

Physics 12 Final Review

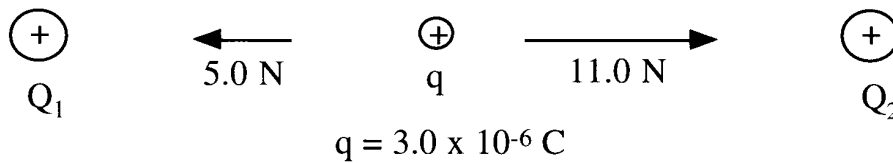
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Instructions:

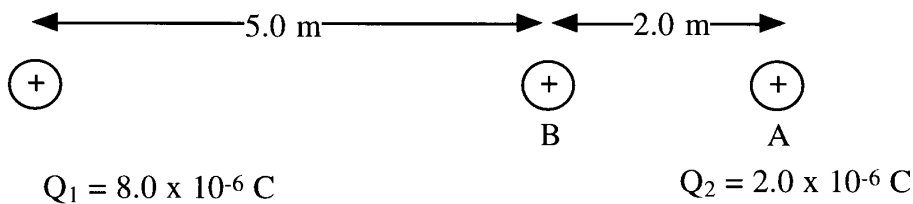
Using a pencil, answer the following questions on a separate piece of paper. The assignment is marked, based on effort, completeness, neatness, and accuracy. Do your best!

Electricity and Magnetism Review

- Calculate the electrostatic force of attraction between a positive charge of $8.0 \times 10^{-6} \text{ C}$ and a negative charge of $5.0 \times 10^{-6} \text{ C}$, when they are 0.30 m apart. (ans: 4.0 N)
- The $3.0 \times 10^{-6} \text{ C}$ charge, q , shown below experiences opposing forces exerted by Q_1 and Q_2 of 11 N and 5.0 N respectively.

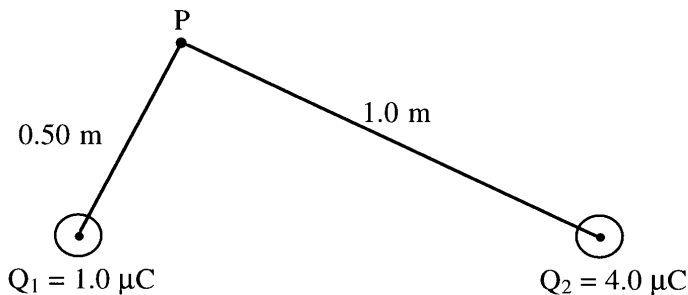


- What is the magnitude and direction of the electric field strength at the location of q ? (ans: $2.0 \times 10^6 \text{ N/C}$ to the right)
 - If Q_1 and q are separated by a distance of 1m, and Q_2 and q are also 1m apart, determine the value of Q_1 and Q_2 . (ans: $4.1 \times 10^{-4} \text{ C}$, $1.85 \times 10^{-4} \text{ C}$)
 - What is the Net force (include direction) acting on charge Q_2 due to Q_1 and q ? (ans: $F_{net} = 176 \text{ N}$ right)
- How much work must be done to move charge $Q_2 = 2.0 \times 10^{-6} \text{ C}$ from A to B? The other charged object has a charge $Q_1 = 8.0 \times 10^{-6} \text{ C}$.



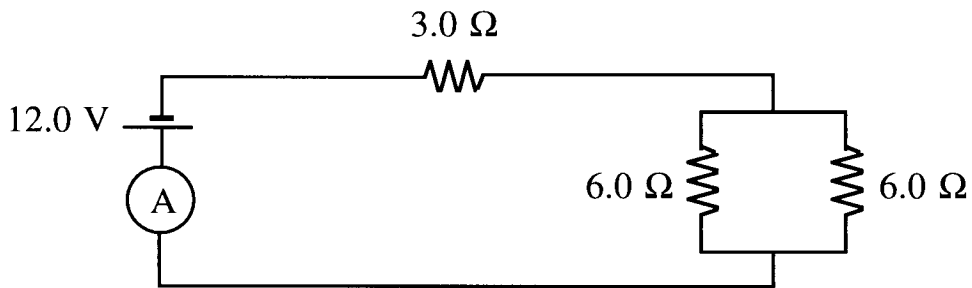
(ans: $8.2 \times 10^{-3} \text{ J}$)

- What is the electric potential at P due to charges Q_1 and Q_2 ?



