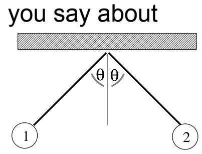
A dozen review slides, with solutions

Two equal mass pith balls are charged and hang as shown. What can you say about Q1 and Q2?



A) Q1=Q2

B) Q1=-Q2

C) You can't conclude EITHER of the above from this figure

Answer C: By Newton's 3rd law (or Coulomb's law), the force of 1 on 2 equals the force of 2 on 1, the angles will be equal no matter WHAT the two charges are, even if they are quite different. (However, we do know they repel – so the charges have the same SIGN!)

Rank the magnitude of the force on Q

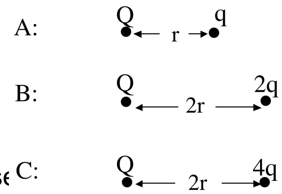
A) FA>FB>FC

B) FA> FB=FC

C) FA=FC>FB

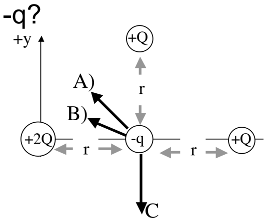
D) FC>FB>FA

E) Something else



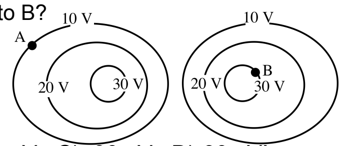
Answer C. Use Coulomb's law, F = kQ1 Q2/r^2, and then note that the (2r) in the denominator gets squared to become 4*r^2. So the 4 cancels the 4q in the numerator for force C, but situation B has a smaller force.

What is the direction of the net force on the test charge -q?



Answer A: Just draw out the three force arrows. the one from 2Q is to the left, and twice the one to the right from +Q. So those result in a net left arrow, which adds to an equal "up" arrow towards the upper +Q, and those two then add to make a 45 degree angle up and left, answer A

How much external work is required to move an electron from A to B?

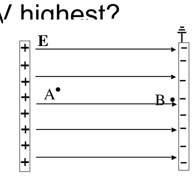


A)+20 eV B)-20 eV C)+30 eV D)-30 eV!

Answer: B External work is qΔV, here the change in voltage is 30 V (final) – 10 V (initial) = +20 V. The particle is moving to HIGHER voltage. But the charge, q, is –e, it's negative (an electron), and thus the work done is -20 eV. Remember, protons tend to move to lower voltage, but electrons go the opposite way, towards higher voltage (which is still lower potential energy, right?!)

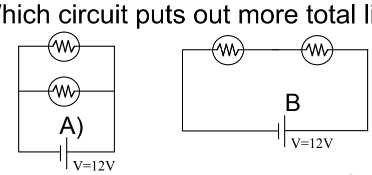
At which point is |E| greatest,
At which point is V highest?

	|E|, V
A)	A, A
B)	A, B
C)	B, A
D)	B, B
E)	Other!



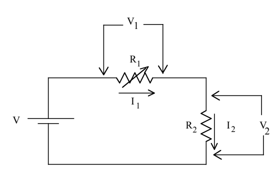
Answer E: The voltage is higher closer to the + charges, but the E field here is UNIFORM, it's the same everywhere, including points A and B. So E is not "greatest" at either point, but voltage is greatest at point A)

Which circuit puts out more total light?



Answer A: In circuit A, they are in parallel, EACH one has 12 V across them, and is “full power”, P = V^2/R = 12^2/R. The two powers simply add. Circuit B is much dimmer, each bulb has only 6 V across it, so P of each bulb is 6^2/R, and even when you add both together, that’s still much less. I leave it to you to CHECK this answer by computing R (equiv) for each circuit, and then using P = V^2/R(equiv)

If variable resistor R1 is decreased, what happens to voltage V2?

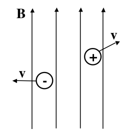


A) increases B) decreases C) constant

Answer A: As R1 is decreased, R(equiv) of the circuit (which = R1+R2 here) is also decreased, and thus by V=I*R(equiv), more current flows out of the battery. But all that current goes through R2, and V2 = I*R2.   so if I goes up, V2 goes up.

The direction of the forces on these - and + charges are:

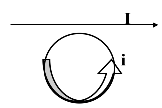
A) in, zero B) out, zero
C) in, in
D) out, in E) other!



Answer E, BOTH forces are OUT of the page!
Practice with the right hand rule, you have to check this for yourself! Did you remember to flip the sign for the negative charge?

The direction of the force on the loop is:

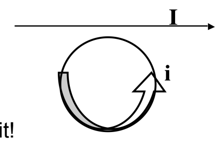
A) up B) right
C) into page
D) down E) other!



Answer D: Right hand rule again, but several parts. First the upper wire I makes a B field that circles around, and is pointing INTO the page below the long straight wire (i.e. where the loop is). The top part of that loop feels an ILxB force which is thus DOWN (work this out for yourself!), the lower part feels an ILxB force which is UP, but since the top half is closer, that dominates. (Alternatively, remember that “antiparallel currents repel”, and the antiparallel portion of the loop is closer, and thus dominates)

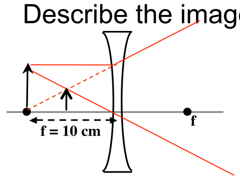
How could we have induced this current i in the small loop?

A) increased I steadily
B) decreased I steadily
C) steady I to right
D) steady I to left
E) None of these would do it!



Answer A: If I is increasing, it makes an “increasing into the page” flux, and to FIGHT that change, we make a CCW current, as shown. (Steady current makes no CHANGE, and thus induces no current at all.)

Describe the image seen from the right?

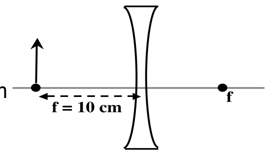


A) Virtual, left of lens
B) Virtual, right of lens
C) Real, left of lens
D) Real, right of lens
E) No image forms if object is at f

Answer A, I drew two rays, do you understand how to do that yourself? The object is virtual, left of lens, upright, and shrunk. di is negative, m is positive and less than one. Use the lens equation to check for yoursellf!

di=?

A) +5 cm B) -5 cm
C) +10 cm D) -10 cm
E) Something else!



Answer B: 1/di + 1/d0 = 1/f, here 1/di + 1/10 = 1/-10
So, 1/di = -1/10 – 1/10 = -2/10 = -1/5, so di = -5.
Note: this means m = -di/do = +0.5, see previous question.

See you Tuesday

And then,
have a great break