Review Session for Final

- Final Exam: MAY 22, 11.30am—1.30pm, here.
- Bring # 2 pencil & eraser
- Cumulative i.e. Chs. 2, 3, 4, 5, 6, 7, 8, 9, 11, 13, 14, 15, 19, 20, 22, 23, 24, 25, 26, 27, 31
- 65 multiple-choice questions: ~ 2 or 3 per chapter for first 16 chapters listed above, and ~ 4 or 5 per chapter for the last 5 chapters
- Study resources: **past midterms, all 3 review sessions** (this and midterms'), **questions in lectures**, check-questions in book.
- Email me if you have *any* questions (nmaitra@hunter.cuny.edu)
- **Review session today** – (i) Summary sheet for post-midterm2 chapters

(ii) Sample problems

Summary sheet for Chs. 24 – 31

Recall:

Ch 24: Magnetism, magnetic forces, poles, magnetic fields, magnetic domains, magnetic field produced by electric current, electromagnet, magnetic force -- perpendicular to charge's velocity and to magnetic field, magnetic force on current-carrying wires, electric meters, electric motors, earth's magnetic field and cosmic rays

Ch 25: Electromagnetic induction, voltage induced by time-varying magnetic field, Faraday's law, generators, AC, transformers, transformer-equation, generality of field induction: a changing magnetic field induces a changing electric field and vice-versa

Ch 26: Properties of Light, electromagnetic waves, speed of EM waves = $c = f\lambda$, EM spectrum, transparent materials, opaque materials, shadows, eclipses, the eye

Ch 27: Color, selective reflection, selective transmission, radiation curve of the sun, additive primary colors, complementary colors, mixing colored lights, mixing colored pigments, color subtraction, why sky is blue and sunsets red, why clouds are white, why water is green-blue

Ch 31: Light Quanta, intro to quantum mechanics, historic debate on is light a wave or particle, Planck's constant, quantization, $E=hf$ for photon, photoelectric effect, Young's double-slit expt (from Ch 29), wave-particle duality of light as well as of material particles, uncertainty principle $\Delta x \Delta p > h/2\pi$

If you’re in a car that gets hit from behind, you can get whiplash (neck injury) if your head is not against a headrest. This is best explained via:

A) your whole body undergoes a sudden acceleration.
B) there is an action-reaction pair of forces between your neck and head.
C) inertia -- the back of your seat pushes your back forward but your head tends to stay where it was.
D) inertia – you resist the motion of the car.
E) none of these

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D) inertia – you resist the motion of the car.
E) none of these

C) Newton's first law…

A truck is moving at constant velocity. Inside the storage compartment, a rock is dropped from the midpoint of the ceiling and strikes the floor below. The rock hits the floor

A) Behind the midpoint of the ceiling

B) Ahead of the midpoint of the ceiling

C) Exactly below the midpoint of the ceiling

D) Need more information to solve this

E) None of the above

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C) Exactly below the midpoint of the ceiling

D) Need more information to solve this

E) None of the above

Answer: C

From Newton’s 1st law – inertia. When the rock is dropped it, has the same velocity as the truck in the horizontal direction, as well as its downward acceleration. Nothing changes its horizontal motion, so it moves along with the truck as it falls.

If a car speeds up from rest to 100 km/h in 20 seconds, its acceleration is

A) 100 km/(h.s)

B) 2000 km/(h.s)

C) 10 km/(h.s)

D) 5 km/(h.s)

E) None of the above

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A) 100 km/(h.s)

B) 2000 km/(h.s)

C) 10 km/(h.s)

D) 5 km/(h.s)

E) None of the above

Answer:D

Acceleration = (change in speed)/time = (100 km/h)/(20 s)

A rock weighs 30 N on Earth. How much would it weigh on the moon? Note g on the moon is one-sixth that on earth.

A) 180 N

B) 30 N

C) 5 N

D) 0 N

E) None of the above

A rock weighs 30 N on Earth. How much would it weigh on the moon? Note g on the moon is one-sixth that on earth.

A) 180 N

B) 30 N

C) 5 N

D) 0 N

E) None of the above

Answer: C, since weight = *mg* and *g* is 1/6 on the moon compared to that on earth.

What if the question asked about the mass – what is its mass on the moon ? (take *g* = 10 m/s2 on the earth)

Answer: the same as that on earth, i.e. Mass = weight/*g* = (30 N)/(10 N/kg) = 3 kg

An object is thrown down from the top of a cliff at a speed of 10 m/s. Neglecting air-resistance, it's speed a second later is about

A) 20 m/s

B) 15 m/s

C) 10 m/s

D) 0 m/s

E) None of the above

* take g = 10 m/s2 unless otherwise stated

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A) 20 m/s

B) 15 m/s

C) 10 m/s

D) 0 m/s

E) None of the above

Answer: A) 20 m/s. In free-fall, falling objects gain g =10m/s every second

How about if it was instead thrown upwards at 10 m/s – what would its speed be a second later?

