# Today:

- Finish few slides from Ch 22

**- Review Session**

- **Midterm 2: Fri Nov 18**

Chs 9, 11, 13, 14, 15, 19, 20, 22

# Review for Midterm 2

- **Midterm 2: Fri Nov 18**

**Chs 9, 11, 13, 14, 15, 19, 20, 22**

- 55 multiple-choice questions
- Bring a No. 2 pencil and an eraser
- You will be given a periodic table

**Resources for studying:**

- go through all questions and examples we did during lectures
- revise lecture slides carefully, read book and "check yourself" qns for support
- additional questions in today's review: *do not* try these until you have studied the material from the lectures
- email me if you have any questions or want to meet (Thu afternoon is best)

# Recall:

- Chapter 9: Gravity: $F= Gm_1m_2/d^2$ , apparent weight = force exerted against supporting surface, ocean tides, spring and neap tides, black holes
- Chapter 11: Atomic Structure: nucleus (protons + neutrons) & electrons, atomic number, atomic mass, periodic table, isotopes, element, molecule, compound, antimatter. *You'll be given a periodic table.*

• Chapter 13: Liquids: Pressure = force/area, liquid pressure = weight density x depth, buoyant force, volume of fluid displaced = submerged volume of object, Archimedes principle: buoyant force = weight of fluid displaced, principle of flotation, Pascal's principle, surface tension, capillarity, adhesion, cohesion

• Chapter 14: Gases and Plasmas: atmospheric pressure, Archimedes' principle for air, barometer, Boyle's law, Bernoulli's principle for pressure of moving fluid, plasma

• Chapter 15: Heat: temperature, thermometer, absolute zero, internal energy, heat flows from hotter to colder object, specific heat capacity, thermal expansion, anomalous expansion of water

• Chapter 19: Vibrations and waves: simple harmonic motion, amplitude, frequency, period, frequency = 1/period, wavelength, wave speed = frequency x wavelength, transverse vs longitudinal, interference, Doppler effect, bow and shock waves, sonic boom

• Chapter 20: Sound: speed of sound, wave of compressions and rarefactions, reflection, refraction, natural frequency, forced vibration, resonance, interference, beats, beat freq $=f_1 - f_2$

• Chapter 22: Electrostatics: charge conservation, charge quantization, Coulomb's law $F= kq_1q_2/d^2$, conductors vs insulators, charging by induction, polarization, electric field, electric potential, electric potential energy

Consider two stars orbiting each other. If the masses of both stars were doubled, then the force between them is

A) Four times as much

B) twice as much

C) unaltered

D) quarter as much

E) None of these

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Answer: A, from $F = Gm_1m_2/d^2$

How about if the distance between them was *also* doubled?

Then, answer would be C, unaltered, (again, directly from F equation)

Consider three heavy objects A, B, and C, that are placed in a line. The mass of A is twice that of C. If B is placed exactly halfway between A and C, it will

1) accelerate toward A

2) accelerate toward C

3) Not accelerate at all

4) Oscillate between A and C

Consider three heavy objects A, B, and C, that are placed in a line. The mass of A is twice that of C. If B is placed exactly halfway between A and C, it will

1) accelerate toward A
2) accelerate toward C
3) Not accelerate at all
4) Oscillate between A and C

## Answer: 1

From the gravitational force law, $F = G M M_B/d^2$

For the force on B due to A, put M = mass of A above and for the force on B due to C, put M = mass of C above.

Since d is the same for both cases (B is halfway between A and C), then the greater mass exerts the greater force, i.e. A. Gravitational force is always attractive, so B accelerates towards A.

Passengers in a high-flying jumbo jet feel their normal weight in flight, while passengers in an orbiting space-shuttle do not. This is because passengers in the space shuttle are

A) Beyond the main pull of earth's gravity

B) Above the earth's atmosphere

C) Without support forces

D) All of these

E) None of these

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C) Without support forces

D) All of these

E) None of these

## Answer: C

Note that Earth's gravitational force is significant on the space shuttle – this is what keeps it in orbit around us -- and likewise for the moon!

.

The reason the Earth does not crash into the sun is that the

A) sun’s gravitational field is negligible as it is far away
B) gravitational pull of other planets keeps the Earth in orbit
C) Earth has sufficient tangential speed
D) Moon’s gravitational field is in the opposite direction so partially cancels out.
E) None of these

The reason the Earth does not crash into the sun is that the

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B) gravitational pull of other planets keeps the Earth in orbit
C) Earth has sufficient tangential speed
D) Moon's gravitational field is in the opposite direction so partially cancels out.
E) None of these

Answer C: the sun's pull curves the earth into orbit around it, see lecture.
Note that A must be wrong since if that was the case, then we wouldn't be in orbit at all around the Sun.
B must also be wrong, since the pull of the other planets will pull Earth into orbit around them.
D is wrong since the direction of the moon's pull changes depending on the phase of the moon and also the strength is much weaker than that of the sun.