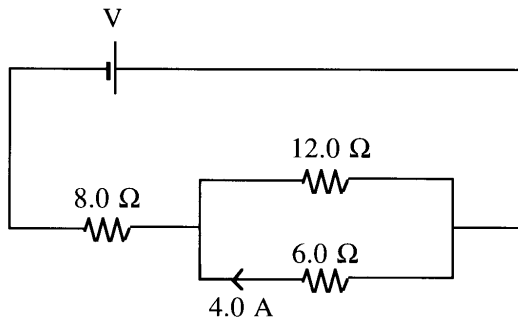
(ans: $5.4 \times 10^4 \text{ V}$)

5. What is the current in the ammeter A shown below?



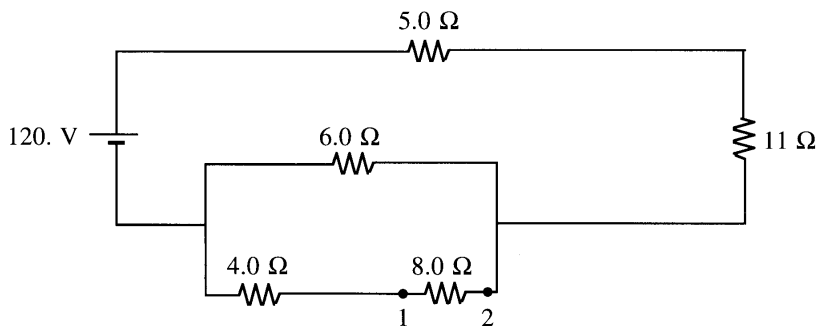
(ans: 2.0A)

6. What is the voltage V of the power supply shown below?



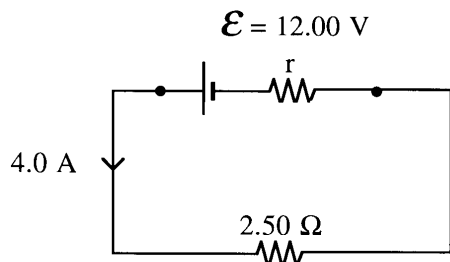
(ans: 72V)

7. Consider the circuit shown below;



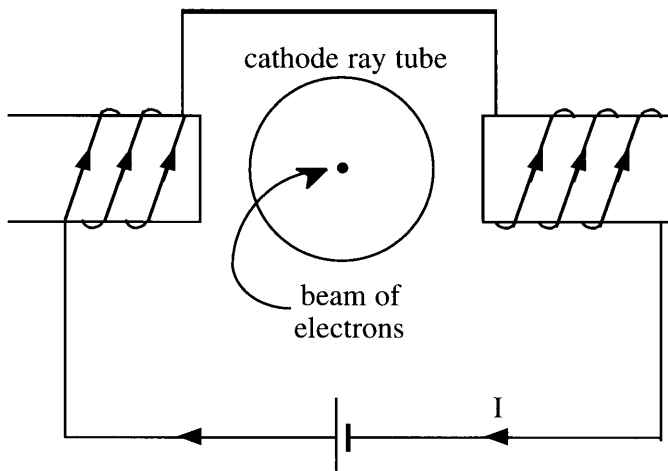
- a. What is the voltage across the 8.0Ω resistor (between 1 and 2)? (ans: 16V)
 b. How much power is dissipated in the 5.0Ω resistor? (ans: 180W)

8. What is the internal resistance of the battery shown below?



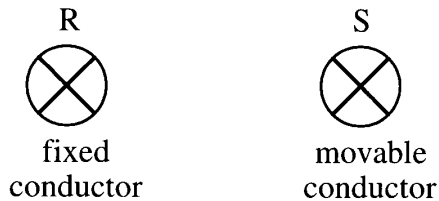
(ans: 0.50 Ω)