If thrown up, it loses 10 m/s every second, therefore will have 0 speed (at the top of its trajectory). Note acceleration due to gravity is 10 m/s2 downward (more precisely 9.8 m/s2)

If you drop an object, it will accelerate downward at a rate of 9.8 meters per second per second. If you instead throw it upwards, its acceleration (in the absence of air resistance) will be

A) 9.8 meters per second per second.
B) greater than 9.8 meters per second per second.
C) less than 9.8 meters per second per second.

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B) greater than 9.8 meters per second per second.
C) less than 9.8 meters per second per second.

Answer: A

Acceleration due to gravity is always this.

If an object falling freely were equipped with an odometer to measure the distance it travels, then the amount of distance it travels each succeeding second would be

A) constant
B) less and less each second
C) greater than the second before
D) doubled

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A) constant
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C) greater than the second before
D) doubled

Answer: C

The distance covered by a falling object increases as t2

A man pulls a sled with a force of 100 N on ice, accelerating it at 4 meters per second per second. What is the mass of the sled?

A)100 kg

B) 50 kg

C) 40 kg

D) 25 kg

E) 20 kg

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A) 100 kg

B) 50 kg

C) 40 kg

D) 25 kg

E) 20 kg

Answer: D

force = mass x acceleration, so mass = force/acc = 100/4 = 25 kg

If no external forces are acting on a moving object it will

A) move slower and slower until it finally stops.
B) continue moving at the same velocity.
C) continue moving at the same speed.

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C) continue moving at the same speed.

B) By Newton’s first law

Disregarding air drag, how fast must you toss a ball straight up in order for it take 2 seconds to return to the point at which you tossed it?

A) 5 m/s
B) 7.5 m/s
C) 10 m/s
D) 15 m/s
E) 20 m/s

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B) 7.5 m/s
C) 10 m/s
D) 15 m/s
E) 20 m/s

Answer: C

It loses 10 m/s every second on the way up and takes just as long to go up as to go back down the same distance. So you want the speed such that after 1s it turns around, i.e. after 1s it has zero speed, and since it loses 10 m/s each second, then it must have been thrown up at 10 m/s.

In which case would you have the largest mass of gold? If your chunk of gold weighed 1 N on the

A) moon
B) earth
C) planet Jupiter
D) same in all cases

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Answer: A
Weight = mass x gravity, so on planets with less gravity, need a larger mass in order for the object to weigh the same as on a planet with more gravitational force. Out of these options, moon has the smallest g

A 100N object is falling through the atmosphere. If, at a certain instant, the air resistance equals 50 N, the object's acceleration in meters per second per second, at that instant is

A) 10

C) 5

C) 0

D) None of the above

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A) 10

C) 5

C) 0

D) None of the above

Answer: B

Net force = weight – R

= 100 – 50 = 50 N

Acceleration = force/mass, where mass = weight/g = 100/10 = 10 kg. So acc = (50 N)/(10 kg) = 5 m/s2.

What is the value of air resistance when the object reaches terminal speed?
Terminal speed means object no longer accelerating, so R = weight = 100 N.

A little girl and her larger and stronger mother attempt a tug-of-war. Who exerts the greater force on the rope?

A) The little girl

B) The large and strong mother

C) Both exert the same force

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A) The little girl

B) The large and strong mother

C) Both exert the same force

Answer: C

Newton’s 3rd law of action-reaction

In order to catch a ball, a baseball player extends the hand forward before impact with the ball, and then lets it ride backward in the direction of the ball’s motion. Doing this reduces the force of impact on the player’s hand principally because the

A) force of impact is reduced

B) Time of impact is increased

C) Time of impact is decreased

D) Impulse is smaller

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B) Time of impact is increased

C) Time of impact is decreased

D) Impulse is smaller

Answer: B

Change of momentum = Impulse = force x time

So when bringing the ball to a stop by riding hand back with it, you're increasing the time, so providing same change of momentum with less force.

Two billiard balls of the same mass *m* roll towards each other, one with speed *v* and the other with twice that speed, *2v* . After the collision, what is their combined momentum?

A) 0

B) *mv*

C) *2mv*

D) *mv/2*

E) None of the above

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B) *mv*

C) *2mv*

D) *mv/2*

E) None of the above

Answer: B

Momentum is conserved, so momentum after = momentum before

= 2mv – mv = mv

A man pushes a crate of oranges 3m across the floor with a force of 12 N. How much work is done by the man?

A) 12 J

B) 15 J

C) 36 J

D) 108 J

E) None of the above

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A) 12 J

B) 15 J

C) 36 J

D) 108 J

E) None of the above

Answer:C

Work done = Force x distance = 12 N x 3 m = 36 J

If he does this in 4 seconds, how much power did he expend on average?