During an eclipse of the sun, the sun, moon and earth are in alignment, and the high ocean tides on earth are then

A) extra high
B) extra low
C) not particularly different than at any other time

During an eclipse of the sun, the sun, moon and earth are in alignment, and the high ocean tides on earth are then

A) extra high
B) extra low
C) not particularly different than at any other time

A) Extra high because the tidal effects from the sun and tidal effects from the moon add up when sun, moon , and earth are in a line.

The best time for digging for clams is when the low tide is extra low. This happens at

A)New or full moon
B)Half moon
C)Quarter moon
D)None of these times in particular

The best time for digging for clams is when the low tide is extra low. This happens at

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A) At new or full moon, the earth, sun, and moon are in near-alignment, so tidal effects from the moon add to those from the sun, and low tides are extra low and high tides are extra high.

Which of these three produces the greatest tidal effect on *you* right now?

A) the moon
B) the sun
C) the Earth

Which of these three produces the greatest tidal effect on *you* right now?

A) the moon
B) the sun
C) the Earth

Answer: C

Tidal effects are created by *differences* in the gravitational pull on different parts of an object that are different distances from the object that is exerting its gravitational force on it. These differences decrease for greater distances between the objects, because the gravitational force “flattens out”.

The planet Jupiter is about 300 times as massive as Earth, yet on its surface you would weigh only about 3 times as much. This is because

A) Jupiter's radius is 10 times the Earth's radius.
B) your mass is 100 times less on Jupiter.
C) Jupiter is significantly farther from the sun.
D) you are 100 times more weightless there.
E) the atmospheric pressure there is much less.

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Answer: A
Recall equation for the force of gravity on an object – proportional to each mass but also inversely proportional to the square of the distance.

Atoms heavier than hydrogen were made by

A) photosynthesis
B) nuclear fusion
C) Nuclear fission
D) Radioactivity
E) None of these

Atoms heavier than hydrogen were made by

A) photosynthesis
B) nuclear fusion
C) Nuclear fission
D) Radioactivity
E) None of these

Answer: B

All nuclei larger than H were made by nuclear fusion in the stars long ago…

The continual increase in the world's population means

A) the average atomic mass of each element in the periodic table is continually decreasing to compensate the increase in the number of atoms

B) the mass of the earth and its inhabitants is increasing

C) the mass of non-human stuff on earth must be decreasing

D) none of the above

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C)
Atoms are continually recycled; the total mass of earth, atmosphere, and everything on it, remains the same. The increase in the number and mass of atoms making up humans means a decrease in the number of atoms making up everything else.

Which of the following statements is true?

A) An atom is the smallest particle known to exist.
B) There are only about 120 different kinds of atoms that combine to form many substances.
C) There are thousands of different kinds of atoms that account for a wide variety of substances.
D) A large atom can be photographed.
E) All of these statements are true.

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Answer: B

Properties like the taste or color of a substance depend primarily on which of the following?

A) how electrons are arranged around the nuclei in a molecule
B) how electrons get ionized in molecules
C) how the protons are arranged in the nucleus
D) the type of isotope – the number of neutrons
E) None of these

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A) how electrons are arranged around the nuclei in a molecule
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E) None of these

Answer: A , from lecture

If one neutron is added to a helium nucleus, the result is

A) beryllium.

B) boron.

C) hydrogen.

D) lithium.

E) helium

If one neutron is added to a helium nucleus, the result is

A) beryllium.

B) boron.

C) hydrogen.

D) lithium.

E) helium

Answer: E, helium – an isotope.

But if instead, a proton was added, then what would the answer be?

Then D, lithium.

To change platinum into gold, a proton must be

A) removed from the platinum nucleus
B) added to the platinum nucleus
C) removed from the gold nucleus
D) added to the gold nucleus
E) none of the above

To change platinum into gold, a proton must be

A) removed from the platinum nucleus
B) added to the platinum nucleus
C) removed from the gold nucleus
D) added to the gold nucleus
E) none of the above

Answer: B
From periodic table, gold (Au) has atomic # 79 while platinum (Pt) has atomic # 78. So gold has one more proton in its nucleus than Pt does.

Which of these atoms has the greatest number of protons?

A) helium

B) oxygen

C) lead

D) uranium

E) gold

Which of these atoms has the greatest number of protons?

A) helium

B) oxygen

C) lead

D) uranium

E) gold

Answer: D, from periodic table – U has the largest atomic number and atomic number = # protons (= # electrons in neutral atom)

Which has the greatest mass?

Also D.

