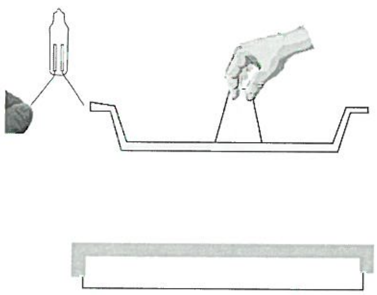
	Total	K+E	I+O
Student	35	16	19
Average	56.2/100	53.6/100	58.3/100
Best	87.0/100	79.5/100	87.0/100

11^{th}G Physics (2018– 19)

3^{rd} Q Exam

(March 19, 2019)

Class	No.	Name Solutions



In a calculation problem, describe equations clearly and systematically enough to show how to solve the problem. <u>If not enough, you won't get any points.</u>

5point/question x 21questions=105points
Max 100 points

Exam ／[Total 100 点]

Lab Reports	Number of Lab Reports	/3	Score	

Gravitational acceleration rate	$g = 9.80\ m/s^2$
Universal Gravitational Constant	$G = 6.67 \times 10^{-11}\ N \cdot m^2/kg^2$
Elementary Charge	$e = 1.60 \times 10^{-19}\ C$
Electron Mass	$m_e = 9.11 \times 10^{-31}\ kg$
Proton Mass	$m_p = 1.673 \times 10^{-27}\ kg$
Coulomb's Law Constant	$k = 8.99 \times 10^9\ N \cdot m^2/C^2$
Magnetic Permeability of Free Space	$\mu_0 = 4\pi \times 10^{-7}\ T \cdot m/A$
Avogadro's Number	$N_A = 6.022 \times 10^{23}\ mol^{-1}$
Speed of Light in vacuum	$c = 3.00 \times 10^8\ m/s$

---

(1) In walking across a carpet, you acquire a net negative charge of 50 μC. How many excess electrons do you have?
(Equations)

$$50 \times 10^{-6}\ C \times \frac{1\ \text{electron}}{1.60 \times 10^{-19}\ C}$$

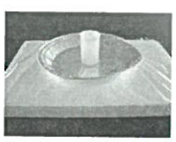
$$= 31.25 \times 10^{13} \longrightarrow 3.1 \times 10^{14}$$

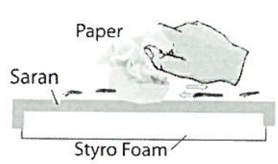
(1) Answer
3.1×10^{14} electrons

80%

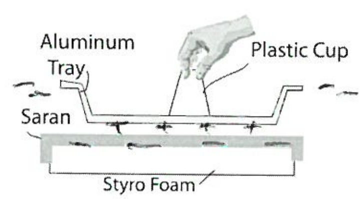
3×10^{14} electrons

(2) The following figure shows an experiment using Saran wound round Styro foam, an aluminum tray and a neon lamp.
(2-a) Draw the distribution of charges in (2-a) to (2-e).
(2-b) Also show which plate in the neon bulb glows.



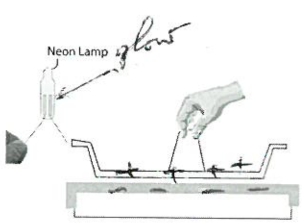


(2-a)

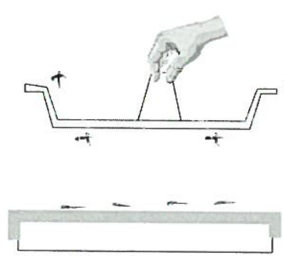


(2-b)

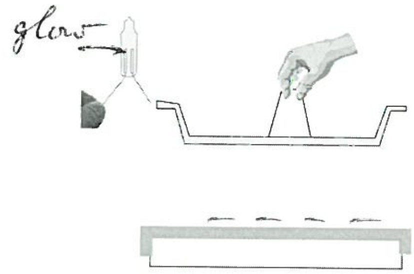
33%



(2-c)



(2-d)



(2-e)

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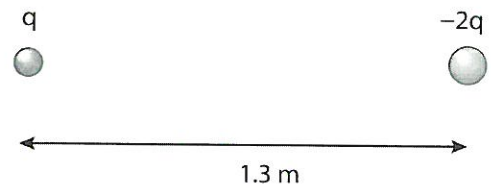
(3) The attractive electric force between the point charges q and −2q has a magnitude of 2.3 N when the separation between the charges 1.3 m. What is the magnitude of charge q?



