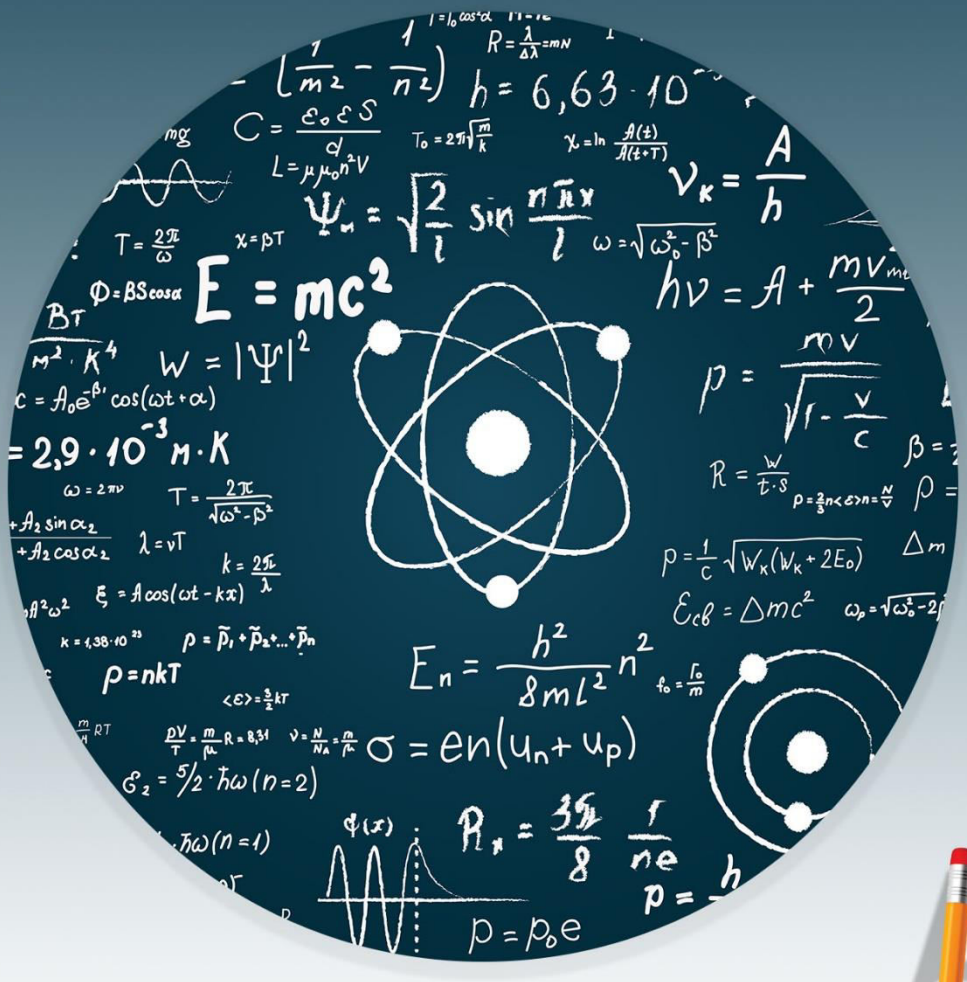
PHYSICS



WORKSHEET-1

STEP

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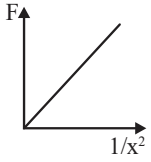
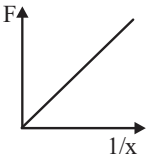
Worksheet-01

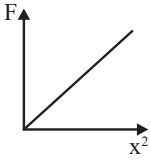
Topics:- Coulomb's Law to Applications of Gauss's Law

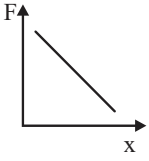
USE THIS SPACE FOR SCRATCH WORK

1. **A point charge at a distance "x" from another point charge experiences a force of repulsion. Which one of following graphs shows how the force is related to "x".**

A. 

B. 

C. 

