

Physics Topics Lists (Study Guides) 1-7

Topics List Test 1 Force and Motion (1-1, 1-2)

1. Motion is an object's change in position relative to a reference point.
2. A reference point or point of reference is an object that appears to stay in place as another object moves. It is necessary to observe motion.
3. Average speed is total distance/total time. Be able to calculate average speed given distance and time.
4. Instantaneous speed is an object's speed at a particular moment, or instant.
5. The difference between speed and velocity is that speed is just how fast something goes while velocity is how fast something goes in a certain direction. Speed is a "scalar" that shows only how fast an object is going while velocity is a "vector" that indicates the rate at which an object changes position. Speed has only a magnitude or size while velocity has both a magnitude and a direction.
6. A scalar is a measurement that has only a size or magnitude while a vector is a measurement with both a size or magnitude and a direction. Given examples of measurements, be able to classify them as scalars or vectors.
7. Acceleration is the rate at which velocity changes.
8. Be able to draw, read, and analyze speed graphs (distance v time). Know what constant speed and changing speed look like on speed graphs.(p.5)
9. Be able to analyze acceleration graphs.(p.8)
10. Circular motion is constant acceleration because you are always changing direction so the velocity is always changing.
11. A force is a push or pull on an object that has both a size and direction.
12. Net force is the combination of forces acting on an object. Forces in the same direction are added while forces in opposite directions are subtracted. You should be able to use net force to determine the direction that an object will move.
13. Unbalanced forces cause changes to objects' motions.
14. Balanced forces cause no changes to objects' motions.

Topics for Test 2 Friction and Slipping and Sliding Lab (1-3)

Friction

- 1 Friction is a force (N) that opposes motion between surfaces that are in contact.
 - 2 Friction occurs among all the different states of matter including liquids and gases.
 - 3 Friction can be either kinetic or static.
 - 4 Static friction occurs when the object is not moving.
 - 5 Kinetic friction occurs when the object is moving.
 - 6 Rolling
 - 7 Sliding
 - 8 Fluid
 - 9 Friction is caused when hills and valleys of solid surfaces touch each other and stick.
 - 10 The amount of friction between two surfaces depends on many factors.
 - 11 The greater the force pushing the surfaces together, the greater the friction
 - 12 The more rough the surfaces, the greater the friction
 - 13 Friction can be both helpful and harmful.
 - 14 Know some examples of how it is helpful and harmful.
 - 15 The force of friction can be increased or decreased.
 - 16 Friction may be reduced by lubricants, changing from sliding to rolling, and smoothing surfaces.
 - 17 Friction may be increased by roughening surfaces or increasing the force pushing them together.

Shipping and Sliding Lab

- 18 Given a description of an experiment, be able to recognize sources of error:
 - 19 failure to keep constant variables constant
 - 20 failure to match the experimental design to the problem or question
 - 21 failure to conduct multiple trials
- 22 Given a data table from an experiment, be able to analyze data:
 - 23 to answer the experimental problem or question or recognize that the data are inconclusive
 - 24 to critique someone else's data analysis
- 25 Given an inquiry task be able to identify the following:
 - 26 question
 - 27 independent variable
 - 28 dependent variable
 - 29 constant variables

Topics List Test 3 Gravity and Motion (1-4, 2-1)

The Law of Universal Gravitation:

- 1 Gravity is a pulling force that attracts all objects to each other.
 - 2 The greater the masses of the objects, the greater the gravitational force
 - 3 The greater the distance between the objects, the less the gravitational force
- 4 Compare and Contrast mass and weight
- 5 Mass is the amount of matter in an object.
 - 6 measured with a beam balance in units of grams
 - 7 does not depend on gravity or location
- 8 Weight is the pulling force of gravity on an object.
 - 9 measured with a spring scale in units of Newtons
 - 10 depends on gravity and location.

11 Falling Objects—Gravity and Air Resistance

- 12 All objects accelerate toward earth at the same rate (9.8 m/s/s)
- 13 Air resistance is the force that opposes the motion of an object through air.
 - 14 Air resistance is fluid friction between the moving object and the molecules of air that it is passing through.
 - 15 The amount of air resistance on a moving object depends on the object's size, shape, and speed
 - 16 Terminal velocity occurs when the force of air resistance equals the force of gravity. Acceleration stops when the forces balance.
 - 17 Free fall is when an object falls without air resistance, as in orbit.

Orbit—Inertia and Centripetal Force

- 18 Orbit is the circular motion of one object around another object in space.
 - 19 Two motions combine to form orbit: inertia(forward motion) and free fall
 - 20 Centripetal force is the unbalanced force that causes orbiting objects to move in a circle.
 - 21 Gravity provides the centripetal force that keeps objects in orbit.