(Equations)

$$F = k\frac{|q||-2q|}{r^2} = k\frac{2q^2}{r^2}$$

$$q^2 = \frac{F r^2}{2k}$$

$$q = r\sqrt{\frac{F}{2k}}$$

$$= 1.3\sqrt{\frac{2.3}{2 \times 8.99 \times 10^9}}$$

$$= 1.3\sqrt{0.1279 \times 10^{-9}}$$

$$= 1.3\sqrt{1.279 \times 10^{-10}}$$

$$= 1.3 \times 1.13 \times 10^{-5}$$

$$= 1.47 \times 10^{-5}$$

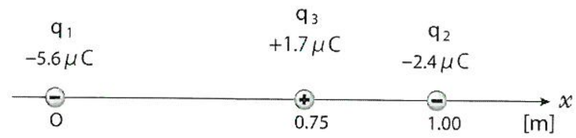
$$\rightarrow 1.5 \times 10^{-5}$$

(3) Answer

1.5×10^{-5} C

64%

(3) A charge $q_1 = -5.6\,\mu$ C is at the origin, and a charge $q_2 = -2.4\,\mu$ C is on the x axis at $x = 1.00$ m. Find the total force acting on a charge $q_3 = +1.7\,\mu$ C located on the x axis at $x = 0.75$ m.



(Equations)

$$F_1 = -k\frac{5.6\mu \times 1.7\mu}{0.75^2}$$

$$F_2 = k\frac{2.4\mu \times 1.7\mu}{0.25^2}$$

$$F = F_1 + F_2$$

$$= 8.99\times10^{9}\times1.7\times10^{-12}\times\left(\frac{2.4}{0.25^2}-\frac{5.6}{0.75^2}\right)$$

$$= 8.99\times1.7\times10^{-3}\times(38.4-9.96)$$

$$= \quad " \quad \times 28.4$$

$$= 434.7\times10^{-3}$$

$$\longrightarrow 0.43$$

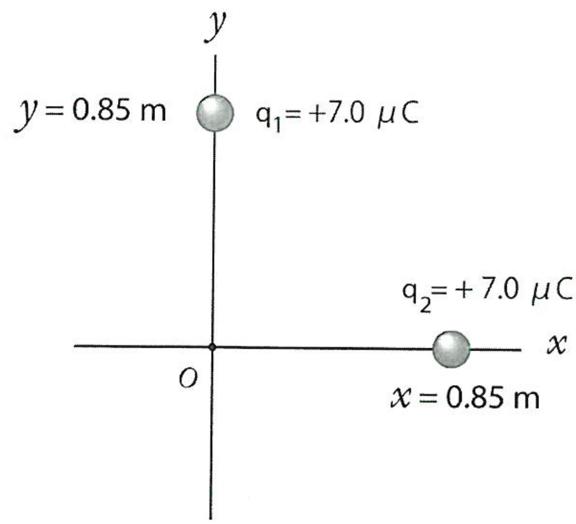
(3) Answer

0.43 N to the right

55%

(4) An electric charge $q_1 = +7.0\,\mu C$ is placed on the y axis at y = 0.85 m. Another charge $q_2 = +7.0\,\mu C$ is placed on the x axis at x = 0.85 m. Find the magnitude and direction of the total electric field at the origin due to the two charges.

