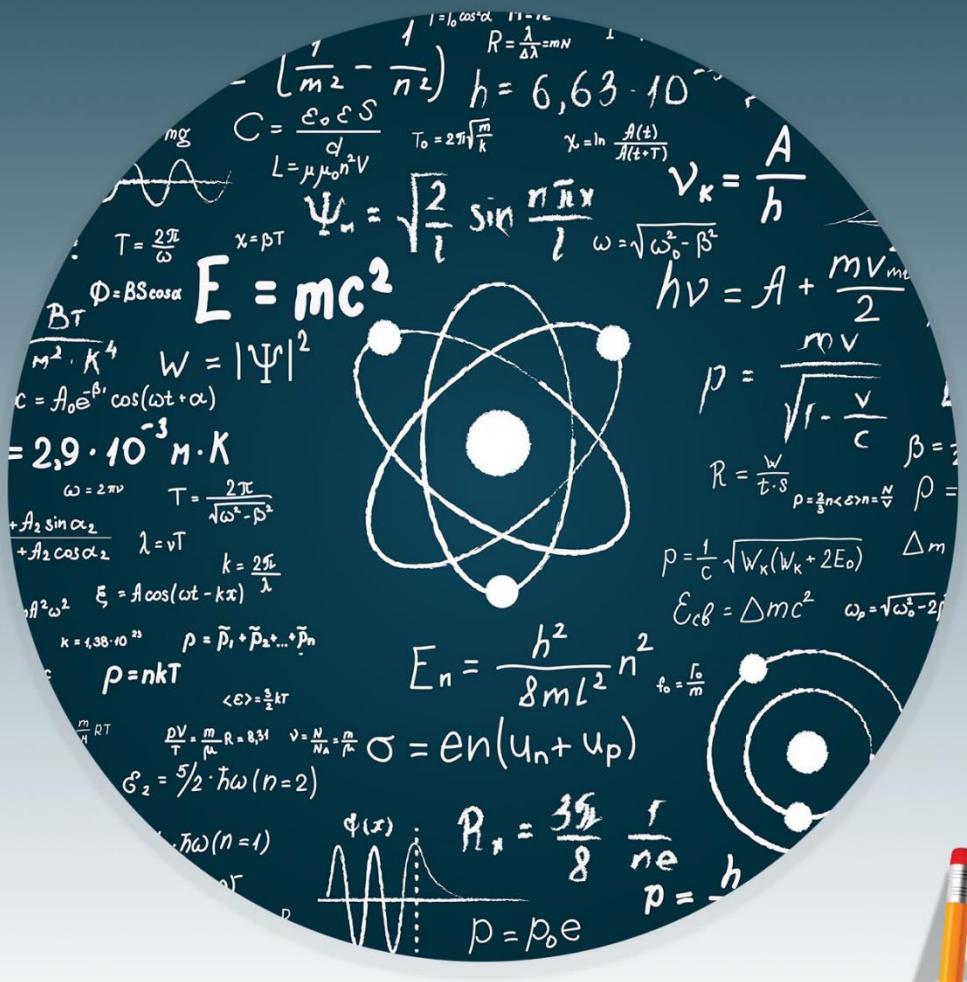
PHYSICS



WORKSHEET-1

STEP

A PROJECT BY PUNJAB GROUP

Worksheet-1

Topics:- Coulomb's Law, Electric Field Strength, Electric Potential & Potential Gradient, Electric and Gravitational Force, Capacitors & Energy Stored in Capacitor

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Q.1 For a capacitor the charge per unit volt is called:

A) Charge density
C) Capacitance
B) Charge per unit volume
D) None of these

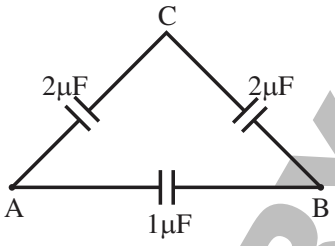
Q.2 Farad is unit of:

A) Charge
C) Current
B) Potential
D) Capacitance

Q.3 A capacitor is a perfect insulator for:

A) A.C
C) Both "A" and "B"
B) Pure D.C
D) Pulsating D.C

Q.4 What is the effective capacitance between A and B?