Answer: Power = work done/time = 36/4 = 9 W

Which requires the greatest amount of work:

A) accelerating a car from10 km/h to 15 km/h

B) decelerating a car from 10 km/h to a stop

C) Both require the same

Which requires the greatest amount of work:

A) accelerating a car from10 km/h to 15 km/h

B) decelerating a car from 10 km/h to a stop

C) Both require the same

Answer:A

W = change in KE

So for A, W = ½ m (15)2 – ½ m (10)2 = ½ m (225 -100) = ½ m (125)

And for B, W = ½ m (0) – ½ m (10)2 = - ½ m(100)

So more work is required for A.

If an object has kinetic energy, then it must also have

A) Impulse

B) Momentum

C) Acceleration

D) Potential energy

E) None of these

F) All of these

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A) Impulse

B) Momentum

C) Acceleration

D) Potential energy

E) None of these

F) All of these

Answer: B, momentum

The chef at the infamous Fattening Tower of Pizza tosses a spinning disk of uncooked pizza dough into the air. The disk's diameter increases during the flight, while its rotational speed

A) decreases.
B) increases.
C) remains constant.

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B) increases.
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Answer: A

Angular momentum is conserved as there are no external torques.

Angular momentum = rotational inertia x angular velocity.

Rotational inertia is increased so angular velocity is decreased.

When you turn a bolt using a wrench whose handle is three times as long, you're multiplying the torque by

A) 3

B) 1/3

C) 6

D) 9

E) 1/9

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C) 6

D) 9

E) 1/9

Answer: A

Torque = lever arm x force

If the Earth's mass decreased to one-half its original mass with no change in radius, then your weight would

A) decrease to one quarter your original weight.
B) stay the same.
C) decrease to one half your original weight.
D) none of these

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A) decrease to one quarter your original weight.
B) stay the same.
C) decrease to one half your original weight.
D) none of these

Answer: C

Because of the gravitational force law, F = GMm/d2

where M has become half

Two planets attract each other with a 400 N gravitational force. If the planets are moved so that the distance between them is twice as far, the force will be

A) 400 N

B) 200 N

C) 100 N

D) 1600 N

E) None of these

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A) 400 N

B) 200 N

C) 100 N

D) 1600 N

E) None of these

Answer:C

Inverse-square law of gravitation, force scales as 1/d2

During an eclipse of the sun the high ocean tides on Earth are

A) Extra high

B) Extra low

C) Not particularly different

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A) Extra high

B) Extra low

C) Not particularly different

Answer: A, extra high

Since the pull of the sun and moon are in the same direction, so the tides from each work in conjunction…

The best time for digging clams (when the low tide is extra low) is during the time of the

A) quarter moon.
B) new or full moon.
C) half moon.
D) none of these times in particular

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Answer: B

At new or full moon, have alignment of earth-sun-moon, so the tidal effects from sun and from moon add up, i.e. extra high and extra low tides.

The smallest particle of those listed below is

A) A molecule

B) An atom

C) A proton

D) A neutron

E) A quark

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Answer: E

Directly from lecture…

If two protons are added to an oxygen nucleus, the result is

A) Heavy oxygen

B) Fluorine

C) Neon

D) Sodium

E) nitrogen

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D) Sodium

E) nitrogen

Answer:C, neon

From periodic table, add 2 to the atomic number

A dam is thicker at the bottom than at the top partly because

A) surface tension exists only on the surface of liquids.

B) water pressure is greater with increasing depth.

C) water is denser at deeper levels.

D) it looks better.

E) none of these

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C) water is denser at deeper levels.

D) it looks better.

E) none of these

Answer: B

Water pressure = water-density x depth

The pressure at the bottom of a jug filled with water does NOT depend on

A) The acceleration due to gravity

B) Water density

C) The height of the liquid

D) Surface area of the water

E) None of these

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A) The acceleration due to gravity

B) Water density

C) The height of the liquid

D) Surface area of the water

E) None of these

Answer: D

Liquid pressure = weight density x height

And weight density depends on g, as well as water density.

(Recall Pressure = force per unit area, so surface-area-dependence divides out.)

A hydraulic press multiplies a force by 100. This multiplication is done at the expense of

A) energy, which is divided by 100

B) The distance through which the force acts

C) The time through which the force acts, which is multiplied by 100

D) The mechanism providing the force

E) None of these

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E) None of these

Answer: B

Hydraulic press operates as a force multiplier but can never create energy ie energy input = energy output. Since work done = force x distance, this means the distance is correspondingly smaller.

A block of styrofoam floats on water while a same size block of lead lies submerged in the water. The buoyant force is greatest on the

A) lead.
B) styrofoam.
C) is the same for both

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Answer: A

Buoyant force depends on the volume of water displaced. Since lead will sink and be fully submerged, it will displace its volume in water, whereas the syrofoam will float and not displace as much.

