KENDRIYA VIDYALAYA PACHMARHI
SUMMER VACATION HOME WORK
CLASS 4TH

English

Que.1 Read at least 02 pages daily (for 40 days only) and write down them in good handwriting. Try to read from your English textbook.

Que.2 Write summary of lessons from Unit II to V in your own words**.** Try to write it in one page or 100 words or 10 sentences.

Que.3 Write 05 sentences of your own on each topic given below.

- **a)** Shetty the Magician
- **b)** Nasruddin as an archer.
- **c)** Alice and her journey to the wonderland
- **d)** Hellen Keller the gifted child
- **e)** Miss Anne Sullivan

Que.4 Write and remember at least 05 new/difficult words daily for 30 days only. Try to learn them. Write whether they are - a naming word, a describing word or an action word. Write one sentence of your own using the words. You can repeat words if you did not remember them.

Que.5 Make an assignment on any one of the following :-

- **a)** Different punctuation marks
  EXAMPLE:- Capital letter, comma, full stop, question mark etc.
- **b)** Homophones with example at least 10
  EXAMPLE:- same sound different spelling
- **c)** Contracted and elongated forms
  EXAMPLE:- do not - don't
- **d)** Silent Letters
  EXAMPLE:- Watch 't' is silent

NOTE:-

- All works except assignment work should be done in a **separate notebook with date and day.**
- Assignment work should done in an **A4 size paper or sheet** or what you can arrange.
- Try to make assignment a **colourful one.**

HOLIDAY HOMEWORK CLASS 6 MATHS

Chapter – 1 (Knowing Our Numbers)

S/No	Nomenclature	
1	Comparing Numbers, Shifting Digits	Prepare a chart and write definition of all
2	Ascending/ Descending Orders	
3	Expended Forms, Greatest Digit Numbers, Smallest Digit Numbers	
4	Indian System of numeration, International System of numeration	
5	Complete Chapter 1 with Try these in Holiday homework Copy	

Chapter – 2 (Whole Numbers)

S/No	Nomenclature	
1	Predecessor, Successor	Prepare a chart and write definition of all
2	Whole Number, Natural Number, Rational Number, Integer	
3	The Number Line in addition, substraction, multiplication	
4	Complete Chapter No 2 with Try these in Holiday Homework Copy	

Note : - Write table 2 to 20, 10 times each in Holiday Homework copy and learn it.

HOLIDAY HOMEWORK CLASS 12 MATHS

Chapter – 3 (Matrix)

S/No	Nomenclature	
1	Types of matrix, transpose, symmetric matrix	Prepare a chart and write definition of all
2	Skew symmetric, elementary operation	
3	Representation of matrix as sum of symmetric and skew symmeric	
4	Complete chapter 3 Q/A in holiday homework copy	

Chapter – 4 (Determinant)

S/No	Nomenclature	
1	Determinant ,area using determinant, minor	Prepare a chart and write definition of all
2	Cofactor, inverse	
3	Consistency, inconsistency, find value of variable	
4	Complete chapter – 4 Q/A in holiday home work copy	

Note : - Write 5 activities in your practical book as briefed in class.

KENDRIYA VIDYALAYA PACHMARHI
SUMMER VACATION HOME WORK
CLASS 2nd

Maths-

- Write 1 to 100 counting.
- Write 100 to 1 back counting.
- Write 1 to 100 number name.
- Do 10 -10 questions of addition and subtraction each.
- Make a chart on rolling and sliding objects.
- Make a chart on heavier and lighter objects. (page 20).

EVS-

- Learn and write 10 fruit's name, 10 animal's name, 10 parts of body name, Day's name, Month's name.
- Write about myself
- Write name of your family members and write relationship with them.
- Make a chart on animals.
- Make 3d pictures/model of fruits and animals on chart or colourful A4 sheet using paper.