A) 2 μF
C) 1.0 μF
B) 1.5 μF
D) 0.5 μF

Q.5 The Coulomb's law is:

$$\vec{F} = \frac{1}{4\pi\varepsilon_\circ}\frac{q_1 q_2}{r^2}\hat{r}$$

The units of "$\varepsilon_\circ$" are:

A) $N\ m^{-2}\ C^{-2}$
C) $N^{-1}\ m^{-2}\ C^{2}$
B) $N\ m^{-2}\ C^{2}$
D) None of these

Q.6 A $50\ \mu F$ capacitor has a potential difference of 8 volts across it, The charge on the capacitor will be:

A) $4\times10^{-4}\ C$
C) $4\times10^{4}\ C$
B) $4\times10^{-3}\ C$
D) $4 \times 10^{3}\ C$

Q.7 Three capacitors of capacitance $3\ \mu F$ each are connected in parallel the equivalent capacitance will be:

A) $9\ \mu F$
C) $27\ \mu F$

B) $\frac{1}{3}\ \mu F$ D) $2\ \mu F$

Q.8 If $6\ \mu F$, $4\ \mu F$ and $2\ \mu F$ capacitors are connected is series the equivalent capacitance is given by:

A) $\frac{12}{11}\ \mu F$ C) $\frac{6}{11}\ \mu F$

B) $\frac{11}{12}\ \mu F$ D) $\frac{11}{6}\ \mu F$

Q.9 The study of charges at rest under the action of electric forces is called:

A) Electromagnetics C) Electricity

B) Electrostatics D) None of these

Q.10 The existence of an object is primarily because of:

A) Magnetic force C) Gravitational force

B) Electric force D) Nuclear force

Q.11 Which one is sure test for the presence of charge on a body?

A) Attraction C) Both A and B

B) Repulsion D) None of these

Q.12 Coulomb's force:

A) Obeys inverse square law

B) Depends on magnitudes of charges

C) Depends on medium between charges

D) All of these

Q.13 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 C) 1:2

B) 2:1 D) 1:4

Q.14 The ratio of the force between two charges in vacuum to that the force between two same charges when a medium is placed between them is:

A) ε_r:1 C) $\varepsilon_\circ$:1

B) 1:ε_r D) 1: $\varepsilon_\circ$

Q.15 The ratio of electric force to electric field strength gives the units of:

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A) Current C) Time

B) Charge D) None of these

Q.16 The work done in carrying a unit positive charge from one point to other in electric field keeping the charge in equilibrium is called:

A) Electric potential energy

B) Electric potential difference

C) Electric field strength

D) None of these

Q.17 An ECG records _____ between points on human skin.

A) Current C) Voltage

B) Charge D) Electric field

Q.18 Which statement is true for two oppositely charged metal plates?

A) Electric field is constant between plates

B) Potential difference is constant between plates

C) Electric potential is zero at mid-point of plates

D) All of these

Q.19 If a charge of 5 C is moved against an electric field of 10 N C^{-1} through a distance of 5 m, the P.E gained by charge is:

A) 25 J C) 2 J

B) 200 J D) 250 J

Q.20 Two point charges each of magnitude "q" and opposite sign are separated by distance "2d". Which one of following statement is true?

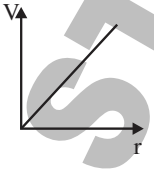
A) Electric Potential at midpoint of charges is zero

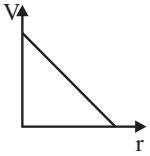
B) Electric field at midpoint of charges is not zero

C) Potential difference (due to electric potentials of both charges) at midpoint is not zero

D) All of these

Q.21 The graph which correctly describes the relation between electric potential "V" at a point due to point charge and distance "r" from point charge is:

A) 

C) 

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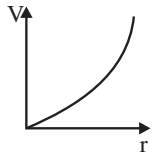
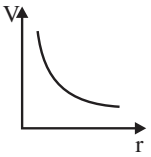
B) 

D) 

Q.22 If the magnitude of a point charge is doubled and distance of a point from point charge is halved, then electric potential and electric field at that point becomes:

A) Two times each

B) Two times & four times

C) Four times & Eight times

D) None of these

Q.23 A particle carrying a charge of 10e falls through a potential difference of 5 V, the energy gained by it is:

A) 50 eV

B) 5 eV

C) 3.2×10^{-18}J

D) Both A and C

Q.24 If a positive charge is brought near the positive plate of a capacitor, its P.E will:

A) Increase

B) Decrease

C) Remain same

D) None of these

Q.25 If a charge of +10 C is stored on either the plate of a parallel plate capacitor of capacitance 5 μF. Then energy stored in the capacitor in mega Joules is:

A) 10

B) 15

C) 20

D) 5

Q.26 The coulomb's force between two charges "q_1=2 μC" and "q_2" is 2 N. The distance between them is 3 m, what is the charge q_2?