Blood pressure is usually greatest in your

A) ears
B) feet
C) same in each

Blood pressure is usually greatest in your

A) ears
B) feet
C) same in each

Answer: B

Liquid pressure = density x depth of column

As a high-altitude balloon sinks lower and lower into the atmosphere, it undergoes a decrease in

A) mass.
B) density.
C) volume.
D) weight.
E) none of these

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A) mass.
B) density.
C) volume.
D) weight.
E) none of these

Answer: C

As it falls, the atmospheric pressure increases, so the balloon volume decreases. The mass stays the same so the density increases.

Suspend a pair of Ping-Pong balls from two strings so there is a small space between them. If you blow air between the balls, they will swing

A) toward each other.
B) apart from each other.
C) away from the air stream, but not necessarily toward or apart from each other

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B) apart from each other.
C) away from the air stream, but not necessarily toward or apart from each other

Answer: A

Bernouilli effect

When a common fluorescent lamp is on, the mercury vapor inside is actually in a

A) solid state.
B) plasma state.
C) liquid state.
D) gaseous state.
E) none of these

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A) solid state.
B) plasma state.
C) liquid state.
D) gaseous state.
E) none of these

Answer: B

Plasma = ionized gas

When you touch a cold piece of ice with your finger, energy flows

A) From your finger to the ice

B) From the ice to your finger

C) actually, both ways

When you touch a cold piece of ice with your finger, energy flows

A) From your finger to the ice

B) From the ice to your finger

C) actually, both ways

Answer: A, from finger to ice

Heat energy always flows from high temp to low temp.

Even if you touched a huge glacier which has more internal energy than you, the heat would still flow from you to it.

We learnt that water has a particularly high specific heat. What does this imply?

A) Water molecules absorb large amounts of energy in the form of internal vibrations and rotations.
B) Water molecules absorb very little energy in the form of internal vibrations and rotations.
C) Water is the optimal substance for heating other substances.
D) Water specifically absorbs heat much more than absorbing sound or other forms of energy.T

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Answer: A

The fact that desert sand is very hot in the day and very cold at night is evidence for

A) A low specific heat

B) A high specific heat

C) No specific heat

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A) A low specific heat

B) A high specific heat

C) No specific heat

Answer: A

Since it heats up and cools down quickly (as opposed to water...)

Between 0 degrees Celsius and 8 degrees Celsius a red-dyed-water-in-glass thermometer would

A) Be especially suitable

B) Always wrong

C) Give ambiguous readings

D) Explode

E) implode

Between 0 degrees Celsius and 8 degrees Celsius a red-dyed-water-in-glass thermometer would

A) Be especially suitable

B) Always wrong

C) Give ambiguous readings

D) Explode

E) implode

Answer: C

Because at 4 degrees Celsius, water expands on heating as well as on expanding.

If the period of a vibrating object is 5 seconds, how many oscillations does it undergo in 1 minute, and what is its frequency?

A) 0.2 oscillations in 1 min, and frequency is 0.2 Hz

B) 6 oscillations in 1 min, and frequency is 12 Hz

C) 12 oscillations in 1 min, and frequency is 12 Hz

D) 12 oscillations in 1 min, and frequency is 0.2 Hz

E) None of the above is correct

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C) 12 oscillations in 1 min, and frequency is 12 Hz

D) 12 oscillations in 1 min, and frequency is 0.2 Hz

E) None of the above is correct

Answer: D

If period is 5 sec, then in 1 min (=60 sec), it has 60/5 = 12 cycles.

Frequency = 1/period = 1/5sec = 0.2 Hz

A leaf floating on the water oscillates up and down two complete cycles each second. If the wave travels an average distance of 6m in one second, its wavelength is

A) 0.5 m

B) 1 m

C) 2 m

D) 3 m

E) 6 m

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A) 0.5 m

B) 1 m

C) 2 m

D) 3 m

E) 6 m

Answer: D

If average distance in 1 s is 6m, that means speed of wave is 6m/s.

Frequency = 2 Hz (= 2 cycles per second)

Wave speed = f λ, therefore wavelength λ = (6 m/s)/2Hz = 3m

Compressions and rarefactions are characteristic of

A) interference
B) resonances
C) transverse waves
D) longitudinal waves
E) all types of waves

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A) interference
B) resonances
C) transverse waves
D) longitudinal waves
E) all types of waves

Answer: D

A longitudinal wave is a pattern of compressions and rarefactions travelling in space.

Why does a foghorn have such a low pitch?

A) Because low pitches travel faster than high pitches

B) Because low pitches do not dissipate as quickly as high pitches

C) Because high frequencies carry farther in air

D) Because high frequencies travel faster

E) None of the above

Why does a foghorn have such a low pitch?