If a gram of antimatter meets a kilogram of matter, the amount of mass to survive is

A) 1 gram

B) 999 grams

C) 1 kilogram

D) 1.1 kilogram

If a gram of antimatter meets a kilogram of matter, the amount of mass to survive is

A) 1 gram

B) 999 grams

C) 1 kilogram

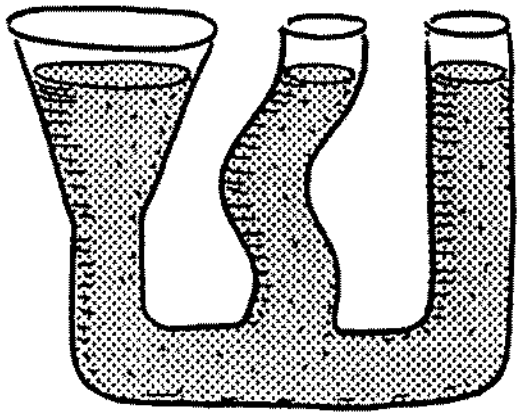
D) 1.1 kilogram

Answer: B

Antimatter and matter annihilate each other, so the 1gram of antimatter annihiliates 1gram of matter, leaving 999 grams of matter.

This is why antimatter is so short-lived in our part of the universe.

Everybody knows that “water seeks its own level,” but very few people know why water seeks its own level. The reason has most to do with



1. atmospheric pressure.
2. water pressure depending on depth.
3. water’s density.

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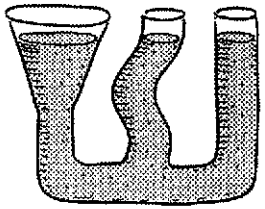


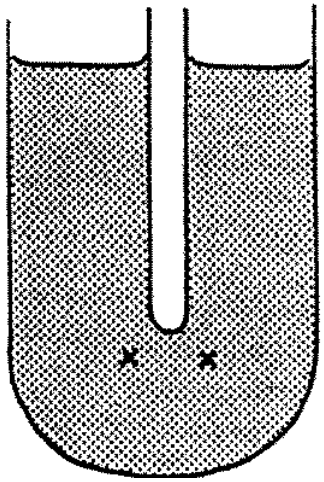
1. atmospheric pressure
2. **water pressure depending on depth.** ✔
3. water's density

**Answer: 2**

Water pressure depends on depth, so only at equal depths of water will the pressure be equal.

Consider the U-tube. If water is at rest where each X is, the pressures must be equal—otherwise a flow would occur from the region of higher to the region of lower pressure until the pressures equalize. For this to happen, the depths below the surfaces must be equal.

This is true whatever the density of water or whether or not there is atmospheric pressure.



Water pressure is greatest against the

A) top of a submerged object.

B) bottom of a submerged object.

C) sides of a submerged object.

D) is the same against all surfaces

E) none of these

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B) bottom of a submerged object.

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E) none of these

Answer: B

From liquid pressure = density x depth.

This is *why* the buoyant force acts *upward* on a submerged object.

The reason the buoyant force acts upward on a submerged object is that

A) it must oppose gravity.
B) if it acted downward instead, nothing would float.
C) upward pressure on its bottom surface is greater than downward pressure against its top
D) liquid density towards the bottom is higher than towards the top of a submerged object.

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Answer: C
Liquid pressure increases with depth; the associated force acts perpendicular to the surface, and because of the depth-dependence, it is larger on the lower surface compared to the upper surface, leading to a net upward buoyancy force.

A completely submerged object always displaces its own

A) volume of fluid.

B) weight of fluid.

C) density of fluid.

D) all of these

E) none of these

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A) volume of fluid.

B) weight of fluid.

C) density of fluid.

D) all of these

E) none of these

Answer: A

Because it is replacing this amount of water with its own volume…

The buoyant force on a rock is least when the rock is *completely* submerged in a lake

A) near the surface

B) halfway to the bottom

C) near the bottom

D) All of the above

The buoyant force on a rock is least when the rock is *completely* submerged in a lake

A) near the surface

B) halfway to the bottom

C) near the bottom

D) All of the above

Answer: D

since buoyant force = weight of the fluid displaced, so only depends on the size of a completely submerged object

If an object is instead only *partly* submerged, then the buoyant force would be less, as less fluid is displaced

When a boat sails from fresh water to salt water, the boat will float

A) lower in the water

B) higher in the water

C) at the same level

When a boat sails from fresh water to salt water, the boat will float

A) lower in the water

B) higher in the water

C) at the same level

Answer: B

Salt water is more dense, so a smaller volume of it will weigh the same as a larger volume of fresh water, hence supplying the same buoyant force but with less displacement.

Is the buoyant force on the sailing boat greater, less or the same in the salt water compared to that in the fresh water?

Answer: the same. For floating objects, the buoyant force always equals the weight of the object (i.e the weight of the boat). (In salt water less water is displaced since a smaller volume of salt water has the same weight as a larger volume of fresh water).