Projectile Motion

- 22 Projectile motion is the curved path that an object follows when it is thrown or propelled near the surface of the earth.
- 23 Projectile motion has two independent/unrelated parts, horizontal and vertical motion.

Topics List Test 4 Newton's Laws (2-2)

24 Newton's First Law: Objects tend to resist changes to their motions. (Inertia)

25 An object that is not moving will not move unless acted upon by an unbalanced force.

26 An object that is moving will continue to move at the same speed and in the same direction (velocity) unless acted upon by an unbalanced force.

27 *Balanced* forces do not cause changes to an object's motion.

28 Newton's Second Law: The acceleration of an object depends on its mass and the force applied to it.

29 Acceleration equals applied force divided by mass of object. ($A=F/M$)

30 Given the mass of an object and the force applied to it, be able to calculate its acceleration in m/s/s using the formula.

31 The greater the force, the greater the acceleration.

32 The greater the mass, the less the acceleration.

33 Be able to explain how a change to force or mass changes acceleration.

34 Newton's Third Law: Forces act in pairs.

35 If a force is exerted, another force occurs that is equal in size and opposite in direction.

36 Action and reaction force pairs are present in moving and non-moving objects.

Topics List Test 5 Work and Machines (Chapter 4)

Section 1: Work(4-1)

1Work is when a force causes an object to move in the direction of the force.

2Work=Force \times Distance. Be able to calculate work given force and distance.

3Work is a scalar, measured in **joules** (Newton-meters), a unit of energy

4Force is a vector, measured in **Newtons**

5Distance is a scalar, measured in **meters**

Section 2: What is a Machine?(4-2)

6A **machine** is a device that makes work easier by changing the size or direction of force.

7Work **input** is the work done **on** a machine (often by a person)

8Work **output** is the work done **by** a machine (on another object)

9Input **force** is the force put on a machine (often by a person)

10Output **force** is the force that the machine applies to another object.

11The force-distance **Tradeoff: machines can change the relationship between input and output force and distance.**

12Force **multipliers:** Some machines increase the input distance to decrease the input force. They make it possible to exert greater force on an object over a shorter distance. These machines make it possible for us to lift heavy things or crush tough objects.
Examples: ramp, nutcracker, wheel barrow

13Distance and speed **multipliers:** Some machines increase the input force to decrease the input distance. They make it possible to move an object a greater distance and speed. These machines make it possible for us to generate faster speeds by covering greater distances in a given time.
Examples: Lacrosse stick, baseball bat, hammer

14Mechanical **advantage** is the number of times a machine multiplies force. It compares the input and output forces.

15MA= output force/input force

16Be able to calculate mechanical advantage given output force and input force.

17Mechanical **efficiency** compares a machine's work output with its work input. It answers the question, "how much work makes it through the machine and how much work is lost due to friction in the machine?"

18ME=work output/work input \times 100%. Be able to calculate mechanical efficiency given work output and work input.

19The work output of a machine is always less than the work input of a machine because of energy lost due to friction, **so no machine can have a mechanical efficiency of 100%.**

Section 3: Types of Machines(4-3)

Lever, pulley, wedge, screw, wheel and axle, inclined plane

20Be able to identify and give examples of six simple machines.

21Be able to analyze the mechanical advantage of each simple machine.

22Be able to recognize machine families: “Wheel is a circular lever while pulley is a grooved wheel. Wedge is a moving inclined plane while screw is an inclined plane wrapped around a cylinder.”

Levers: (107-8)

Lever Class	Input, Fulcrum, and Load-Output locations	Direction change	Force distance tradeoff	Mechanical Advantage
First	I-F-LO	yes	variable	variable
Second	F-LO-I	no	Force multiplier	>1
Third	F-I-LO	no	Distance/speed multiplier	<1

23First class lever: Input, Fulcrum, Load-output

Changes the direction of force. May be a force or distance multiplier or neither.

Mechanical advantage is variable.

24Second class lever: Fulcrum, Load-output, Input. Does not change the direction of the force. Force multiplier. Mechanical advantage is greater than 1.

25Third class lever: Fulcrum, Input, Load-output. Does not change the direction of force. Distance/speed multiplier. Mechanical advantage is less than 1.

Pulleys(108): a grooved wheel with a rope or cable

26Fixed pulley is a single pulley that only spins, so it changes only direction, not force. MA=1

27Movable pulley is a single pulley that spins and moves up with the load-output as it is lifted. It is a force multiplier, MA=2.