(Equations)



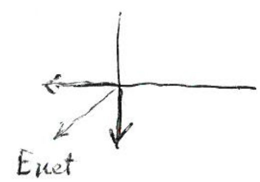
$$E_1 = E_2 = k\frac{q}{r^2}$$

$$= 8.99\times10^9 \times \frac{7.0\times10^{-6}}{0.85^2}$$

$$E = \sqrt{2}\,E_1$$

$$= \frac{\sqrt{2}\times8.99\times10^9\times7.0\times10^{-6}}{0.85^2}$$

$$= 123\times10^3 \longrightarrow 1.2\times10^5\ (N/C)$$



$45^\circ + 180^\circ = 225^\circ$

(4) Answer

1.2×10^5 N/C

225°

40%

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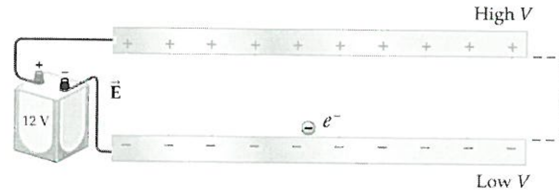
(4,5) A uniform electric field is established by connecting the plates of a parallel-plate capacitor to a 12-V battery.

(4) If the plates have a separation of 0.65 cm, what is the magnitude of the electric field in the capacitor?

(5) An electron moves from the negative plate to the positive plate. Find the change in electric potential energy for the electron.
(Equations)



(4) $E = \frac{V}{d} = \frac{12\ V}{0.65 \times 10^{-2}\ m}$

$= 18.46 \times 10^{2} \longrightarrow 1.8 \times 10^{3}\ (V/m)$

(5) $U = qV = -eV$

$= -1.60 \times 10^{-19} \times 12$

$= -19.2 \times 10^{-19} \longrightarrow -1.9 \times 10^{-18}\ (J)$

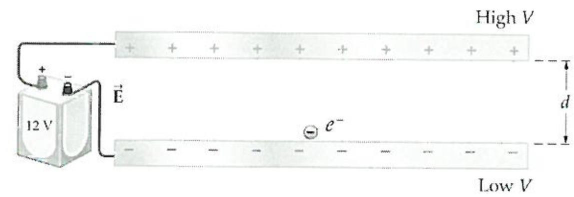
(4) Answer

$1.8 \times 10^{3}\ V/m$ 47%

(5) Answer

$-1.9 \times 10^{-18}\ J$ 21%

(6) A uniform electric field is established by connecting the plates of a parallel-plate capacitor to a 12-V battery. An electron is released from rest at the negative plate and reaches the positive plate. Find the final speed on the electron.



(Equations)

Conservation of energy. $E_i = E_f$

$$qV = \frac{1}{2}mv^2$$

$$v = \sqrt{\frac{2qV}{m}}$$

$$= \sqrt{\frac{2 \times 1.60 \times 10^{-19} \times 12}{9.11 \times 10^{-31}}}$$

$$= \sqrt{4.21 \times 10^{12}}$$

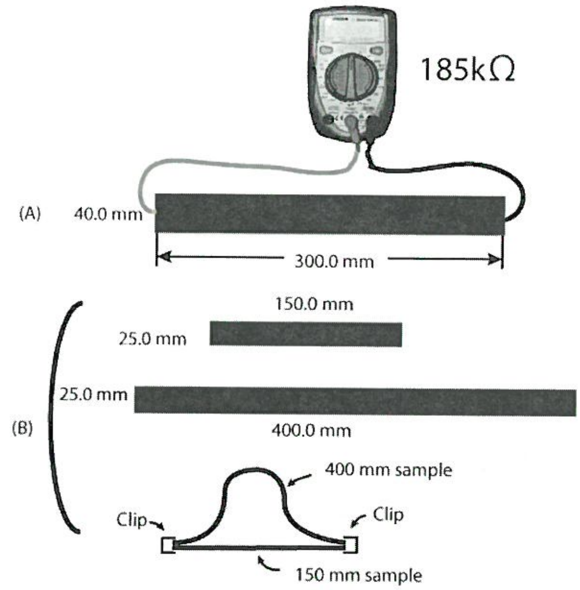
$$= 2.053 \times 10^{6} \longrightarrow 2.1 \times 10^{6} \,(m/s)$$

(6) Answer

2.1×10^{6} m/s

14 %

(7) In Physics Lab, you are measuring the resistances of various shapes of conductive paper. A piece of paper (A), 40.0mm x 300.0mm, shows 185 kΩ. Predict the resistance of the combined sample (B) where a 25.0mm x 150.0mm sample is combined with a 25.0mm x 400.0mm sample, as the figure in the bottom shows.