You buy two fancy necklaces, each of an ornate intricate shape, that you are told contain a mixture of gold and aluminum. They both weigh exactly the same. How can you determine which contains more gold? (note that gold is more dense than aluminum)

A) Put them each in a fixed volume of water. The one which floats lower will be more dense and therefore contains more gold.

B) Put each of them in a fixed known volume of water and measure the volume of the water displaced. The necklace which displaces more contains more gold.

C) Put each of them in a fixed known volume of water and measure the volume of the water displaced. The necklace which displaces less water contains more gold.

D) Ask at the nearest pawn shop.

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C) Put each of them in a fixed known volume of water and measure the volume of the water displaced. The necklace which displaces less water contains more gold.

D) Ask at the nearest pawn shop.

Answer: C
The amount of water displaced is equal to the volume of the object submerged in it. So the necklace that displaces less volume has itself a smaller volume, so therefore a larger density, since the weight of the two necklaces is the same. (Recall Archimedes and the King's crown)

The weight of water displaced by a floating 20-ton boat

A) is less than 20 tons.

B) is 20 tons.

C) is more than 20 tons.

D) depends on the shape of the ship's hull.

E) none of these

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A) is less than 20 tons.

B) is 20 tons.

C) is more than 20 tons.

D) depends on the shape of the ship's hull.

E) none of these

Answer: B

A floating object displaces  amount of water equal to its own weight -- since then the buoyant force balances the weight.

Recall buoyant force = weight of fluid displaced, so this question could be rephrased “The buoyant force on a floating 20-ton boat is…”

If floating, then no net force, so buoyant force  must equal weight of object.

The density of ice is about 0.9 that of water, while the density of alcohol is about 0.8 that of water. Will an ice-cube float higher or lower or the same in a mixed drink as more alcohol is added?

A) Higher

B) Lower

C) The same

D) Need more information

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A) Higher

B) Lower

C) The same

D) Need more information

**Answer: B, Lower**

In water, an ice-cube floats on the surface since its density is less than that of water. It displaces less water than its volume, since its weight is less than its volume of water, and weight of the water displaced is equal to the buoyant force.

Now adding alcohol means that the mixed drink density becomes less; therefore, to balance the same weight of the icecube requires more of it. i.e. the icecube will float lower in the drink with more alcohol.

In fact, in pure alcohol, ice-cubes will sink to the bottom!

The ratio of output force to input force of a hydraulic press will be equal to the ratio of the output and input piston

A) areas.

B) diameters.

C) radii.

D) all of these

E) none of these

The ratio of output force to input force of a hydraulic press will be equal to the ratio of the output and input piston

A) areas.

B) diameters.

C) radii.

D) all of these

E) none of these

Answer: A

Pascal's principle says that pressure is transmitted undiminished. Since pressure = force per unit area, then ratio of forces scales as ratio of the areas.

When you put a stick in water and remove it, the stick is wet. When you put a stick in mercury and remove it, the stick is dry. The reason for this is that adhesive forces are greater

A) between the stick and mercury.
B) between the mercury and the water.
C) between stick and water.

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A) between the stick and mercury.
B) between the mercury and the water.
C) between stick and water.

Answer: C

Adhesive forces are attractive forces between different types of molecules (eg fluid and stick)

Note: cohesive forces are attractive forces between like molecules – and give rise to surface tension…

As a balloon rises higher and higher into the atmosphere, its

A) volume decreases.

B) mass decreases.

C) weight increases.

D) density increases.

E) none of these

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A) volume decreases.

B) mass decreases.

C) weight increases.

D) density increases.

E) none of these

Answer E

As it rises, it experiences less atmospheric pressure, so it tends to expand (volume increases), if not rigid. Mass doesn't change, and weight doesn't change much (if anything, it decreases as g decreases a little bit). Since same mass, but increased volume, then density = mass/volume, is decreased.

Which of the following is true?

A)The density of a large body of liquid (e.g. ocean) remains about constant throughout its volume
B) The density of a large body of gas (e.g. our atmosphere) remains about constant throughout.
C) The pressure in the ocean remains about constant throughout its volume
D) The pressure in the atmosphere remains about constant throughout.
E) None of the above is true

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C) The pressure in the ocean remains about constant throughout its volume
D) The pressure in the atmosphere remains about constant throughout.
E) None of the above is true

Answer: A
Liquids are mostly incompressible, so their density remains about the same throughout. The pressure in a liquid increases with depth. Gases can be compressed and both the atmospheric density and pressure varies greatly throughout the atmosphere.

In drinking through a straw, we make use of

A) atmospheric pressure.
B) capillary action.
C) surface tension.
D) Bernoulli's principle.
E) none of these

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Answer: A)

Recall, the drink is pushed up the straw by the pressure difference between the atmospheric pressure pushing down on the liquid, and the very small pressure caused by your sucking the air out of your mouth…

Eg, can’t drink using a straw on the moon, since almost zero atmospheric pressure there

A suction cup sticks to a wall. It is

A) pulled to the wall by the vacuum.

