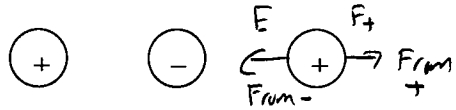
5. Three charged objects are placed in a straight line with the middle one equal distance from the other two. The objects have the same magnitude of charge but different signs as shown in the figure. Which direction is the net electrostatic force felt by the object on the far right?



$F_- > F_+$ since − is closer

0, no net force

(A) (B) (C) (D) (E)

7. Two objects are attracted to each other by an electrostatic force. One of the objects is found to have a negative charge. What do you know about the charge of the other object?

negative attracts positive

negative attracts neutral by induction

A) It definitely has a positive charge.
B) It definitely has a negative charge.
C) It could be positively charged or electrically neutral.
D) It could be negatively charged or electrically neutral.
E) You don't know anything about the electric charge of the other object.

8. Two charged objects are attracted to each other by an electrostatic force. If the distance between the two objects is halved the force between them will

$F = \frac{kq_1q_2}{r^2}$ when $r \to r/2$

$F \to 4F$

A) stay the same.
B) increase by a factor of 2.
C) increase by a factor of 4.
D) decrease by a factor of 1/2.
E) decrease by a factor of 1/4.

9. A uniform electric field points upward and has a magnitude of 50 N/C. A charged object is placed in the field and feels a force of 10 N downward. What is the charge on the object?

A) –0.2 C
B) +0.2 C
C) –5.0 C
D) +5.0 C
E) +500 C

$\vec{F} = \vec{E}q$

$q = \frac{\vec{F}}{\vec{E}} = \frac{10\ N}{50\ N/C} = .2$

negative since E is opposite direction of F

10. An object with a charge of 6.5 mC is moved from a point where the electric potential is 40 V to a point where the electric potential is 380 V. What is the change in electric potential energy of the object?

$\Delta V = \Delta PE / q$

$\Delta PE = q(\Delta V) = q(V_f - V_i)$

$= (6.5 \times 10^{-3} C)(380 - 40\ V)$

$= 2.2$

A) –2.2 J
B) +2.2 J
C) +25 J
D) –52,000 J
E) +52,000 J

11. Resistors of 10 Ω, 20 Ω, and 30 Ω are connected in parallel to a 120 V power supply. How much total current does the power supply produce?

In parallel

$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{10} + \frac{1}{20} + \frac{1}{30} = .1833$

$R_p = \frac{1}{.1833} = 5.46\ \Omega$

$\mathcal{E} = IR$

$I = \mathcal{E}/R = \frac{120\ V}{5.46\ \Omega} = 22\ A$

A) 0.5 A
B) 2.0 A
C) 6.5 A
D) 7.3 A
E) 22 A

12. If the current in a resistor doubles and the resistance stays the same, what happens to the power dissipated in the resistor?

$P = I^2 R$

when $I \rightarrow 2I$

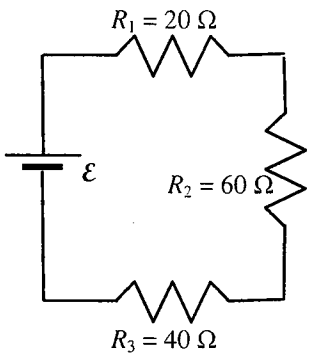
$I^2 \rightarrow 4I^2$

A) It is cut by one-quarter
B) It is cut by half.
C) It stays the same.
D) It doubles.
E) It quadruples.

13. Three resistors are placed in series as shown in the figure to the right. The current going through R_1 is I_1, through R_2 is I_2 and through R_3 is I_3. Rank the current going through each resistor, least to greatest?

In Series

A) $I_1 < I_2 < I_3$
B) $I_3 < I_2 < I_1$
C) $I_1 = I_2 = I_3$
D) $I_1 < I_3 < I_2$
E) $I_2 < I_3 < I_1$



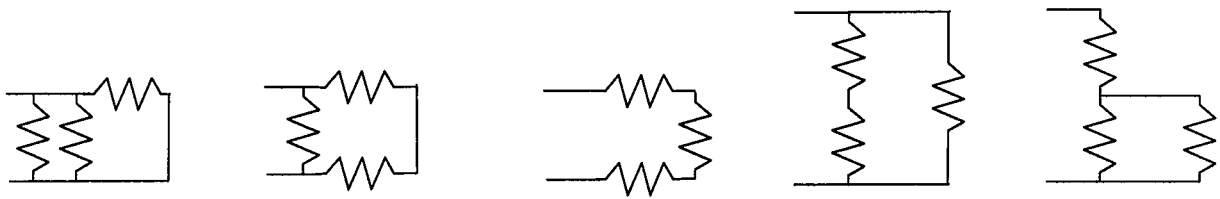
14. Your cell phone is powered by a 3.6 V battery. When you send a text message the phone uses 40 mW of power. What is the current in your cell phone when sending the message?