(Equations)

$$185\ k\Omega \times \frac{150}{300} \times \frac{40}{25} = 148.\ k\Omega$$

$$185\ k\Omega \times \frac{400}{300} \times \frac{40}{25} = 394.7\ k\Omega$$

$$\frac{1}{R} = \frac{1}{148} + \frac{1}{394.7}$$

$$R = 107.6\ k\Omega \longrightarrow 108\ k\Omega$$

(7) Answer 108 kΩ

51%

(8, 9) An electric device operates on a 120V.
(8-a) If the power consumed by the device is 1550W, what is the current in it?

(8-b) When the above device operates during 8.00 hours, find the electric energy consumed in kWh.

(9) If the above device operates on a 100 V, what is the current in it?

(Equations)

(a) $P = VI$

$I = \frac{P}{V} = \frac{1550}{120} = 12.92 \longrightarrow 12.9\text{ A} \sim 13\text{ A}$

(b) $W = Pt$

$= 1550\text{ W} \times 8.00\text{ hr} = 12{,}400\text{ Wh} \longrightarrow 12.4\text{ kWh}$

(9) $P = \frac{V^2}{R} \rightarrow R = \frac{120^2}{1550} = 9.290\ (\Omega)$

$I = \frac{V}{R} = \frac{100}{9.290} = 10.76 \longrightarrow 10.8\text{ A}$

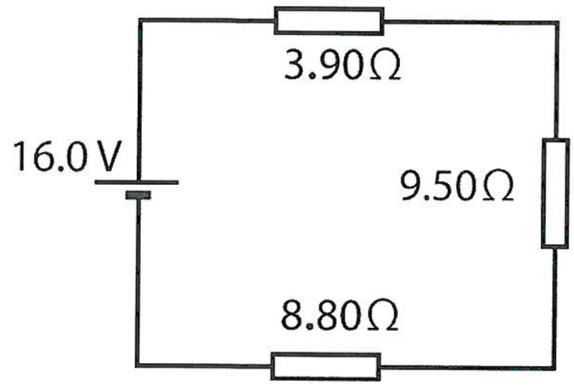
(8-a) Answer
12.9 A or 13 A
(8-b) Answer
12.4 kWh

75%

(9) Answer
10.8 A

11%

(10) Find the potential difference between the terminals of the 9.50 Ω resistor in the circuit shown.
(Equations)



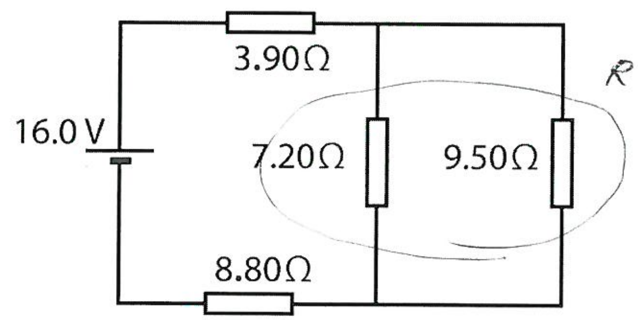
$$I = \frac{E}{R}$$
$$= \frac{16.0}{3.9 + 9.5 + 8.8}$$
$$= \frac{16.0}{22.2}$$
$$= 0.7207 \text{ (A)}$$

$$V = IR'$$
$$= 0.7207 \times 9.50$$
$$= 6.846 \longrightarrow 6.85 \text{ (V)}$$