B) pushed to the wall by the atmosphere.

C) both of these

D) neither of these

A suction cup sticks to a wall. It is

A) pulled to the wall by the vacuum.

B) pushed to the wall by the atmosphere.

C) both of these

D) neither of these

Answer: B)

In a vacuum a marshmallow becomes

A) larger.

B) flat.

C) smaller.

D) a hollow shell.

E) none of the above choices

In a vacuum a marshmallow becomes

A) larger.

B) flat.

C) smaller.

D) a hollow shell.

E) none of the above choices

**Answer: A**

Still have inside pressure of marshmallow cohesive forces and air inside marshmallow, but no outside pressure, so it will expand.

We discussed in class that a barometer made of water would have to be 10.3m tall. Alcohol is less dense than water. If alcohol is used to make a barometer on a day when atmospheric pressure is normal, the height of the alcohol column would be

A) 10.3 m.
B) less than 10.3 m.
C) more than 10.3 m.

We discussed in class that a barometer made of water would have to be 10.3m tall. Alcohol is less dense than water. If alcohol is used to make a barometer on a day when atmospheric pressure is normal, the height of the alcohol column would be

A) 10.3 m.
B) less than 10.3 m.
C) more than 10.3 m.

**Answer: C**

Recall that 10.3m is the height of a water column whose pressure balances the atmospheric pressure (ie weight of a 10.3m column of water = weight of same column of atmosphere).

Since alcohol is less dense, need more of it to balance the atmospheric pressure.

Suppose you are standing on a weighing scale and suddenly all the atmosphere vanished. Accounting for the buoyancy of air, the reading on the scale would

A) Increase

B) Decrease

C) Remain the same

D) Quickly reduce to zero

When you measure the weight of objects using scales, the buoyant force should be accounted for. Suppose you are standing on a weighing scale and suddenly all the atmosphere vanished. The reading on the scale would

A) Increase

B) Decrease

C) Remain the same

D) Quickly reduce to zero

Answer: A

In the presence of the atmosphere, there is an upward buoyancy force on you, that makes the apparent weight as measured by the scales less than your mg.

If this buoyant force is removed, the scales then measure mg, i.e. reading goes up.

Most of the matter in the universe is in the

A) Solid state

B) Liquid state

C) Gaseous state

D) Plasma state

E) None of these

Most of the matter in the universe is in the

A) Solid state

B) Liquid state

C) Gaseous state

D) Plasma state

E) None of these

Answer: D

Recall plasma = ions and electrons in a gaseous phase (eg in a fluorescent lamp). Least common in everyday life but most common form of matter in universe, eg stars

A substance that heats up relatively quickly has a

A) high conductivity.

B) low conductivity.

C) low specific heat.

D) high specific heat.

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A) high conductivity.

B) low conductivity.

C) low specific heat.

D) high specific heat.

Answer: C

Specific heat is like thermal inertia – objects with low specific heat don't require as much heat to raise their temp by the same amount as objects with higher specific heat.

Then, for objects with high specific heat, what is happening to the heat they are absorbing?

Answer: Materials with high specific heat (eg water )can absorb large amounts of energy in the form of internal vibrations and rotations.

The moderate temperatures of islands throughout the world has much to do with water's

A) poor conductivity
B) vast supply of internal energy
C) high specific heat
D) high evaporation rate
E) absorption of solar energy

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Answer C:
Specific heat capacity reflects the amount of energy needed to raise the temperature of the substance, as discussed in class, and water's specific heat is higher than most substances → doesn't change temperature as much..

If you stake out (measure) a plot of land with a steel tape on a very hot day, the actual amount of land you will have will be

A) smaller than measured.

B) larger than measured.

C) correct.

If you stake out (measure) a plot of land with a steel tape on a very hot day, the actual amount of land you will have will be

A) smaller than measured.

B) larger than measured.

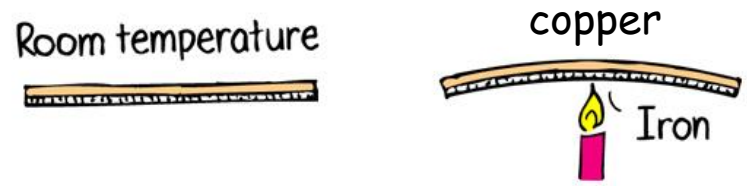
C) correct.

Answer: B

Due to the thermal expansion of the steel, the tic marks on it would be more widely spaced than usual. So a measurement of say 10cm on the expanded tape would represent a larger distance than 10cm.