D. 

2. **An uncharged metal object M is insulated from its surroundings. A positively charged metal sphere S is then brought near to M. Which diagram best illustrates the resultant distributions of charge on S and M?**

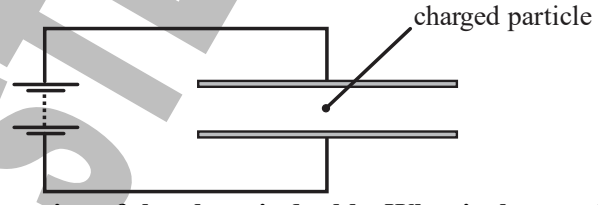
A. 

B. 

C. 

D. 

3. **A charged particle is in the electric field between two horizontal metal plates connected to a battery, as shown. There is a force F on the particle due to the electric field.**



The separation of the plates is double. What is the new force on

the particle?

A. $\frac{F}{4}$ B. $\frac{F}{2}$

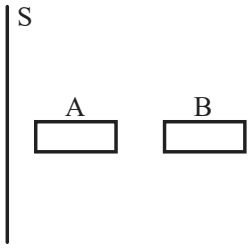
C. F D. 2F

4. The electric field between two plates is E. Now the electric field between same two plates in a medium of relative permittivity "10" is:

A. 10E B. $\frac{10}{E}$

C. $\frac{E}{10}$ D. E+10

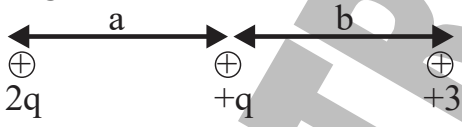
5. A large non-conducting sheet S is given a uniform positive charge density. Two uncharged small metal plates A and B are placed near the sheet as shown. Which of the following is false?



A. S attracts A B. A attracts B

C. S attracts B D. B repels A

6. The figure shows three-point charges. If the net force on the central charge is zero, what is the value of a/b?



A. $\frac{2}{3}$ B. $\sqrt{\frac{2}{3}}$

C. $\frac{3}{2}$ D. $\sqrt{\frac{3}{2}}$

7. The study of charges at rest under the action of electric forces is called:

A. Electromagnetics B. Electrostatics

C. Electricity D. Electrodynamics

8. The existence of an object is primarily because of:

A. Magnetic force B. Electric force

C. Gravitational force D. Nuclear force

9. Which one is sure test for the presence of charge on a body?

A. Attraction B. Repulsion

C. Both A and B D. None of these

10. Coulomb's force:

A. Obeys inverse square law

B. Depends on magnitudes of charges

C. Depends on medium between charges

D. All of these

11. **If the distance between two charges is doubled the force between them:**

A. Becomes 4 times B. Becomes 2 times

C. Becomes $\frac{1}{4}$ times D. Becomes $\frac{1}{2}$ times

12. **Conventionally attractive force between charges is taken as _____ and repulsive force is taken as _____.**

A. Positive, Positive B. Positive, Negative

C. Negative, Positive D. Negative, Negative

13. **If the magnitude of both charges is doubled and distance between them is halved then electric force becomes?**

A. 4 times B. 8 times

C. 16 times D. 2 times

14. **The value of electrical constant $\varepsilon_\circ$ is:**

A. 9×10^{9} N m^2 C^{-2} B. 8.85×10^{-12} C^2 N^{-1} m^{-2}

C. 9×10^{9} N^2 m^2 C^{-2} D. 8.85×10^{-12} C^2 N^{-2} m^{-2}

15. **A charge q is divided into two parts 'q_1 *and* $(q-q_1)$'. What is the ratio $\frac{q}{q_1}$ so that force between the two parts placed at a given distance is maximum?**

A. 1:1 B. 2:1

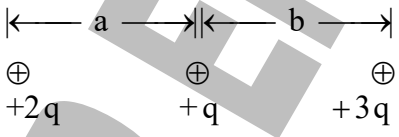
C. 1:2 D. 1:4

16. **Two point charges placed at a certain distance r in air exert a force of F on each other. Then the new distance at which these charges will experience the same force in a medium of dielectric constant 'k' is::**