28Block and tackle is 4 pulleys with four rope segments running among them. It is a force multiplier, MA=4.

29Compound machine (112) is a machine made up of two or more simple machines working together. Given an example of a compound machine, be able to identify the simple machines that make it up.

Topics List 6 Energy

What is Energy(5-1)

1Energy is the ability to do work.

2expressed in units of joules (J)

3when one object does work on another, the energy is transferred from the first object to the second object.

There are many different forms of energy:

4Kinetic energy	Energy of motion
5Potential energy	Stored energy or energy due to an object's position
Mechanical energy	the sum of an object's kinetic and potential energy
6Thermal energy	the energy of an object's moving particles (atoms and molecules); it is related to but different from heat and temperature
7Sound energy	the energy of vibrations traveling in waves through matter
8Nuclear fission energy	comes from changes to the atom's nucleus: when the nucleus of an atom divides
9Nuclear Fusion energy	comes from changes to the atom's nucleus: when two or more nuclei join together
10Electrical energy	the energy of moving electrons being pushed or pulled by electromagnetic force
11Chemical energy	the energy contained in the bonds among atoms and molecules. It changes as the bonds change.
12Light energy	produced by the vibrations of charged particles; it moves in waves and doesn't need matter to move; its characteristics depend on the wavelengths; it can be invisible or visible.

13Potential energy is stored energy that an object has because of its shape position.

14Be able to calculate gravitational potential energy:

15GPE = weight x height

16Unit label is newton-meters or joules (J)

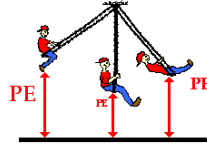
17Kinetic energy is the energy of an object due to its motion. It depends on mass and speed, but speed matters more than mass does.

18Given mass and velocity, be able to calculate an object's KE:

19 $KE = \frac{1}{2} mv^2$

20Unit label is joules

21The PE or KE of an object can increase or decrease, but the total energy of an object (**ME**) **remains the same** unless it transfers some of its energy to another object.



Ex:

- When the child is pulled back at the highest point on the swing, the ME is PE.
- As the child swings forward toward the lower (middle) part of the wing, the child accelerates and gains KE, but due to the height position the PE of the child decreases.
- Child continues to swing upward and slows down as KE decreases, but the height and PE increase.
- The child reaches the highest point of the swing and the ME is PE.

22The Law of Conservation of Energy is that energy may change form, but it cannot be created or destroyed. (The total amount of energy remains constant.)

23Energy Conversions are when energy changes from one form to another.

- Any form of energy can change into any other form(s) of energy.

Energy Conversions(5-2)

24Given a real world situation that we have not previously discussed, be able to describe and explain the energy transformations that are occurring in it.

Energy conversion example: Swingset

With every pass of the swing, friction and air resistance are unbalanced forces which cause some of the ME of the swing to change to thermal energy (heat).

Energy conversion in plants: Nuclear fusion in the sun produces light energy that travels through space until it reaches the leaves of plants on earth. The plant leaves absorb the light energy from the sun. They use the light energy along with chlorophyll to turn CO_2 and H_2O into sugar which stores the sun's energy chemically.

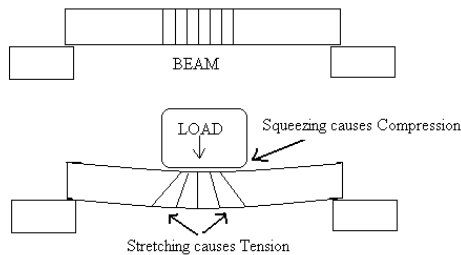
Energy conversions in the human body:

- Every time you move your hand you rely on the conversion of stored PE to KE on your hand as you do work on it.
- Some of the stored PE in your body is used to maintain constant internal body temperature. Some of the stored PE is also converted to excess heat your body gives off to its surroundings.
- In your body stored energy is found in fat and is lost when work is done or when heat is lost by your body to its surroundings.
- To stay healthy you need a proper balance between energy taken in and energy lost from your body as work or heat.
- **Food is our chemical potential energy**
Your body chemically changes food into molecules that can combine with oxygen and be used as fuel. Your body converts energy stored in fats for its immediate needs until you eat. We get energy (Calories) from food. The energy from food allows us to maintain constant body temperature, helps organs function, allows us to move and do work.