9. A flashlight contains a battery of two cells in series, with a bulb of resistance 12.0Ω . The internal resistance of each cell is 0.260Ω . If the potential difference across the bulb is 2.88 V , what is the EMF of *each* cell? (*ans: 1.5V*)
10. A 1500 W kettle is connected to a 110 V source. What is the resistance of the kettle element? (*ans: 8.1 Ω*)
11. A power station delivers 500 kW of power to a village through lines with a total resistance of 5.00Ω . The input voltage is $400,000 \text{ V}$. If the input voltage was reduced to $10,000 \text{ V}$, by what factor would the power wasted as heat in the lines be multiplied? (*ans: 1600 times as much wasted power*)
12. What is the efficiency of a transmission line if 20.0 A , input at 120 V , delivers $2.0 \times 10^3 \text{ W}$ of power? (*ans: 83%*)
13. A particle carrying a charge of $0.50 \mu\text{C}$ enters a magnetic field of strength 0.045 T , with a velocity of 350 m/s . The velocity is perpendicular to the magnetic field. What is the magnetic force acting on the charged particle? (*ans: $7.9 \times 10^{-6} \text{ N}$*)
14. Two solenoids are being used to deflect the same beam of electrons in a cathode ray tube as shown below:



- a. In what direction will the electron beam be deflected? (*ans: up – don't forget that electrons are reversed*)
- b. If the magnetic field strength B is doubled, and the polarity of the currents in the electromagnets is reversed. how will the deflection change? (*ans: electrons will deflect down and further from the centre*)

15. Two conducting wires, **R** and **S**, run parallel with each other, and both carry current into the page. Conductor **R** is fixed, but conductor **S** can move. In what direction will the magnetic fields due to currents in the wires tend to make conductor **S** move?



(ans: left)

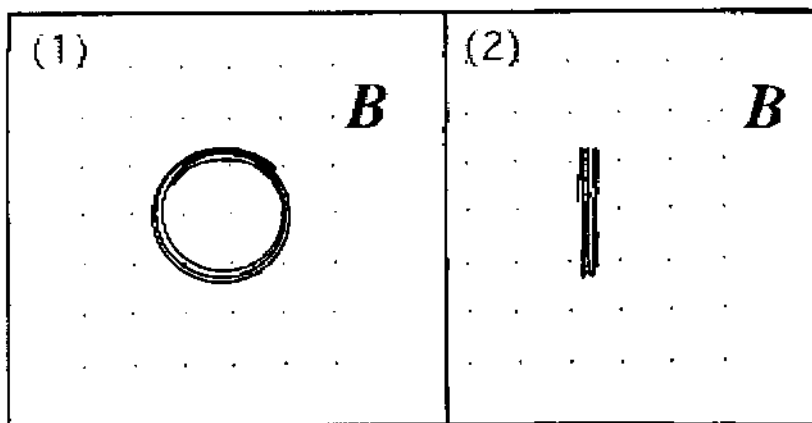
16. A solenoid 0.20 m long has 600 turns of wire. What current must be passed through the solenoid to produce a magnetic field of 2.0×10^{-2} T? (ans: 5.3 A)

17. A particle of mass m and charge q is moving with speed v in a circular path of radius R in a uniform magnetic field B .

- How would you calculate the radius from the other information? (ans: $R = mv/Bq$)
- An alpha particle, of mass 6.7×10^{-27} kg and charge 3.2×10^{-19} C, is accelerated from rest by a voltage of 2.00×10^3 V. What will be the radius of curvature of its path in a uniform magnetic field of 0.070 T? (ans: 0.13 m)
- What is the momentum of the alpha particle? (ans: 2.9×10^{-21} kg·m/s)

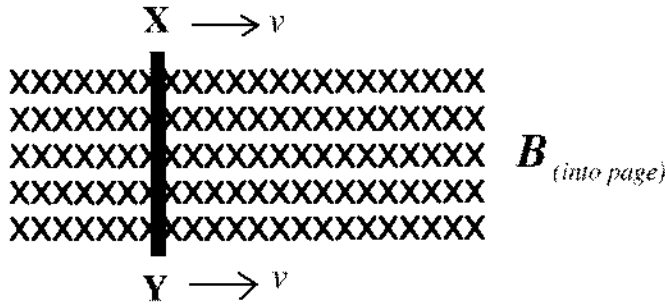
18. What is the magnetic flux, ϕ , through a coil of wire having an area of 5.0×10^{-2} m², whose plane is perpendicular to a magnetic field of magnitude 2.0×10^{-3} T? (ans: 1.0×10^{-4} Wb)

19. A coil in a magnetic field consists of 55 circular loops of wire, with an area of 0.18 m². The coil takes 0.13 s to turn from the position shown in diagram (1) to the position shown in diagram (2).