(10) Answer
6.85 V

80%

(11) Find the potential difference between the terminals of the 9.50 Ω resistor in the circuit shown.
(Equations)



$$\frac{1}{R'} = \frac{1}{7.2} + \frac{1}{9.5}$$

$$R' = 4.096\ (\Omega)$$

$$R = 3.90 + 4.096 + 8.80 = 16.796$$

$$I = \frac{E}{R} = \frac{16.0}{16.796} = 0.9526\ (A)$$

$$I_{9.50} = 0.9526 \times \frac{7.2}{7.2 + 9.5} = 0.4107\ (A)$$

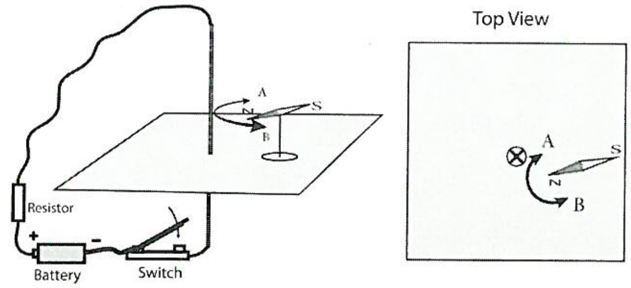
$$V_{9.50} = 0.4107 \times 9.50 = 3.902 \longrightarrow 3.90\ (V)$$

(11) Answer

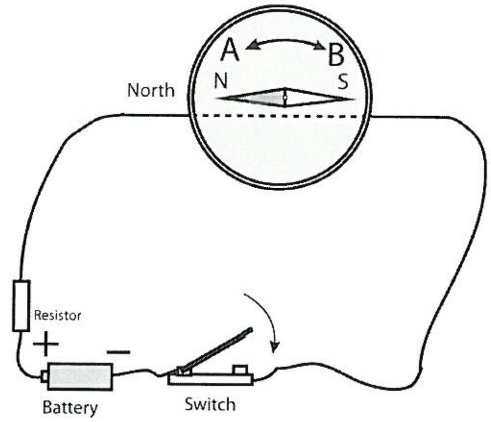
3.90 V

61%

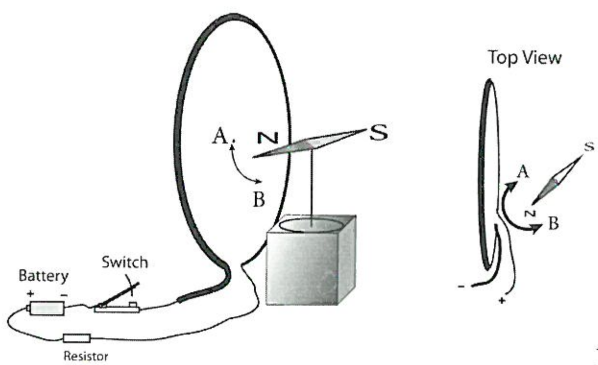
(12-a~e) When the current is applied in wire, the north pole of the compass moves in the direction, A or B. Answer A or B.



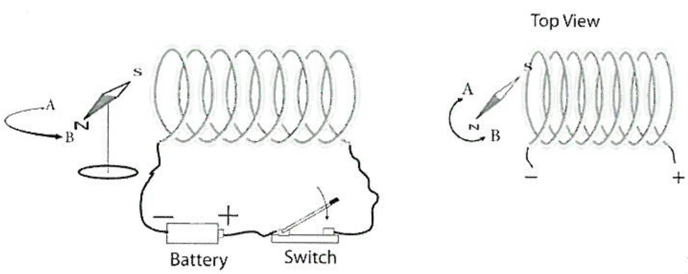
12-a



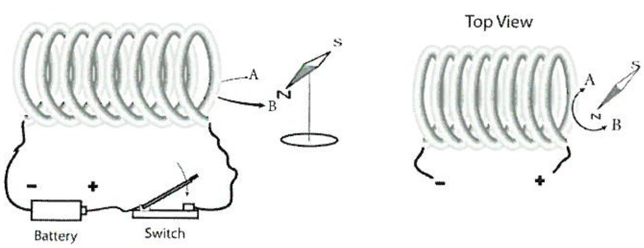
12-b



12-c



12-d

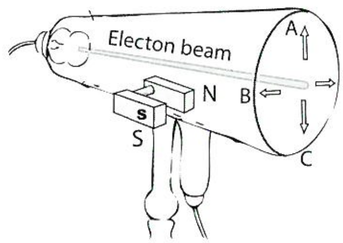


12-e

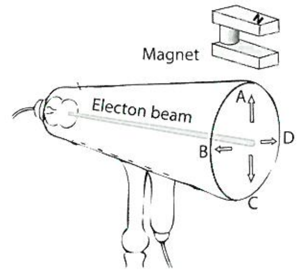
(12-a) Answer
B
(12-b) Answer
A
(12-c) Answer
B
(12-d) Answer
B
(12-e) Answer
A

81%

(13-a,b) Electron beam is shown in the Crooks Tube. A magnet is brought near the tube as shown. In which direction does the electron beam move, A, B, C or D?