When a bimetallic bar made of copper and iron strips is heated, the bar bends toward the iron strip. The reason for this is

A) iron expands more than copper.
B) copper expands more than iron.
C) copper gets hotter before iron.
D) iron gets hotter before copper.
E) none of these

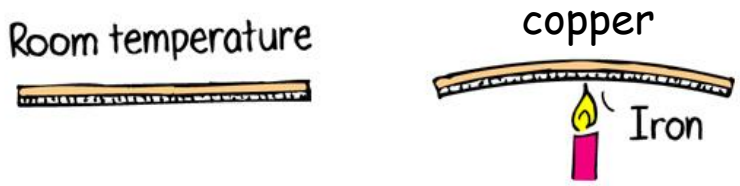


When a bimetallic bar made of copper and iron strips is heated, the bar bends toward the iron strip. The reason for this is

A) iron expands more than copper.
B) copper expands more than iron.
C) copper gets hotter before iron.
D) iron gets hotter before copper.
E) none of these

Answer: B

The copper becomes longer than the iron, but they are stuck together, so the bar bends, with the copper on the outside:



When you pour a small amount of hot fudge sauce on to your large serving of icecream,

A) heat will flow from the fudge to the icecream, as the icecream has a greater internal energy
B) heat will flow from the fudge  to the icecream, as the fudge has the higher temperature.
C) no heat will flow at all
D) none of the above
E) More than one of the above.

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E) More than one of the above

Answer: B
Heat always flows from the hotter object to the cooler object, regardless of internal energy

What does temperature indicate?

A) The heat energy of a substance
B) The internal energy of a substance
C) The kinetic energy of all the molecules in the substance
D) The average kinetic energy per molecule in the substance
E) The average translation kinetic energy per molecule in the substance

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Answer: E

From lecture.

Note that kinetic energy includes rotational, vibrational, and translational (jiggling), but the temperature is sensitive only to the translational. Internal energy includes all the kinetic energy as well as potential from the chemical bonds etc.

Consider a sample of water at 0 degrees C. If the temperature is slightly increased, the volume of the water

A) increases.

B) decreases.

C) remains the same

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A) increases.

B) decreases.

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Answer B)

Ice-water is anomalous in that it contracts on heating. This is why ice floats on water – ponds freeze from their surface downwards.

During cold winter months, you are most likely to find ice in a deep lake at

A) the bottom
B) the surface
C) the surface or the bottom, depending on the temperature
D) at a certain depth in the water, at which the water pressure is enough to hold ice crystals intact
E) surface of bodies of water, provided the water below is at zero Kelvin

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E) surface of bodies of water, provided the water below is at zero Kelvin

Answer: B
Because water expands upon cooling below 4 degrees Celsius, so ice is less dense than water and will float.

The vibrations of a transverse wave move in a direction

A) at right angles to the direction of wave travel.

B) that changes with speed.

C) along the direction of wave travel

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Answer: A

Eg. water waves, waves on a string, light…, the vibrations move at right angles to the direction of wave travel.

(not like, eg sound, which is a longitudinal wave)

The Doppler effect is characteristic of

A) water waves.

B) light waves.

C) sound waves.

D) all of the above choices

E) none of the above choices

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A) water waves.

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D) all of the above choices

E) none of the above choices

Answer: D

A floating object oscillates up and down 2 complete cycles in 1 second as a water wave of wavelength 5 meters passes by. The speed of the wave is

A) 15 m/s.

B) 5 m/s.

C) 2 m/s.

D) 10 m/s.

E) none of these

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Answer: D

Freq = 2 Hz, and wavelength = 5 m.

So speed = freq x wavelength = 10m/s

An AM radio station broadcasts at 1 kHz. This means they are generated by electrons

A) whose vibrations take 1,000 s per cycle
B) which vibrate at 1,000 cycles per second.
C) whose waves have crests separated by $10^3$ m.
D) which are amplified at the source by a factor of a thousand
E) none of the above

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E) none of the above

Answer: B
1kHz means 1000 Hz, i.e. 1000 cycles per second.

At a concert the oboe is playing a long steady note as you walk away from the stage at an accelerating velocity toward the rest room. The pitch of the sound that you hear, is

A) continually increasing.

B) continually decreasing.

C) steady but lower than normal.

D) steady but higher than normal

E) None of the above choices are correct

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E) None of the above choices are correct

Answer: B

Doppler effect – if moving away, pitch is lower than that emitted depending on the speed v. So if accelerating away, then it gets lower and lower.

Destructive interference occurs when

A) two or more waves overlap with such large amplitude that the medium is destroyed.
B) two or more waves overlap such that the displacements of the medium each cause are equal.
C) two or more waves overlap such that the displacements of the medium each cause are in opposite directions.
D) sound waves bend (refract) towards warmer air temperatures
E) sound waves bend (refract) towards cooler air temperatures

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Answer: C
From class…

Sound travels faster in air if the air temperature is

A) average.