A) Because low pitches travel faster than high pitches
B) Because low pitches do not dissipate as quickly as high pitches
C) Because high frequencies carry farther in air
D) Because high frequencies travel faster
E) None of the above

Answer: B

All sound eventually dissipates (gets transformed into heat etc) but low frequencies (= low pitches) dissipate slower than high frequencies.

If the beat frequency increases as one tightens a violin string played alongside a tuning fork, what should one do to the string in order to tune it to the tuning fork?

A) Loosen it

B) Tighten it more

C) Do nothing

D) Need more information

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A) Loosen it

B) Tighten it more

C) Do nothing

D) Need more information

Answer: A

Recall beat frequency = difference in the frequencies.

So if upon tightening, the beat freq increases, this means the difference is increasing …so loosen it in order to bring them to the same pitch.

A mosquito zips by you at top speed. What changes in the buzzing sound that you hear as it approaches you, compared to if it wasn't moving by?

A) the sound wave's speed is increased

B) the perceived wavelength is increased

C) the perceived frequency is increased

D) both the wavelength and frequency are increased

A mosquito zips by you at top speed. What changes in the buzzing sound that you hear as it approaches you, compared to if it wasn't moving by?

A) the sound wave's speed is increased

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C) the perceived frequency is increased

D) both the wavelength and frequency are increased

Answer: C

The frequency is increased due to the Doppler effect – sources of sound that are moving towards the receiver (you) are perceived with a higher frequency (higher pitch) than otherwise. (Likewise if the receiver is moving towards the source of sound)

Interference is a property of

A) Water waves

B) Sound waves

C) Light waves

D) Waves on a string

E) All of the above

Interference is a property of

A) Water waves

B) Sound waves

C) Light waves

D) Waves on a string

E) All of the above

Answer: E, all of the above

Interference is a characteristic of waves – eg waves can cancel each other out whereas particles cannot.

Sound refraction depends on the fact that the speed of sound is

A) variable

B) inversely proportional to wavelength

C) proportional to frequency

D) constant

E) none of the above is correct

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A) variable

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D) constant

E) none of the above is correct

Answer: A, variable

Speed of sound depends eg on air temperature, wind etc but *not* on frequency or wavelength.

Wave refracts (bends) towards the part of the medium in which sound is traveling slower.

To say that electric charge is conserved 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.

To say that electric charge is conserved 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.

Answer: E

When anything is conserved, it means the total amount of the thing remains the same always. So it can’t be created or destroyed.

Note that A and B are true (but don’t answer the question)

C is not correct, rather D is – recall property of charge quantization

The electric field inside an uncharged metal ball is zero. If the ball is negatively 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 negatively 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 two protons is doubled, the electrical repulsion force between the charges

A) Doubles

B) quadruples

C) halves

D) is quartered

E) stays the same

When the distance between two protons is doubled, the electrical repulsion force between the charges

A) Doubles

B) quadruples

C) halves

D) is quartered

E) stays the same

Answer: D, is quartered

Inverse square law – force goes as 1/d2.

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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A) Half as much

B) The same

C) Twice as much

D) Four times as much

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

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

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.

Consider two lamps almost identical but one with a thicker filament than the other.

Which has the higher resistance?

A) thicker filament

B) thinner filament

C) both same

D) it depends on the current

Consider two lamps almost identical but one with a thicker filament than the other.

Which has the higher resistance?

A) thicker filament

B) thinner filament

C) both same

D) it depends on the current

Answer: B, thinner filament

Resistance is greater when conductor is thinner (and longer)

Consider again two lamps almost identical but one with a thicker filament than the other.

If connected in parallel, which would draw the greater current?

A) thicker filament

B) thinner filament

C) both same

D) it depends on the current

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If connected in parallel, which would draw the greater current?

A) thicker filament

B) thinner filament

C) both same

D) it depends on the current

Answer: A. since voltage same for each, and current = voltage/resistance, where resistance less for thicker filament, so larger current.

How about if connected in series?

Answer: C since current is same in series…

When a 40-W light bulb is connected to a 120-V source, the current in the light bulb is

A) 0.33 A

B) 3 A

C) 4 A

D) 8 A

E) none of these

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A) 0.33 A

B) 3 A

C) 4 A

D) 8 A

E) none of these

Answer: A, 0.33A

Power = voltage x current, so current = power/voltage = 40-W/120 = 0.33A

A 20-ohm resistor is connected across a 120-V power supply. What is the current drawn?

A) 20 A

B) 120 A

C) 6 A

D) 240 A

E) none of these

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A) 20 A

B) 120 A

C) 6 A

D) 240 A

E) none of these

Answer: C, 6A

Current = voltage/resistance = 120/20 = 6 A

(Ohm’s law)

There are electrons in the filament of the ac lamp in your bedroom. When you turn on the lamp and it glows, the glowing comes from

A) the same electrons

B) different electrons – coming from the power company

C) different electrons – coming from the electrical outlet

D) the positive charges that flow in your filament.