A. r B. $\frac{r}{k}$

C. $\frac{r}{\sqrt{k}}$ D. $r\sqrt{k}$

17. **The figure shows three point charges, if the net electric force on the central charge is zero, What is the value a/b:**



A. $\frac{2}{3}$ B. $\sqrt{\frac{2}{3}}$

C. $\frac{3}{2}$ D. $\sqrt{\frac{3}{2}}$

18. **Two point charges exert a force of 20 N when a dielectric of dielectric constant "2" is present between them. If the dielectric is removed keeping all the other parameters same, what is the force now?**

A. 40 N B. 20 N

C. 10 N D. 5 N

USE THIS SPACE FOR SCRATCH WORK

19. **Electric field due to point charge depends upon:**
A. Magnitude of charge
B. Distance from charge
C. Medium in which charge is placed
D. All of these

20. **Two positive charges $q_1 = 16\ \mu C$ and $q_2 = 4\ \mu C$ are separated by a distance of 3 m. The distance of zero field spot from smaller charge is:**
A. 1 m B. 2 m
C. 3 m D. 4 m

21. **The zero field spot in case of two unequal and opposite charges exist:**
A. Between the charges at mid-point
B. Between the charges but closer to smaller charge
C. Both A and B
D. None of these

22. **The ratio of electric force to electric field strength gives the units of:**
A. Current B. Charge
C. Time D. None of these

23. **In photocopier the drum is given _____ charge and toner is given _____ charge:**
A. Positive, Negative B. Positive, Positive
C. Negative, Positive D. Negative, Negative

24. **Electric flux passing through a surface area will be half of maximum value when:**
A. $\vec{A}$ makes 60° with $\vec{E}$ B. $\vec{A}$ makes 30° with $\vec{E}$
C. $\vec{A}$ makes 45° with $\vec{E}$ D. $\vec{A}$ makes 0° with $\vec{E}$

25. **Electric flux passing through a surface area will be $\frac{\sqrt{3}}{2}$ times the maximum flux if plane area makes _____ angle with electric field.**
A. 30° B. 45°
C. 60° D. 75°

26. **The electric flux passing through a surface area is because of:**
A. Acosθ only B. Asinθ only
C. Asin(90°-θ) only D. Both A and C

27. **Five charge $q_1 = +1C$, $q_2 = +3C$, $q_3 = +5C$, $q_4 = -5C$ and $q_5 = -4C$ are present in a closed surface, the electric flux through that surface will be:**
A. $\frac{18}{\varepsilon_\circ}$ B. $\frac{9}{\varepsilon_\circ}$

USE THIS SPACE FOR SCRATCH WORK

C. $\frac{5}{\varepsilon_\circ}$ D. Zero

28. The flux passing through a closed surface does not depend on:

A. Charge enclosed
B. Medium present between charge and surface
C. Shape of surface
D. Both A and B

29. If E_1 is the electric field near an infinite charged sheet and E_2 is the electric field between two oppositely charged plates then which statement is correct?

A. $E_1 = E_2$ B. $E_1 = \frac{1}{2}E_2$

C. $E_1 = 2E_2$ D. $E_1 = \frac{1}{4}E_2$

30. Electric field strength between two similar and equally charged parallel plates is:

A. $\frac{\sigma}{2\varepsilon_\circ}$ B. $\frac{\sigma}{\varepsilon_\circ}$

C. $\frac{2\sigma}{\varepsilon_\circ}$ D. Zero

ANSWER KEY (Worksheet-01)					
1	A	11	C	21	D
2	D	12	C	22	B
3	B	13	C	23	A
4	C	14	B	24	A
5	D	15	B	25	C
6	B	16	C	26	D
7	B	17	B	27	D
8	B	18	A	28	C
9	B	19	D	29	B
10	D	20	A	30	D