B) cold.

C) warm.

Sound travels faster in air if the air temperature is

A) average.

B) cold.

C) warm.

Answer: C

From lecture – speed of sound is faster if temperature is warmer (also if more moist).

What phenomenon is behind why we may not hear the thunder from a far away thunderstorm?

A) Interference
B) Resonance
C) Reflection
D) Refraction

What phenomenon is behind why we may not hear the thunder from a far away thunderstorm?

A) Interference
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Answer: D
Waves travel faster in warmer air, so bends– i.e. refracts -- from warmer air to cooler air (recall picture from slide). In thunderstorm, air tends to be warmer lower than higher, so the sound bends (refracts) upwards.

As a wave propagates, some of its energy dissipates as heat. In time, this will reduce the wave's

A) Speed

B) Wavelength

C) Amplitude

D) Frequency

E) Period

As a wave propagates, some of its energy dissipates as heat. In time, this will reduce the wave's

A) Speed

B) Wavelength

C) Amplitude

D) Frequency

E) Period

Answer: C

(And note that higher frequencies dissipate faster than lower ones i.e. lower pitches tend to travel further.)

When you tune a radio to a certain station, you match the frequency of the internal electrical circuit to the frequency of the wanted radio station. In so doing you are employing the principle of

A) wave interference.
B) forced vibrations.
C) reverberation.
D) resonance.
E) beats.

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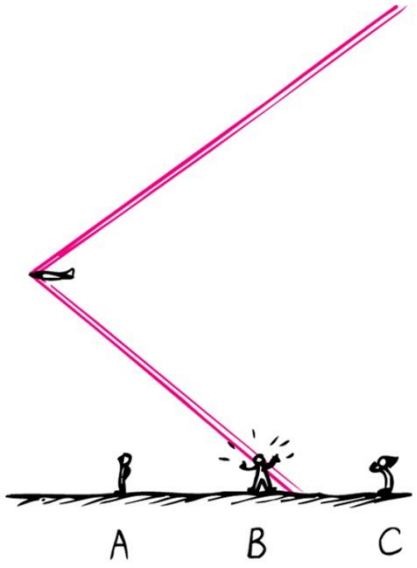



A supersonic aircraft is passing overhead as shown.

Which of the following statements is true ?

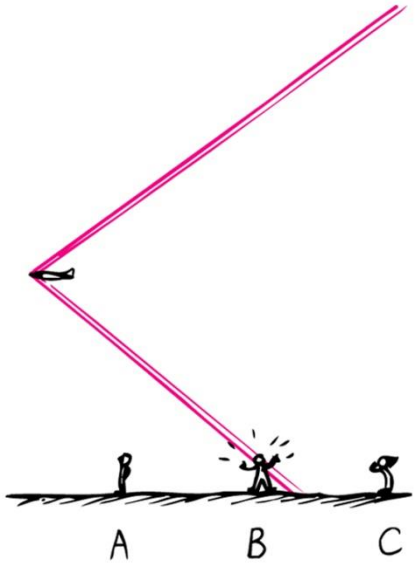
A) No-one hears anything, although B receives a burst of radiation at the instant shown.

B) B hears a sonic boom at the instant shown while A and C hear relatively little.

C) B and C hear a sonic boom at the instant shown while A hears nothing.

D) If the craft's speed increases further, the "V"-shape becomes less narrow

E) The sonic boom increases in intensity as the craft goes by.

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Answer: B, supersonic → waves travelling faster than speed of sound, crests all bunch up, and reach observer all at once, yielding the sonic boom

In which one of these media does sound travel the fastest?

A) water vapor
B) water
C) ice
D) Cannot determine without knowing the frequency or wavelength.
E) Sound travels the same speed in each of the above media.

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A) water vapor
B) water
C) ice
D) Cannot determine without knowing the frequency or wavelength.
E) Sound travels the same speed in each of the above media.

Answer: C

Sound travels fastest in a solid

Suppose you sound a 1056-hertz tuning fork while striking a note on the piano and hear 2 beats/second. You loosen the piano string very slightly, making it a lower pitch, and now hear 3 beats/second. What is *now* the frequency of the piano string?

A) 1053 hertz
B) 1054 hertz
C) 1058 hertz
D) 1059 hertz
E) 1056 hertz

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A) 1053 hertz
B) 1054 hertz
C) 1058 hertz
D) 1059 hertz
E) 1056 hertz

Answer: A

Since you hear 3 beats/sec, the frequency of the string must either be 1053-Hz or 1059-Hz. Before it was loosened, the beat frequency was lower, at 2 beats per second, i.e. closer to the tuning fork frequency 1056-Hz. So the new frequency must be 1053-Hz, as tightening it, raising the frequency, decreases the beating and so brings it closer to the tuning fork frequency.