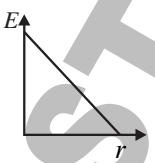
A) 1×10^{0} C

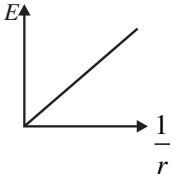
B) 1×10^{-3} C

C) 2×10^{2} C

D) 4×10^{-2} C

Q.27 While moving from positive plate of a charged capacitor towards its negative plate, the electric field "E" varies with distance covered "r" as:

A) 

C) 

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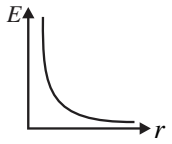
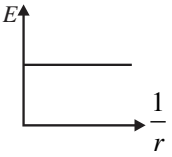
B) 

D) 

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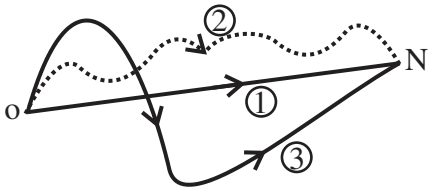
Q.28 In the region of an electric field a charge is moved from "O" to "N" via three different paths W_1, W_2 and W_2 denote the work done along three paths. Then:



A) $W_1<W_2<W_3$ C) $W_1=W_2>W_3$

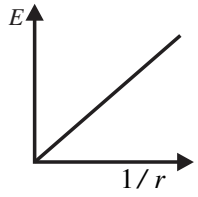
B) $W_1>W_2>W_3$ D) $W_1=W_2=W_3$

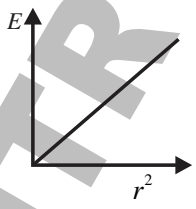
Q.29 The electric field strength between two oppositely charged parallel plates is E. If the distance between the plates is halved and potential difference is doubled, then the electric field strength becomes:

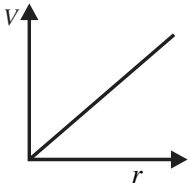
A) E C) 4E

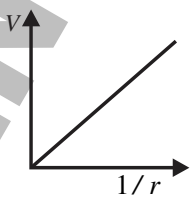
B) 2E D) 8E

Q.30 Which of the following is correct graph for a point charge?

A) 

C) 

B) 

D) 

Q.31 Five identical capacitors connected in series have an equivalent capacitance of 4 µF. If all of them are now connected in parallel across a 400 V source, the total energy stored in them will be:

A) 2 J C) 6 J

B) 4 J D) 8 J

Q.32 How three capacitors of 2 µF each be connected to have an equivalent capacitance of 3 µF?

A) All the capacitors should be connected in series

B) All the capacitors should be connected in parallel

C) Two capacitors in series and one is parallel across their series combination

D) Two capacitors in parallel and one is in series with their parallel combination

Q.33 In the diagram below are shown three capacitors C_1, C_2, C_3 joined to a battery. With symbols having their usual meanings, the correct conditions will be:

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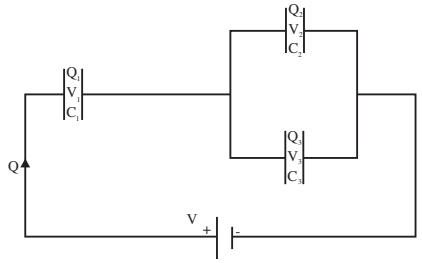


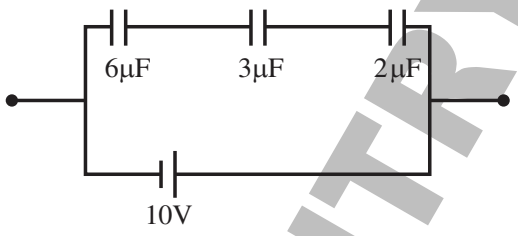
A) $Q_1=Q_2=Q_3$ and $V_1=V_2=V_3=V$

B) $Q_1=Q_2+Q_3$ and $V=V_1+V_2+V_2$

C) $Q_1=Q_2+Q_3$ and $V=V_1+V_2$

D) $Q_2=Q_3$ and $V_2=V_3$

Q.34 In figure below, the charge on 3 μF capacitor is:



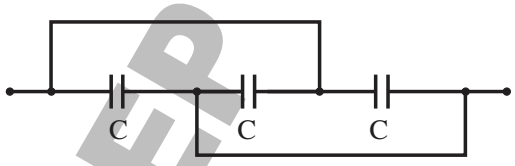
A) 3 μC

B) 5 μC

C) 10 μC

D) Zero

Q.35 What is the equivalent capacitance of the combination shown:



A) 3C

B) C

C) $\frac{C}{2}$

D) $\frac{C}{3}$

Q.36 Which of the following is similarity between electric and

gravitational force?

A) Both are Conservative forces

B) Both are long range forces

C) Both obey inverse square law

D) All of these

ANSWER KEY (Worksheet-1)							
1	C	11	B	21	D	31	D
2	D	12	D	22	C	32	C
3	B	13	B	23	A	33	C
4	A	14	A	24	A	34	C
5	C	15	B	25	A	35	A
6	A	16	B	26	B	36	D
7	A	17	C	27	D		
8	A	18	D	28	D		
9	B	19	D	29	C		
10	B	20	D	30	D		

SOLUTIONS

Unit – 9 (WS-1)

Q.1 Answer is "C"

Solution:- $Q = CV \Rightarrow C = \frac{Q}{V}$

$$1 \text{ farad} = \frac{1 \text{ coulomb}}{1 \text{ volt}}$$

Q.2 Answer is "D"

Solution:- Capacitance of capacitor has the unit "Farad" which is defined as:

$$1 \text{ farad} = \frac{1 \text{ coulomb}}{1 \text{ volt}}$$

Q.3 Answer is "B"

Solution:- Capacitor has infinite reactance for pure D.C. i.e $X_c = \frac{1}{2\pi fC}$

As $f_{D.C} = 0, \text{so} \Rightarrow X_c = \infty$

Q.4 Answer is "A"

Solution:-

The equivalent capacitance between A and B is:

$$C_{AB} = \left(\frac{2\times 2}{2+2}\right) + 1 = 2\ \mu F$$

Q.5 Answer is "C"

Solution:- The units of "$\varepsilon_\circ$" are reciprocal of the units of "k".

Q.6 Answer is "A"

Solution:- $Q = CV$

Q.7 Answer is "A"

Solution:- $C_e = nC$

Q.8 Answer is "A"

Solution:- $\frac{1}{C_e} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$

Q.9 Answer is "B"

Solution:- "The study of charges at rest under the action of the electric force is named as electrostatics".

Q.10 Answer is "B"

Solution:- Matter is composed of atoms and existence of atom is primarily due to electric forces present in it.

Q.11 Answer is "B"

Solution:- If a test charge is brought near an object (about which we are going to find whether it is charged or not) and test charge is attracted towards it, this leads to two possibilities:

i. That object is oppositely charged

ii. That object is neutral but because of Electrostatic Induction it shows attraction for test charge.

Hence, attraction is not a sure test to find whether an object is charged or not.

Q.12 Answer is "D"

Solution:- Coulomb's law is given as

$$F = \frac{1}{4\pi\varepsilon_\circ\varepsilon_r}\frac{q_1 q_2}{r_2}$$

$$F \propto q_1 q_2 \ , \ F \propto \frac{1}{r^2} \ , \ F \propto \frac{1}{\varepsilon_r}$$

Q.13 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 $\Rightarrow q_1 = q - q_1$

Q.14 Answer is "A"

Solution:- The Coulomb's force in case of vacuum and medium is given as:

$$F_{vac} = \frac{1}{4\pi\varepsilon_\circ}\frac{q_1 q_2}{r^2}; F_{med} = \frac{1}{4\pi\varepsilon_\circ\varepsilon_r}\frac{q_1 q_2}{r^2}$$

Taking ratio

$$\frac{F_{vac}}{F_{med}} = \varepsilon_r$$

Q.15 Answer is "B"

Solution:- Electric field strength is defined as:

$$E = \frac{F}{q} \Rightarrow \frac{F}{E} = q = \text{coulomb}$$

Q.16 Answer is "B"

Solution:- Electric potential difference is defined as:

$$\Delta V = \frac{W_{AB}}{q_\circ}$$

Q.17 Answer is "C"

Solution:- ECG records electric voltage and display it on graph.