SOLUTIONS

Chapter – 12 (WS-01)

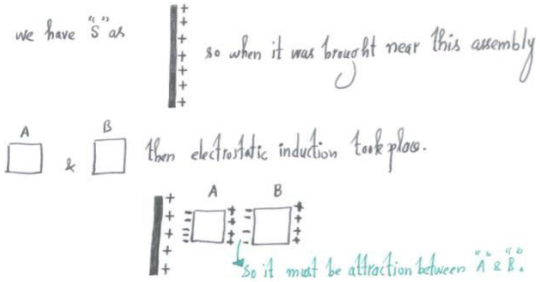
1. Answer is "A"
Solution:-
"F" is inversely proportional to "x^2" but it must be directly proportional to "$\frac{1}{x^2}$" which means
their curve must be a straight line.

2. Answer is "D"
Solution:-
An example of electrostatic induction.

3. Answer is "B"
Solution:-
$F = qE \rightarrow E \propto \frac{1}{r}$ so when "r" is doubled then "E" reduces to $\frac{E}{2}$ and hence $F \rightarrow \frac{F}{2}$

4. Answer is "C"
Solution:-
$E \propto \frac{1}{\varepsilon_r}$ so $E' = \frac{E}{10}$

5. Answer is "D"
Solution:-



6. Answer is "B"
Solution:-
The net force is zero means that;
$F_1 + F_2 = 0$

$$\frac{K(2q)(q)}{a^2} + \frac{K(q)(3q)}{b^2} = 0$$

$$\frac{2}{3} = -\frac{a^2}{b^2}$$

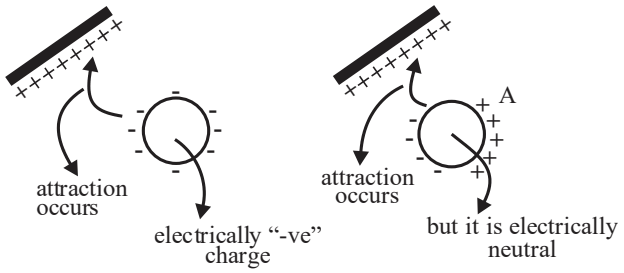
$$\frac{a}{b} = \sqrt{\frac{2}{3}}$$

7. Answer is "B"
Solution:- As electrostatic is a combination of two words "electro" means charge and "static" means at rest.

8. Answer is "B"
Solution:- An object primarily is composed of millions of atoms and molecules which are binded together with most basically the electrical force.

9. Answer is "B"
Solution:- When we bring a "+ve" charged rod near an object under observation whose charge has to be determined then there are two possibilities

(i) Attraction occurs:-
If attractions occurs then there are further two possibilities, either it has "-ve" charge or it may have no charge and attraction occurred only due to electrostatic induction which leaves us double minded, so on attraction we are never 100% sure that object has charge or not.



(ii) Repulsion occurs:-

If repulsion occurs then only possibility is that same charge must be present on object under observation making 100% sure.

10. Answer is "D"

Solution:- As according to Coulomb's law;

$F_c \propto q_1 q_1 \rightarrow$ Depends upon magnitudes of charges

$F_c \propto \frac{1}{r^2} \rightarrow$ Obeys inverse square

$F_c = \frac{1}{4\pi\varepsilon_\circ \varepsilon_r}\frac{q_1 q_2}{r^2} \rightarrow$ Depends upon "ε_r" which is a medium parameter.