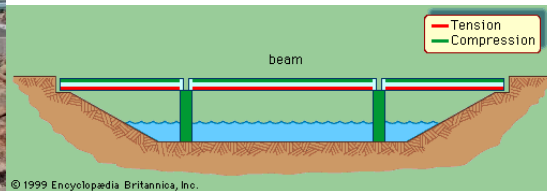
Bridge Basics

Bridges can be designed in different ways and from different materials to withstand certain loads and potentially destructive forces.

1. **Bridges** are elevated structures designed to support the movement of objects over a **span**. **Span** can describe the distance the bridge covers or the unsupported distance between **supports** or **piers** that are attached to the ground. Bridges must support their own weight (**dead load**) and the weight of those objects that will cross over them or other forces that will act on them from time to time, such as wind, snow and ice (**live load**). Bridges are kept stable by balancing the load forces with the supporting forces of the structure. These forces can cause parts of the bridge structure to push together (**compression**) or pull apart (**tension**).



2. Different bridge designs distribute tension and compression forces in different ways, depending on the shapes of the parts of the structure. The biggest difference among bridge designs is the distances they can cross in a single span. Shapes commonly used in bridge design include arches, triangles and rectangles.
3. Bridges are constructed of different materials whose properties and costs vary. Some materials are strong against compression forces but weak against tension forces; some materials resist fire, corrosion or weathering. Materials commonly used in bridge design include wood, rope, aluminum, concrete and steel.
4. A **beam bridge** balances the load by concentrating it entirely onto the two **piers** that support the bridge at either end, or sometimes on **piers** distributed throughout the span. When a force pushes down on the beam, the beam bends. Its top edge is pushed together (compression), and its bottom edge is pulled apart (tension). The amount of bend depends on the length of the beam. Beam bridges are cheap and simple, but they can only span short distances unsupported.

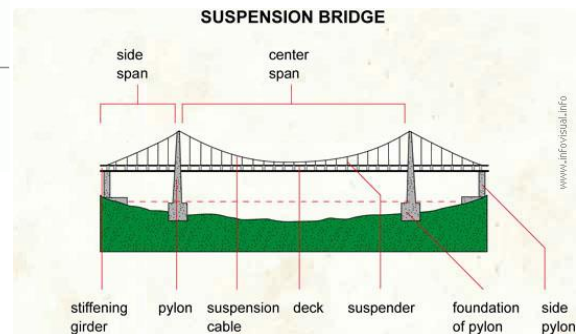
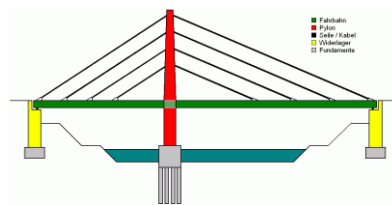


5. A **truss bridge** is a beam bridge with extra supports above the main beams. It uses rigid, interlocking **members** to form a system of triangles that distribute the load among all parts of the structure, increasing the structural strength of the bridge. Truss bridges can span longer distances than beam bridges can because the trusses support the beams.



6. A **suspension bridge** or **cable-stayed bridge** uses cables (steel ropes) suspended from tall towers to hold up the **deck** and distribute the load. The tension and compression forces acting on the beam are distributed among the cables (tension) and the towers (compression).

The **suspension bridge** has two sets of **cables**: a pair of thicker cables that runs horizontally and is attached to the towers and the land at the ends of the bridge and a thinner set of many cables that hangs the bridge from the thicker set. The **cable-stayed bridge** has only one set of cables that attach the deck directly to the towers. Suspension and cable stayed bridges can span the longest distances.



7. Engineers build models of bridges, conduct controlled experiments to learn how they will withstand various stresses, and consider the benefits and trade-offs of various design alternatives.
8. Bridge design is influenced by the length of the span, the properties of the materials, and environmental conditions, as well as by practical considerations, such as the bridge's appearance, cost of materials or construction site challenges.
9. Bridges can fail because they have faulty parts, are used in ways that exceed what was intended by the design, or were poorly designed to begin with. Most commonly, bridges fail because they have been **poorly maintained**—rusted steel or cracking concrete piers.

Bridge Basics Questions

1. Compare and contrast beam and truss bridges.
2. Compare and contrast truss and suspension bridges.
3. Explain the forces acting on the different parts of a loaded beam.
4. Which force do piers normally have to withstand?
5. What are the advantages and disadvantages of each bridge type?(beam, truss, suspension)
6. What are some materials that are used to make bridges and what are the advantages and disadvantages of each?
7. What are some things that builders and designers have to consider when building and designing bridges?
8. Why do bridges fail?
9. On the picture of the suspension bridge and truss bridges, label one place where there is tension and one place where there is compression.