Q.18 Answer is "D"

Solution:- Between two oppositely charged metal plates:

i. $E = -\frac{\Delta V}{\Delta r} = \text{constant}$

ii. $\Delta V = -E\Delta r = \text{constant}$

iii. $V_{mid} = V_+ + V_- = \frac{kq}{r} - \frac{kq}{r} = 0$

Q.19 Answer is "D"

Solution:- $\Delta V = \frac{\Delta U}{q}$ …… (i)

Also $\Delta V = E\Delta r$ …… (ii)

Compare (i) and (ii) and solve for P.E.

Q.20 Answer is "D"

Solution:-

i. $V_{mid} = V_+ + V_- = \left(\frac{kq}{d}\right) + \left(\frac{k(-q)}{d}\right) = 0$

ii. $\vec{E}_{mid} = \vec{E}_+ + \vec{E}_- \neq 0$

iii. $\Delta V = V_+ - V_- = \left(\frac{kq}{d}\right) - \left(\frac{k(-q)}{d}\right) \neq 0$

Q.21 Answer is "D"

Solution:- $V \propto \frac{1}{r}$

Q.22 Answer is "C"

Solution:- $E = \frac{kq}{r^2}, V = \frac{kq}{r}$

Q.23 Answer is "A"

Solution:- K.E = QΔV

Q.24 Answer is "A"

Solution:- If a charge is moved against the coulomb force, then P.E increases and vice versa.

Q.25 Answer is "A"

Solution:- Energy stored is given as:

$$E = \frac{1}{2}\frac{Q^2}{C}$$

Q.26 Answer is "B"

Solution:- Use Coulomb's law;

$$F = k\frac{q_1 q_2}{r_2} \Rightarrow q_2 = \frac{Fr^2}{kq_1}$$

Put the values and solve for q_2.

Q.27 Answer is "D"

Solution:- Electric field between capacitor plates is constant at every point. So, graph of electric field strength will be a horizontal straight line whether it is plotted against "r" or "1/r".

Q.28 Answer is "D"

Solution:- Electric field just like gravitational field is conservative so, work done is independent of path followed.

Q.29 Answer is "C"

Solution:- Electric field strength is given as

$$E = \frac{\Delta V}{\Delta r}$$

If $\Delta V' = 2\Delta V$ and $\Delta r' = \frac{1}{2}\Delta r$ then

$$E' = \frac{2\Delta V}{\frac{1}{2}\Delta r} = 4\frac{\Delta V}{\Delta r}$$

$$E' = 4E$$

Q.30 Answer is "D"

Solution:- $V = \frac{kq}{r} \Rightarrow V \propto \frac{1}{r}$

Q.31 Answer is "D"

Solution:- Series Equivalent

$$C_{s,e} = \frac{C}{n} = \frac{C}{5} = 4\ \mu F$$

$$C = 20\ \mu F$$

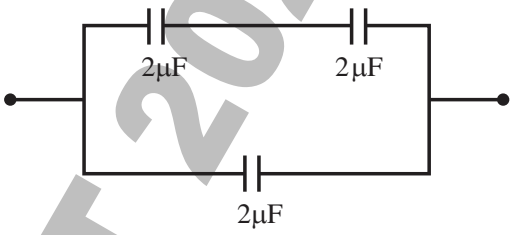
Now if these five capacitors each of capacitance 20 μF are connected in parallel across 400 V source, then

$$C_{p,e} = nC = 5C = 100\ \mu F$$

$$Energy\ stored = \frac{1}{2}C_{p,e}V^2$$

Q.32 Answer is "C"

Solution:-



$$C_e = \left(\frac{2\times 2}{2+2}\right) + 2 = 3\ \mu F$$

Q.33 Answer is "C"

Solution:- In series charge is same and in parallel combination the voltage is same.

Q.34 Answer is "C"

Solution:- In series combination;

i. $Q_{6\mu F} = Q_{3\mu F} = Q_{2\mu F} = C_e V$

ii. $\frac{1}{C_e} = \frac{1}{6} + \frac{1}{3} + \frac{1}{2}$

Find C_e from (ii) and put in (i) to find Q.

Q.35 Answer is "A"

Solution:- All capacitors are in parallel, so their parallel equivalent is given as:

$$C_e = nC = 3C$$

Q.36 Answer is "D"

Solution:- Read properties of electric and gravitational forces.

STEP

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