11. Answer is "C"

Solution:- $F = k\frac{q_1 q_2}{r^2} \Rightarrow F \propto \frac{1}{r^2}$

12. Answer is "C"

Solution:- As attraction occurs between opposite charges which means if $q_1 = +ve, \mathrm{q}_2 = -\mathrm{ve}$ then

- $F_c \propto (+q_1)(-q_1) \propto -q_1 q_2$ (Comes out to be negative).
- As repulsion takes place between either +ve, +ve or –ve, -ve so

  $F_c \propto (+q_1)(+q_2) \propto +q_1 q_2$

  $F_c \propto (-q_1)(-q_2) \propto +q_1 q_2$ (Comes out be +ve in these two cases)

13. Answer is "C"

Solution:- $F = \frac{k\, q_1 q_2}{r^2}$

14. Answer is "B"

Solution:- As

$$k = \frac{1}{4\pi\varepsilon_\circ}$$

$$k = \frac{1}{4\times 3.14\times 8.85\times 10^{-12}} C^2 N^{-1} m^{-2}$$

$$k = 9\times 10^9\, Nm^2 C^{-2}$$

15. Answer is "B"

Solution:- If the charge q is divided into equal parts, the product of these parts and electric force between them will be maximum. i.e $\Rightarrow \mathrm{q}_1 = \mathrm{q} - \mathrm{q}_1$

$$\Rightarrow q_1 + q_1 = q$$

$$\Rightarrow \frac{q}{q_1} = 2$$

16. Answer is "C"

Solution:- $F_{vac} = F_{med}$

$$\frac{q_1 q_2}{4\pi\varepsilon_\circ r^2} = \frac{q_1 q_2}{4\pi\varepsilon_\circ k r'^2}$$

17. Answer is "B"

Solution:- $F_a = F_b$, $k\frac{(2q)(q)}{a^2} = k\frac{(3q)(q)}{b^2}$, solve it.

18. Answer is "A"

Solution:- $F_{med} = \frac{F_{vac}}{\varepsilon_r}$

19. Answer is "D"

Solution:- $\vec{E} = \frac{\vec{F}}{q_\circ}$

20. Answer is "A"

Solution:- $E_1 = E_2 \Rightarrow k\frac{q_1}{(3-d)^2} = k\frac{q_2}{d^2}$

21. Answer is "D"

Solution:- In this case zero field location cannot be present between the two charges as $\vec{E}$ starts from +ve and ends up at –ve, it must be on other side of smaller charge.

22. Answer is "B"

Solution:- $\frac{F}{E} = \frac{N}{\frac{N}{C}} = coulomb$

23. Answer is "A"

Solution:- Positive charge is usually sprinkled on drum whereas toner being negative charge gets attracted to it.

24. Answer is "A"

Solution:- $\phi = EA\cos\theta$

Put $\phi = \frac{EA}{2}$ and solve

25. Answer is "C"

Solution:- $\phi = \frac{\sqrt{3}}{2}\phi_{max}$

$$EA\cos\theta = \frac{\sqrt{3}}{2}EA$$

Solve for θ.

To find angle between plane area and electric field use

$\alpha = 90° - \theta$

26. Answer is "D"

Solution:- As in relation of electric flux we have;

$\phi_e = EA\cos\theta$

Which can be written as;

$\phi_e = EA\sin(90° - \theta)$

Which means Acosθ=Asin(90°-θ) so both options are true.

27. Answer is "D"

Solution:-

$$\phi = \frac{Q_{total}}{\varepsilon_\circ} = \frac{1+3+5-5-4}{\varepsilon_\circ} = zero$$

28. Answer is "C"

Solution:- For closed surface we apply Gauss's law; $\phi_e = \frac{q}{\varepsilon_\circ}$, which does not depend upon shape of surface rather depends upon charge and medium.

29. Answer is "B"

Solution:-

$$E_1 = \frac{\sigma}{2\varepsilon_\circ}; E_2 = \frac{\sigma}{\varepsilon_\circ} \Rightarrow \frac{E_1}{E_2} = \frac{\left(\frac{\sigma}{2\varepsilon_\circ}\right)}{\left(\frac{\sigma}{\varepsilon_\circ}\right)}$$

$$\frac{E_1}{E_2} = \frac{1}{2}$$

30. Answer is "D"

Solution:- Electric field will be zero because similar charges cancel their fields

STEP

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