(13-a)



(13-b)

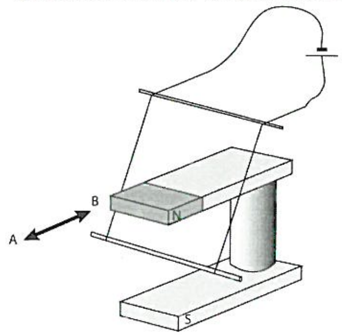
(13-a) Answer

C

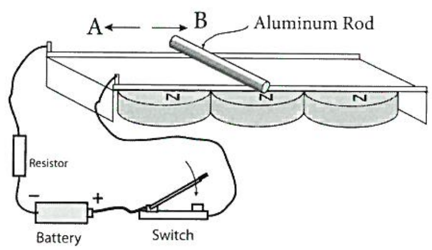
(13-b) Answer

D

(13-c,d) When the current is applied in wire, the metal rod moves in the direction, A or B. Answer A or B.



(13-c)



(13-d)

(13-c) Answer

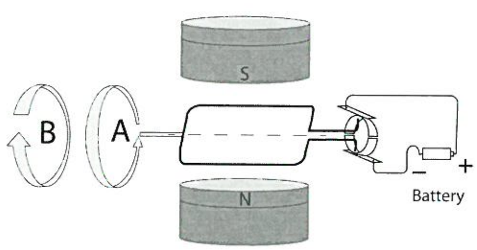
A

(13-d) Answer

B

89%

The figure shows a motor. How does it rotate, in the direction **A** or in the direction **B**?

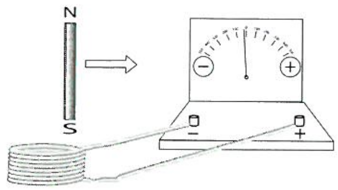


(13-e)

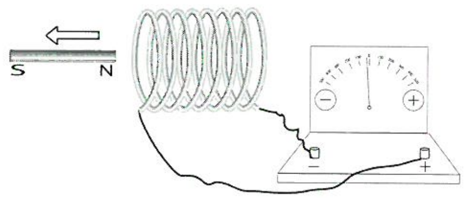
(13-e) Answer

B

(14-a,b) When the magnet is moved as shown, the galvanometer shows a swing to the positive or negative side. Answer "positive" (+) or "negative" (–).



(16-a)



(16-b)

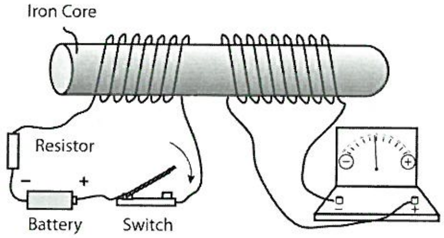
(14-a) Answer

–

(14-b) Answer

+

(14-c) The instance the current is applied in the coil at the left, the galvanometer shows a swing to the positive or negative side. Answer "positive" (+) or "negative" (–).



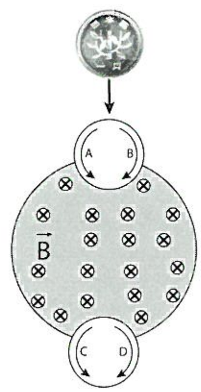
(16-c)

(14-c) Answer

+

60%

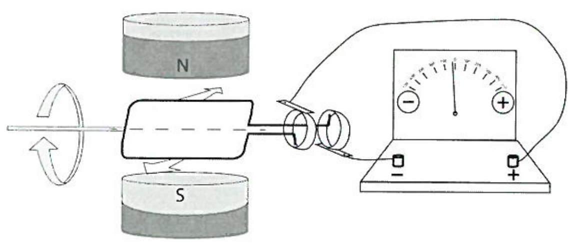
(14-d) A one yen coin slides down onto a magnet where the N pole directs upside. When the coin passes through the upper edge and lower edge, a current flows inside the coin. Predict the directions. Answer two directions from A to D.