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C) different electrons – coming from the electrical outlet

D) the positive charges that flow in your filament.

Answer; A, the same electrons

The electrons move back and forth in response to the ac electric field but do not progress along the circuit.

As more lamps are put into a parallel circuit, the overall current in the power source

A) increases.
B) stays the same.
C) decreases.

As more lamps are put into a parallel circuit, the overall current in the power source

A) increases.
B) stays the same.
C) decreases.

Answer: A

More current is drawn from the power source when more elements are added in parallel, since they each must have the same voltage across them, and so the current in each is V/R; the total current is then the sum of V/R for each R.

Modern automobile headlights are connected in

A) parallel

B) perpendicular

C) series

D) None of these

Modern automobile headlights are connected in

A) parallel

B) perpendicular

C) series

D) None of these

Answer: A

This is why one can still be on while the other is out.

If a steady magnetic field exerts a force on a moving charge, that force is directed

A) in the direction of the motion.
B) opposite the motion.
C) at right angles to the direction of the motion.
D) nowhere - there is no force.

If a steady magnetic field exerts a force on a moving charge, that force is directed

A) in the direction of the motion.
B) opposite the motion.
C) at right angles to the direction of the motion.
D) nowhere - there is no force.

Answer: C

Magnetic force is in a direction perp to moving charge's velocity, and also perp to magnetic field direction.

The intensity of cosmic rays bombarding the Earth's surface is largest at the

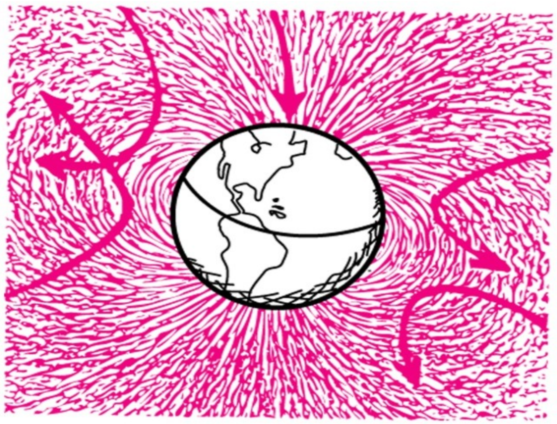
A) mid-latitudes.
B) equator.
C) poles.

The intensity of cosmic rays bombarding the Earth's surface is largest at the

A) mid-latitudes.
B) equator.
C) poles.

Answer: C

The magnetic field lines of the Earth deflect incoming charged particles of the cosmic ray, when they enter at right-angles to the field lines. At the poles, the rays come in more parallel to the field lines than at the equator, so there is less deflection



The source of all magnetism is

A) Tiny pieces of iron

B) Tiny domains of aligned atoms

C) Ferromagnetic materials

D) Moving electric charge

E) None of these

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A) Tiny pieces of iron

B) Tiny domains of aligned atoms

C) Ferromagnetic materials

D) Moving electric charge

E) None of these

Answer: D, Moving electric charge

Directly from lecture…

When there is a change in the magnetic field in a closed loop of wire

A) A voltage is induced in the wire

B) A current is created in the loop of wire

C) Electromagnetic induction occurs

D) All of these

E) None of these

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A) A voltage is induced in the wire

B) A current is created in the loop of wire

C) Electromagnetic induction occurs

D) All of these

E) None of these

Answer: D, all of these

From lecture…

Moving a coil of wire into a magnetic field induces a voltage through the coil. If a second coil, that has half as many turns, is pushed in to the field,

A) twice as much voltage is induced

B) the same voltage is induced

C) half as much voltage is induced

D) a quarter as much voltage is induced

E) none of these

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A) twice as much voltage is induced

B) the same voltage is induced

C) half as much voltage is induced

D) a quarter as much voltage is induced

E) none of these

Answer: C, half as much

Faraday’s law: the induced voltage is proportional to the number of turns in the wire.

Disconnect a small-voltage battery from a coil of many loops of wire and a large voltage is produced by

A) the resistance of the battery to a change in polarity.
B) the electric field between the battery terminals.
C) the sudden collapse in the magnetic field.
D) latent energy in the battery.
E) electrons already in the wire.

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C) the sudden collapse in the magnetic field.
D) latent energy in the battery.
E) electrons already in the wire.

Answer: C

Self-inductance effect – same reason why you see a spark when pull appliance out of socket. A large and rapid change in the current means a large and rapid change in the magnetic field associated with the current, which induces a large voltage.

