct answer is A. When a spring is loaded it will stretch toward the direction the load is applied.

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12. correct answer is B. This question involves how gears perform work. Look at the chain around the top gear. When the top gear moves counterclockwise, the chain moves counterclockwise as well. The chain will continue in the counterclockwise direction all the way around the bottom gear. This means the chain will go down towards A (not up at A) and up towards B as the arrow at B shows.
13. The correct answer is A. This question involves levers. A lever is a simple machine that uses an immovable point of support called a fulcrum. The load exerts a downward force on the lever that is supported by a fulcrum that can rotate. As the load is applied, the lever lowers on the side marked A. When the lever lowers on this side, it creates an incline beneath the ball. The ball will roll down, which in this case, is toward side A.
14. The correct answer is A. This question involves fluid pressure. As the depth of the fluid increases, its pressure increases. The pressure in the drum increases when filled with more oil.
15. The correct answer is B. A moving gear rotates the gear beside it in the opposite direction. When the top right sprocket gear moves counterclockwise as shown by the arrow, the bottom gear will move clockwise in direction B.
16. The correct answer is A. This question involves trajectory, which is the curved path an object will take when launched. Gravitational forces cause the object to return to the ground. At each arrow's maximum height, the velocity of the arrow will be zero. Treating the ground as the X-axis and the height as the Y-axis, you can break the trajectory into two components of motion - an X direction or range, and a Y direction or range. The Y height obtained for a 60° launch is always greater than the Y height obtained for a 45° launch.
17. The correct answer is B. The circuit is completed when the switch is closed, allowing flow of electricity. The voltmeter will register electricity when it flows. In position A, the voltmeter registers no electrical power flowing in the circuit.
18. The correct answer is B. This question involves pulleys. At point A, the weight the motor must lift is 100 pounds. In the case of point B, the additional pulleys are not oriented to decrease the work for the motor, and in fact, add friction resistance to the load.
19. The correct answer is A. This question involves forces caused by fluid pressure that keep things, including gas bubbles afloat. The gas pumped in from the pipe at X is a vapor. A vapor form that becomes trapped in a liquid creates pockets of gas that we know as gas bubbles. As the gas enters and breaks into bubbles, it displaces (takes the place of) the liquid in the container. The gas bubble has a weight and the liquid that it displaces also has a weight. The buoyancy force is upward and equal to the weight of the fluid displaced. In this case, the pipe exiting at B is filled with liquid and anything moving through the pipe at B would be moving downward.
20. The correct answer is B. As a liquid changes to vapor form, the volume of liquid decreases. Less volume of liquid means, the surface of the liquid will be lower in the beaker.
21. The correct answer is A. Pressure builds inside the flask as the water heats and turns to steam. This is because steam is a gas that expands inside the flask, creating a pressure vessel with the potential to explode as steam builds.
22. The correct answer is A. Rotation of the paddle wheel produces thrust, forward or backward as required. In this case, the boat pointed toward B, but the paddle wheel is rotating toward A, which moves the boat in that direction.

23. The correct answer is B. This question involves the behavior of gases. Placing the same volume of gas into a smaller container increases the pressure created by the gas against the sides of the container.
24. The correct answer is A. When an object with greater mass hits an object with less mass, the result is that the object with greater mass moves less than the object with less mass.
25. The correct answer is A. This question involves how levers and fulcrums work. Look at how the lever is balanced over the fulcrum support. The lever extends further toward B, than it does toward A. The greater the distance between the end of the lever and its support point, the greater the impact of the force (moment). Side A of the lever has less force effect than side B with the application of the force on each end. This upsets the balance of the lever, causing the side with the greatest force effect to move down and the other side to move up at A.
26. The correct answer is B. This question involves the potential momentum of an object. As the lever is pulled upward on its left side, the right side of the lever travels downward. The lever will graze the ball shown, transferring energy to the ball propelling it toward B.