(14-d) Answer

A and D

(14-e) The figures show generators. The coil rotates around the rotating rod in the direction shown. the galvanometer shows a swing to the positive or negative side. Answer "positive" (+) or "negative" (–).



(14-e)

(14-e) Answer

+

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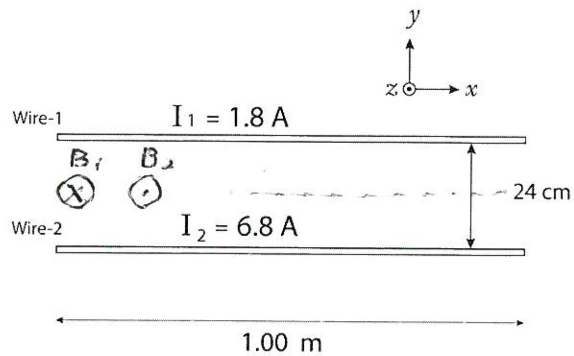
(15) Two wires 24 cm apart carry current I_1 = 1.8 A and I_2 = 6.8 A, flowing to the positive x.



(15-a) Find the magnitude and direction of the magnetic field at the middle point between the wires.

(15-b) Find the magnitude and direction of the force exerted on the wire-1

(Equations)

$$B = \frac{\mu_0}{2\pi}\frac{I}{r}$$

(a) $B_1 = \frac{\mu_0}{2\pi}\frac{1.8}{0.12}$

$B_2 = \frac{\mu_0}{2\pi}\frac{6.8}{0.12}$

$B = B_1 - B_2 = \frac{2\times10^{-7}}{0.12}(6.8 - 1.8)$

$= 83.3\times10^{-7} \longrightarrow 8.3\times10^{-6}\ (T)$ ⊙

(b) $B = \frac{\mu_0}{2\pi}\frac{6.8}{0.24}$

$F = ILB$

$= 1.8\times1.00\times2\times10^{-7}\times\frac{6.8}{0.24}$

$= 102\times10^{-7} \longrightarrow 1.0\times10^{-5}\ (N)$ ↓

(15-a) Answer
8.3×10^{-6} T positive Z (or out of page)
(15-b) Answer
1.0×10^{-5} N negative y

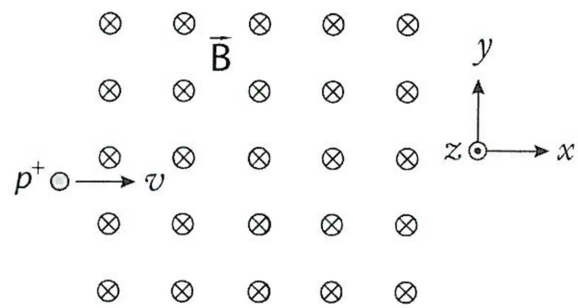
40%

(16,17) A proton travels to the positive x through a region of space where the magnetic field point to the negative z, as shown.

(16) Find the direction of the magnetic force exerted on the proton.

(17) The speed of the proton is v = 1.42 x 10^7 m/s and the magnetic force is 4.25 x 10^{-12} N. Find the strength of the magnetic field.

(Equations)



(16)

(17) $F = qvB$

$$B = \frac{F}{qv}$$

$$= \frac{4.25 \times 10^{-12}}{1.42 \times 10^{7} \times 1.60 \times 10^{-19}}$$

$$= 1.871 \longrightarrow 1.87\ (T)$$

(16) Answer

Positive y

31%

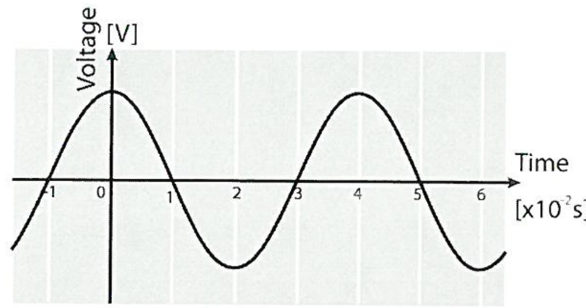
(17) Answer

1.87 T

43%

(18,19) The figure shows the voltage change of a 240V alternating current. Find the followings:
(18-a) Period,
(18-b) Frequency