The voltage across the input terminals of a transformer is 220 V. The primary has 20 loops and the secondary has 40 loops. The voltage the transformer puts out is

A) 220 V

B) 110 V

C) 440V

D) 4400 V

E) 8800 V

The voltage across the input terminals of a transformer is 220 V. The primary has 20 loops and the secondary has 40 loops. The voltage the transformer puts out is

A) 220 V

B) 110 V

C) 440V

D) 4400 V

E) 8800 V

Answer: C

(Voltage in primary) / (# turns in primary) =

(voltage in secondary) / (# turns secondary)

So 220V/20 = ?V/40, i.e. ? = 440 V

Power is transmitted at high voltages because the corresponding current in the wires is

A) High to deliver appreciable power to distant places

B) Low so that overheating of wires is minimized

C) It enables power to increase as the current flows

D) None of the above

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A) High to deliver appreciable power to distant places

B) Low so that overheating of wires is minimized

C) It enables power to increase as the current flows

D) None of the above

Answer: B, low to minimize overheating of wires

Power = voltage x current

So high voltage means low current. Low current means less loss to heating.

Note power input = power output, otherwise energy would be created, which never happens!

The source of all electromagnetic waves is

A) Heat

B) Vibrating atoms

C) Vibrating electric charges

D) Crystalline fluctuations

E) Electric fields

F) None of these

The source of all electromagnetic waves is

A) Heat

B) Vibrating atoms

C) Vibrating electric charges

D) Crystalline fluctuations

E) Electric fields

F) None of these

Answer: C, vibrating charges

An accelerating charge produces changing electric and magnetic fields. If oscillating, these can maintain one another and propagate through space -- EM waves.

Things seen by moonlight are not usually colored because moonlight

A) doesn’t have very many colors in it

B) Is too dim to activate the retina’s cones

C) Photons don’t have enough energy to activate the retina’s cones

D) All of these

E) None of these

Things seen by moonlight are not usually colored because moonlight

A) doesn't have very many colors in it

B) Is too dim to activate the retina's cones

C) Photons don't have enough energy to activate the retina's cones

D) All of these

E) None of these

Answer: B, too dim to activate the retina's cones

Recall cones have a higher threshold of intensity before they fire.

When visible light is incident upon clear glass, atoms in the glass

A) are forced into vibration

B) resonate

C) convert the light energy into internal energy

D) All of the above

When visible light is incident upon clear glass, atoms in the glass

A) are forced into vibration

B) resonate

C) convert the light energy into internal energy

D) All of the above

Answer: A, forced into vibration

Natural frequencies of glass are in the UV range, not visible; so resonate with UV but not with visible, which they just let pass.

A partial solar eclipse occurs for people in the sun’s

A) umbra

B) penumbra

C) none of these

A partial solar eclipse occurs for people in the sun's

A) umbra

B) penumbra

C) none of these

Answer: B, penumbra

Partial shadow – only part of the sun's light is blocked

When blue light is incident on water, atoms in the water

A) resonate

B) are forced into vibration

C) convert the light energy into internal energy

When blue light is incident on water, atoms in the water

A) resonate

B) are forced into vibration

C) convert the light energy into internal energy

Answer: B, are forced into vibration

The natural frequencies of water are lower, in the infrared and somewhat in the red. So water molecules do not resonate with blue light, but they are forced into vibration by the electric field of the light, and then re-emit it.

The whiteness of clouds is evidence in the clouds for a variety of

A) “seeds” upon which condensation of cloud material forms

B) water prisms

C) light intensities

D) molecules

E) particle sizes

The whiteness of clouds is evidence in the clouds for a variety of

A) “seeds” upon which condensation of cloud material forms

B) water prisms

C) light intensities

D) molecules

E) particle sizes

Answer: E, particle sizes

Different particle sizes scatter different frequencies of light, and so add up to white.

The fact that you can get sunburned while submerged in water is evidence that water

A) absorbs ultraviolet light

B) transmits ultraviolet light

C) transmits infrared light

D) absorbs infrared light

The fact that you can get sunburned while submerged in water is evidence that water

A) absorbs ultraviolet light

B) transmits ultraviolet light

C) transmits infrared light

D) absorbs infrared light

Answer: B, transmits uv

U-V is what causes sunburn. If water absorbed this, it would mean it turns it into heat energy, and then you wouldn’t get sunburnt underwater…but you can. In fact water transmits uv. (ie is off-resonant in the uv range)

Complementary colors are two colors that

A) are right for each other

B) are additive primary colors

C) look good together

D) produce white light when added together

E) are subtractive primary colors

Complementary colors are two colors that

A) are right for each other

B) are additive primary colors

C) look good together

D) produce white light when added together

E) are subtractive primary colors

Answer: D, produce white when added together

From definition.

Red sunsets are due to lower frequencies of light that

A) are scattered from larger particles in the air

B) are refracted from larger particles in the air

C) are reflected by clouds and relatively large particles in the air

D) survive being scattered in the air

E) appear reddish orange to the eye.