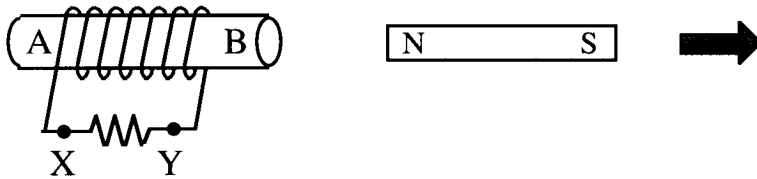


If the strength of the magnetic field B is 0.58 T, what is the average emf induced in the wire while it is turning? (ans: 44 V)

20. A generator coil has 170 turns. It has a cross-sectional area of $4.00 \times 10^{-2} \text{ m}^2$. In a time of 0.20 s, the magnetic field changes from 1.20 T to 1.50 T. What is the average emf induced in the coil?
 (ans: $-1.0 \times 10^2 \text{ V}$)
21. Segment XY of wire is 10.0 cm long. It is moved with a speed of 2.00 m/s through a magnetic field of strength 0.500 T, as shown in the below diagram.



- What is the emf induced in the wire segment? (ans 0.10V)
 - If B is doubled and v is doubled, how will the magnitude of the induced emf, \mathcal{E} be affected?
 (ans: \mathcal{E} will be increased to $4\mathcal{E}$)
 - Which end of segment XY will become positively charged? (ans: end X)
22. When the north end of the bar magnet is moved out of the solenoid as shown below, what is the direction of the induced current in the solenoid, and what is the polarity of end B of the solenoid?



(ans: from Y to X, and end B is South)

23. A DC motor is connected to a 12.0 V power supply. When the armature is rotating, the current is 3.80 A and the back emf is 10.40 V.
- What is the resistance of the armature? (ans: 0.42Ω)
 - If the armature 'jams' and cannot turn, what will the current in the armature be? (ans: 28.6 A)
24. A transformer is plugged into a 120 V AC source. It has an output of 16 V AC. If the primary coil has 300 turns, how many turns are there in the secondary coil? (ans: 40 turns)

Part 2: Mechanics Review

- A rescue pilot needs to drop a package of emergency supplies so that it lands as close as possible to a crashed airplane. If the plane has a velocity of 81 m/s and is flying 125 m above the ground, how far before the downed airplane (horizontally) must the rescue pilot drop the package? (ans: 409 m)

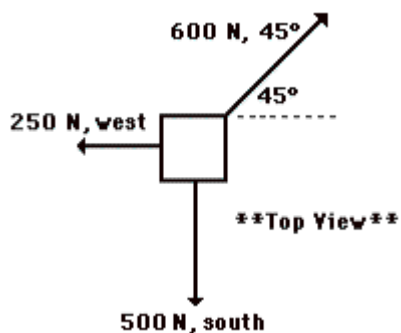
2. A ball is thrown with an initial velocity of 120m/s at an angle of 30° above the horizontal. If it is thrown off of a cliff that is 100m high
 - a. How long will it take to hit the ground? (*ans: 13.7s*)
 - b. How far from the cliff will the ball land (range)? (*ans: 1427m*)
 - c. What is velocity of the ball just before it hits? (*ans: 128m/s @ 35.7° below horizontal*)

3. A motorboat traveling 4 m/s, East encounters a current traveling 7.0 m/s, North.
 - a. What is the resultant velocity of the motorboat? (*ans: 8.06m/s @ 60° NofE*)
 - b. If the width of the river is 80 meters wide, then how much time does it take the boat to travel shore to shore? (*ans: 20s*)
 - c. What distance downstream does the boat reach the opposite shore? (*ans: 140m*)

4. An airplane is heading due north at a speed of 300 km/h. If a wind begins blowing *from* the southwest (45° E of N) at a speed of 50 km/h, what is the resultant velocity of the plane? (*ans: 337 km/h, at 6° E of N*)

5. Two Small Men with Big Hearts must move a refrigerator across the floor. They must exert a forward force of 524 N to get the fridge from rest and get it up to speed. The 158-kg fridge (full of food) experiences 418 N of friction.
 - a. What is the fridge's acceleration during this phase of its motion? (*ans: 0.671 m/s^2*)
 - b. If they maintain this forward force for 1.44 seconds, then what speed will the fridge have? (*ans: 0.966 m/s*)

6. Three hyenas are fighting over the carcass of a dead rhino. A top view of the magnitude and direction of the three forces is shown in the diagram below.