A) 9.0 mA
B) 11 mA
C) 32 mA
D) 44 mA
E) 140 mA

$P = IE$

$I = \frac{P}{E} = \frac{40 \times 10^{-3} W}{3.6 V} = .011 A = 11 mA$

15. Which figure shows three resistors in parallel?



(A) (B) (C) (D) (E)

13. Two charged objects are attracted to each other by an electrostatic force. If the distance between the two objects is halved the force between them will

A) stay the same.
B) increase by a factor of 2.
C) increase by a factor of 4.
D) decrease by a factor of 1/2.
E) decrease by a factor of 1/4.

$F = \frac{kq_1q_2}{r^2}$ when $r \Rightarrow \frac{1}{2}r$

$\frac{1}{r^2} \Rightarrow 4\frac{1}{r^2}$

14. A uniform electric field points to the east and has a magnitude of 260 N/C. If a charged object with a charge of +1.5 C is placed in this field, what force is felt by the object (magnitude and direction)?

A) 390 N to the east
B) 390 N to the west
C) 170 N to the east
D) 170 N to the west
E) 570 N to the west

$F = Eq$
$= (260\ N/C)(1.5\ C)$

15. Resistors of 10 Ω, 20 Ω, and 30 Ω are connected in series to a 120 V power supply. How much total current does the power supply produce

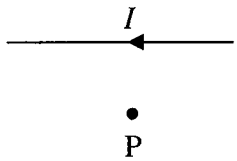
A) 0.5 A
(B) 2.0 A
C) 6.5 A
D) 7.3 A
E) 22 A

$R_{eq} = R_1 + R_2 + R_3 = 10\Omega + 20\Omega + 30\Omega = 60\Omega$

$\mathcal{E} = IR$

$I = \frac{\mathcal{E}}{R} = \frac{120\,V}{60\,\Omega} = 2.0\,A$

16. A long straight wire is lying in the plane of the paper and has a current flowing to the left as shown. At the point P, also in the plane of the paper, what direction is the magnetic field created by this current?



By RHR-1

(A) (B) (C) (D) (E)

17. An electron with a *negative charge* is moving directly toward you as shown by the vector labeled **v** in the figure. A magnetic field points straight up as shown by the vector labeled **B**. What direction is the magnetic force on the electron?

By RHR-3 for a negative charge

(A) (B) (C) (D) (E)

18. Two long straight wires are parallel to each other with currents running in opposite directions. If the distance between the wires is increased by a factor of 3, what happens to the magnetic force between the wires?

A) It stay the same.
B) It increase by a factor of 3.
C) It increase by a factor of 9.
(D) It decrease by a factor of 1/3.
E) It decrease by a factor of 1/9.

$\frac{F}{\ell} = \frac{2k'I_1I_2}{r}$

when $r \to 3r$

$\frac{1}{r} \to \frac{1}{3}r$

19. A circular loop of wire has 40 turns and a radius of 5.0 cm. A magnetic field is turned on perpendicular to the plane of the wire, going from a magnitude of 0 T to 0.95 T in a time of 0.75 s. What electric potential is induced around the coil of wire?

A) 0.13 V
(B) 0.40 V
C) 0.80 V
D) 2.5 V
E) 8.0 V

$B_{final} = .95t$
$B_{initial} = 0$
$A = \pi r^2$

$$\mathcal{E} = \frac{\Delta\Phi}{t} = \frac{\Phi_{final} - \Phi_{initial}}{t}$$

$$= \frac{NB_{final}A - NB_{initial}A}{t} = \frac{NB_{final}\pi r^2 - 0}{t}$$

$$= \frac{40(.95T)\pi(.05m)^2}{.75s} = .398\,V = .40V$$

20. A wire with a length of 0.50 m is perpendicular to a magnetic field of strength 1.8 T. If the wire feels a magnetic force of 0.72 N, what is the current in the wire?

A) 0.20 A
B) 0.65 A
(C) 0.80 A
D) 1.3 A
E) 2.6 A

$$F = ILB$$

$$I = \frac{F}{LB} = \frac{(0.72\,N)}{(.50m)(1.8T)} = 0.80\,A$$