Red sunsets are due to lower frequencies of light that

A) are scattered from larger particles in the air

B) are refracted from larger particles in the air

C) are reflected by clouds and relatively large particles in the air

D) survive being scattered in the air

E) appear reddish orange to the eye.

Answer: D, survive being scattered in the air.

Recall it is the high frequency blues that are scattered by the atmospheric particles which are relatively small. This leaves orange/red to be transmitted…see lecture…

If sunlight were blue instead of white, the most comfortable color to wear on a cold day would be

A) blue.
B) violet.
C) magenta.
D) green.
E) yellow.

If sunlight were blue instead of white, the most comfortable color to wear on a cold day would be

A) blue.
B) violet.
C) magenta.
D) green.
E) yellow.

Answer: E

Want to absorb blue, so want resonant frequencies in the blue, ie. Reflect the complementary color to blue, which is yellow.

The worst thing you can do for the health of a green-leafed plant is to illuminate it with only

A) red light.
B) green light.
C) blue light.
D) All are equally bad
E) none of these

The worst thing you can do for the health of a green-leafed plant is to illuminate it with only

A) red light.
B) green light.
C) blue light.
D) All are equally bad
E) none of these

Answer: B

The plant is green because it reflects green light and absorbs frequencies other than green – so if exposed only to green light it has nothing to absorb, can gain no energy, cannot photosynthesize λ

In the photoelectric effect, the brighter the illuminating light on a photosensitive surface, the greater the

A) Number of ejected electrons

B) Speed of ejected electrons

C) Both of these

D) None of these

In the photoelectric effect, the brighter the illuminating light on a photosensitive surface, the greater the

A) Number of ejected electrons

B) Speed of ejected electrons

C) Both of these

D) None of these

Answer: A, # of ejected electrons

From lecture…

Which has the least energy per photon?

A) infrared

B) ultraviolet

C) blue light

D) Red light

E) They all have the same energy

Which has the least energy per photon?

A) infrared

B) ultraviolet

C) blue light

D) Red light

E) They all have the same energy

Answer: A, infrared

Recall, $E = hf$, where f is the frequency of the EM wave.

And note, that ultraviolet has the most energy per photon

Why doesn’t microwave radiation cause damage to our living cells like UV does?

A) Because microwave radiation is not as intense as UV
B) Because each microwave photon does not enough energy to interact with our molecules but each UV photon does
C) Because each UV photon has much less energy than each microwave photon so interacts more readily with our molecules
D) None of the above

Why doesn't microwave radiation cause damage to our living cells like UV does?

A) Because microwave radiation is never as intense as UV
B) Because each microwave photon does not enough energy to interact with our molecules but each UV photon does
C) Because each UV photon has much less energy than each microwave photon so interacts more readily with our molecules
D) None of the above

Answer: B
A photon of UV radiation has enough energy to trigger a chemical reaction, but a microwave photon does not – photon's energy is proportional to its frequency, $E = hf$

Light behaves primarily as a wave when it

A) Travels from one place to another

B) Interacts with matter

C) Both of the above

D) None of the above

Light behaves primarily as a wave when it

A) Travels from one place to another

B) Interacts with matter

C) Both of the above

D) None of the above

Answer: A, travels from one place to another

And, it behaves like a particle when it interacts with matter…

The particle nature of light is best illustrated by

A) The photoelectric effect

B) The double-slit experiment

C) Neither

The particle nature of light is best illustrated by

A) The photoelectric effect

B) The double-slit experiment

C) Neither

Answer: A

Shows aspects that cannot be explained by light being a wave

Heisenberg’s uncertainty principle states that

A) The position of an object is always uncertain on the scale of Planck’s constant

B) The momentum of an object is always uncertain on the scale of Planck’s constant

C) If one measures the position very accurately, then little is known about its momentum

D) None of the above is true

Heisenberg’s uncertainty principle states that

A) The position of an object is always uncertain on the scale of Planck’s constant

B) The momentum of an object is always uncertain on the scale of Planck’s constant

C) If one measures the position very accurately, then little is known about its momentum

D) None of the above is true

Answer:C, since the uncertainty principle involves the product of the uncertainties in position and momentum always being above a lower bound (see notes…)

According to the uncertainty principle, the more we know about a particle's position, the less we know about its

A) kinetic energy.
B) speed.
C) momentum.
D) all of these
E) none of these

According to the uncertainty principle, the more we know about a particle's position, the less we know about its

A) kinetic energy.
B) speed.
C) momentum.
D) all of these
E) none of these

Answer: D

The uncertainty in position times the uncertainty in momentum is always greater or equal to Planck's constant/2. So the more we know about the position (i.e. less the uncertainty in position), the more the uncertainty in momentum. Since momentum = mv, then also this means the less we know about its speed and kinetic energy.