(19) The maximum value of voltage.
(Equations)



(b) $f = \frac{1}{T}$

$= \frac{1}{4.0 \times 10^{-2}}$

$= 25.0 \longrightarrow 25$

(19)

$V_{max} = \sqrt{2}\, V_{rms}$

$= \sqrt{2} \times 240$

$= 339.4 \longrightarrow 339(V)$ or $340(V)$

(18-a) Answer
4.0×10^{-2} s

(18-b) Answer
25 Hz

52%

(19) Answer
340 V

26%

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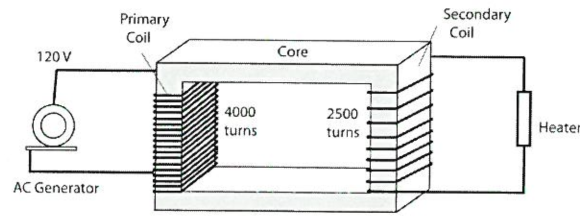
(20) An alternating EMF of 120 V is applied to a transformer having 4000 turns on its primary and 2500 turns on its secondary. On the secondary side, a heater is connected: its specification is 1100W for 120V. Find the followings:



(20-a) What is the secondary voltage?

(20-b) What is the primary current?
(Equations)

(a)

$$V_2 = V_1 \times \frac{N_2}{N_1}$$

$$= 120 \times \frac{2500}{4000}$$

$$= 75.0 \longrightarrow 75 (V)$$

(b)

$$P_2 = \frac{V^2}{R_2} \longrightarrow R_2 = \frac{V^2}{P_2} = \frac{120^2}{1100} = 13.09 (\Omega)$$

$$I_2 = \frac{V_2}{R_2} = \frac{75.0}{13.09} = 5.729 (A)$$

$$V_1 I_1 = V_2 I_2$$

$$\longrightarrow I_1 = \frac{V_2 I_2}{V_1} = \frac{75 \times 5.729}{120} = 3.580 \longrightarrow 3.6 (A)$$

(20-a) Answer
75 V
(20-b) Answer
3.6 A

46%

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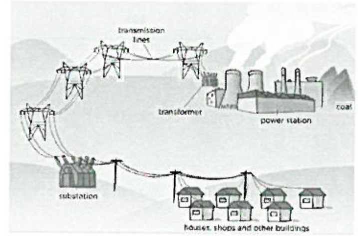

(21-b) A power station produces electric power of 600 kW at 20 kV. The power is transmitted 250 km totally over transmission lines whose resistance is 1.2 Ω/km.

In order to decrease the power loss [less] than 1.0%, what turn ratio (secondary/primary) should a transformer be used before the transmission?
(Equations)

$R = 1.2 \times 250 = 300\ (\Omega)$

$600\ kW \times 0.01 = 6\ kW = P(loss)$

$P(loss) = I^2 R \qquad I = \sqrt{\frac{6\times10^3}{300}} = 4.47\ (A)$

$P = VI \qquad V = \frac{P}{I} = \frac{600\times10^3}{4.47} = 134\times10^3\ (V)$

$\frac{N_2}{N_1} = \frac{V_2}{V_1} = \frac{134\ kV}{20\ kV} = 6.71 \longrightarrow 6.7$

(21-a) Answer

6.7

(21-b) Alternating current (AC) is broadly produced in electric plants, not direct current (DC). Explain why?
(Answer in English or Japanese)

24%

(21-b) Answer

AC can easily change its voltage using a transformer especially to high voltages. If the voltage is higher, the current can be lower because P = VI. The lower current results in lower power loss in power transmission due to $P(loss) = I^2R$.

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Your opinions