The magnitude of charge on one electron is

A) one Coulomb
B) a specific very large number of Coulombs.
C) a specific very small number of Coulombs
D) 1/2000 of that on a proton
E) zero

The magnitude of charge on one electron is

A) one Coulomb
B) a specific very large number of Coulombs.
C) a specific very small number of Coulombs
D) 1/2000 of that on a proton
E) zero

Answer: C
The charge on one electron is $1.6 \times 10^{-19}$ C

Which of the following is true?

A) Gravitational forces are always attractive but electrical forces can be attractive or repulsive
B) Electrical forces are always attractive, but gravitational forces can be attractive or repulsive
C) The gravitational force obeys the inverse-square law but the electrical force decays faster with distance
D) The gravitational force between two objects is always weaker than the electrical force between them.
E) None of the above is true.

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E) None of the above is true.

Answer: A

This is directly from class.

Note that both these forces obey the inverse-square law. Although often the grav force is weaker than the electrical force between two objects, it can be sometimes stronger e.g. if the two objects are uncharged then the electrical force is zero.

To say that electric charge is quantized is to say that electric charge

A) will interact with neighboring electric charges.
B) is sometimes positive.
C) may occur in an infinite variety of quantities.
D) is a whole-number multiple of the charge of one electron.
E) can be neither created nor destroyed.

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A) will interact with neighboring electric charges.
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D) is a whole-number multiple of the charge of one electron.
E) can be neither created nor destroyed.

Answer: D

For anything to be quantized, it means that the value of it only exists in integer multiples of something. In the case of charge, the "something' is the charge of an electron.

The electric field inside an uncharged metal ball is zero. If the ball is positively charged, the electric field inside the ball is then

A) less than zero

B) zero

C) greater than zero

The electric field inside an uncharged metal ball is zero. If the ball is positively charged, the electric field inside the ball is then

A) less than zero

B) zero

C) greater than zero

Answer: B

Always inside any shaped conductor, be it hollow or solid, there is zero electric field.

(This is why keep electrical equipment in metal casing, and why it's safe to stay in car during lightning storm…)

When the distance between an electron and proton is halved, the electrical attractive force between them

A) Doubles

B) quadruples

C) halves

D) is quartered

E) stays the same

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A) Doubles

B) quadruples

C) halves

D) is quartered

E) stays the same

Answer: B, four times as much

Inverse square law – force goes as $1/d^2$.

The electric field around an isolated electron has a certain strength 1 cm from the electron. The electric field strength 2 cm from the electron is

A) Half as much

B) The same

C) Twice as much

D) Four times as much

E) None of the above is correct

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E) None of the above is correct

Answer: E, none of the above

Inverse-square dependence on distance (see previous qn), so if double the distance, then the field (and force on a test charge) goes down by ¼.

To say that an object is electrically polarized is to say

A) It is electrically charged

B) Its charges have been rearranged

C) Its internal electric field is zero

D) It is only partially conducting

E) It is to some degree magnetic

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A) It is electrically charged

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C) Its internal electric field is zero

D) It is only partially conducting

E) It is to some degree magnetic

Answer: B, its charges have been rearranged

From lecture: the electron cloud around the nucleus gets slightly displaced, so that on one side of the object there is more – charge and on the other, more + charge.

An uncharged pith ball is suspended by a nylon fiber. When a negatively charged rubber rod is brought nearby, without touching it, the pith ball

A) is repelled by the rod.
B) Is attracted by the rod
C) becomes charged by induction.
D) is unaffected.
E) None of the above choices are correct.

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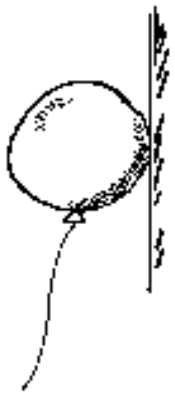
E) None of the above choices are correct.

Answer: B

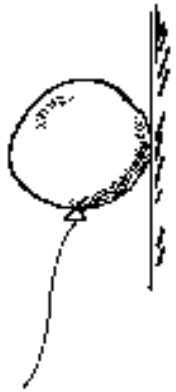
The charges in the pith ball rearrange, with the electrons shifting away from the negative rod. This is polarization. The attraction of the negative rod to the closer positive charges in the pith ball is larger than the repulsion of the rod with the pith ball's electrons (further away), so there is net attraction between the rod and the ball.

Note that if instead the rod was positively charged, there is still a net attraction (see lecture notes)



A balloon will stick to a wooden wall (i.e. is attracted to it) if the balloon is charged

A) negatively.
B) positively.
C) either positively or negatively.
D) None of the above choices are correct.



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A) negatively.
B) positively.
C) either positively or negatively.
D) None of the above choices are correct.

Answer: C
The wall becomes polarized – redistribution of charges so that the unlike charges are closer to the balloon than the like charges…see lecture and recall the demo for full explanation…