- a. Determine the resultant or net force acting upon the carcass. (*ans: 190N @ 23° S of E*)
- b. Determine the acceleration of the 750-kg carcass. (*ans: 0.25 m/s²*)
7. Barney is practicing his sweeping techniques for an upcoming curling tournament. He exerts a force on a 1.1-kg broom as he walks across a tile floor at a constant speed. The coefficient of friction between the floor and the broom is 0.45 and the broom handle makes an angle of 41° with the horizontal. Determine the amount of force with which Barney pushes downward (along the handle of the broom) in order to achieve this constant speed motion. Begin with a free body diagram. (*ans: 10.6N*)
8. A 355.0N boy and a 300.0N girl sit on a 50.5N porch swing that is 1.5m long. The swing is supported by a chain on each end. What is the tension in each chain when the boy sits .35m from one end and the girl sits .45m from the other? (*ans: boys side = 390 N, girls side = 320 N*)
9. A uniform ladder has a mass of 16.0 kg and a length of 8.50 m. It stands on the ground and leans against a vertical wall, making an angle of 62.0° with the ground. The friction between the wall and the ladder is not significant. What is the smallest force of friction between the ladder and the ground that will just prevent the ladder from slipping? (*ans: 41.7N*)
10. Sara rear-ended Bob's rented truck. Sara's 1300-kg car was moving at 11 m/s and stopped in 0.14 seconds.
- a. Determine the momentum change of Sara's car. (*ans: -1.4×10^4 kg•m/s*)
- b. Determine the impulse experienced by Sara's car. (*ans: -1.4×10^4 N•s*)
- c. Determine the magnitude of the force experienced by Sara's car. (*ans: -1.0×10^5 N*)
11. There is a collision at an intersection as a 2080-kg pickup truck traveling north at 32.6 m/s collides with a 18400-kg dump truck moving east at 12.4 m/s. The pickup and the dump truck entangle together in the middle of the intersection and move as a single object. Determine the post-collision speed and direction of the two entangled vehicles. (*ans: 11.6 m/s, 16.6° N of E*)
12. Bubba runs up the stairs, elevating his 102 kg body a vertical distance of 2.29 meters in a time of 1.32 seconds at a constant speed.
- a. Determine the work done by Bubba in climbing the stair case. (*ans: 2.30×10^3 J*)
- b. Determine the power generated by Bubba. (*ans: 1.73×10^3 W*)
13. Jessie (m=56.2 kg) is traveling at a speed of 12.8 m/s at the top of a 19.5-m high roller coaster loop.

- a. Assuming negligible losses of energy due to friction and air resistance, determine Jessie's total mechanical energy at the bottom of the loop ($h=0$ m). (*ans: 1.53×10^4 J*)
 - b. Determine Jessie's speed at the bottom of the loop. (*ans: 23.4 m/s*)
 - c. What force does Jessie feel from her seat at the bottom of the loop? (*ans: 3707N*)
14. Geostationary satellites are satellites which are orbiting the Earth above the equator and make one complete orbit every 24 hours. Because their orbital period is synchronized with the Earth's rotational period, a geostationary satellite can always be found in the same position in the sky relative to an observer on Earth. (GIVEN: $M_{\text{Earth}} = 5.98 \times 10^{24}$ kg).
- a. Determine the orbital radius of a geostationary satellite. (*ans: 4.23×10^7 m*)
 - b. Determine the orbital speed of a geostationary satellite. (*ans: 3.07×10^3 m/s*)
 - c. Determine the acceleration of a geostationary satellite. (*ans: 0.223 m/s²*)
15. Mars has a mass 6.46×10^{23} kg and a radius of 3.39×10^6 m. Determine the escape velocity for this planet. (*ans: 5.04×10^3 m/s*)