KENDRIYA VIDYALAYA PACHMARHI
SUMMER VACATION HOME WORK
CLASS 5TH

Hindi

कक्षा – पांचवीं

1. 2 पेज प्रतिदिन सुलेख लिखें।
2. बारहखड़ी को पाँच बार लिखो और पढ़ने का अभ्यास करो।
3. प्रतिदिन 2 पेज का पठन (Reading) करें।
4. वर्षा ऋतु के बारे में 10-15 पंक्तियों में विस्तार से लिखो।
5. "राख की रस्सी" अध्याय लोककथा को बिना देखे लिखने का प्रयास करो।
6. अपनी आँखों देखे किसी क्रिकेट खेल का वर्णन करो।
7. संज्ञा प्रकरण के ऊपर एक चार्ट बनाओ।
8. प्रतिदिन 5 शब्द लिखें और याद करें।
9. विलोम और पर्यायवाची शब्द लिखो और पढ़ो।
10. प्राचार्य महोदय को संबोधित कर अवकाश के लिए आवेदन पत्र लिखो।

Note -: ग्रीष्मकालीन अवकाश गृहकार्य के लिए अलग से एक कॉपी बनाएं और प्रतिदिन कार्य करें(With Date)।

KENDRIYA VIDYALAYA PACHMARHI
SUMMER VACATION HOME WORK
CLASS 8TH

ASSIGNMENT QUESTIONS
CLASS VIII: CHAPTER - 1
RATIONAL NUMBERS

1. Simplify: (i) $\frac{-2}{5}-\left(\frac{-3}{10}\right)-\left(\frac{-4}{15}\right)$ (ii) $\frac{5}{3}-\frac{7}{6}+\left(\frac{-2}{3}\right)$ (iii) $\frac{-3}{2}+\left(\frac{5}{4}-\frac{7}{4}\right)$

2. Verify that $(x\times y)^{-1}=x^{-1}\times y^{-1}$ when $x=\frac{-2}{3}$ and $y=\frac{-3}{5}$

3. If you subtract $\frac{1}{2}$ from a number and multiply the result by $\frac{1}{2}$, you get $\frac{1}{8}$. What is the number?

4. Three consecutive integers are such that when they are taken in increasing order and multiplied by 2, 3, and 4 respectively, they add up to 74. Find these numbers.

5. Represent the following rational numbers on the number line
(a) $-\frac{1}{4}$ (b) $-1\frac{1}{5}$ (c) $-3\frac{8}{5}$

6. Represent the following rational numbers on the number line
(a) $-\frac{7}{10}$ (b) $-5\frac{3}{5}$.

7. Find two rational numbers between (i) –2 and 2. (ii) –1 and 0.

8. Insert six rational numbers between (i) $-\frac{1}{3}$ and $-\frac{2}{3}$ (ii) $\frac{1}{4}$ and $\frac{1}{2}$.

9. Arrange the following numbers in ascending order: $\frac{4}{-9}, \frac{-5}{12}, \frac{7}{-18}, \frac{-2}{3}$

10. Arrange the following numbers in descending order: $-\frac{5}{6}, -\frac{7}{12}, \frac{-13}{28}, \frac{23}{-24}$

PRACTICE QUESTIONS
CLASS VIII: CHAPTER - 1
RATIONAL NUMBERS

1. Find $\frac{3}{7}+\left(\frac{-6}{11}\right)+\left(\frac{-8}{21}\right)+\frac{5}{22}$
2. Find $\frac{-4}{5}\times\frac{3}{7}\times\frac{15}{16}\times\left(\frac{-14}{9}\right)$
3. Find using distributive property: $(i)\left\{\frac{7}{5}\times\left(\frac{-3}{12}\right)\right\}+\left\{\frac{7}{5}\times\frac{5}{12}\right\}$ $(ii)\left\{\frac{9}{16}\times\frac{4}{12}\right\}+\left\{\frac{9}{16}\times\frac{-3}{9}\right\}$
4. Find $\frac{2}{5}\times\frac{-3}{7}-\frac{1}{14}-\frac{3}{7}\times\frac{3}{5}$
5. Simplify: $\frac{-4}{5}\times\frac{3}{7}\times\frac{15}{16}\times\left(\frac{-14}{9}\right)$
6. Multiply $\frac{6}{13}$ by the reciprocal of $\frac{-7}{16}$.
7. What number should be added to $\frac{7}{12}$ to get $\frac{4}{15}$?
8. What number should be subtracted from $-\frac{3}{5}$ to get -2?
9. Is $\frac{8}{9}$ the multiplicative reciprocal of $-1\frac{1}{8}$? Why or why not?
10. Is 0.3 the multiplicative reciprocal of $3\frac{1}{3}$? Why or why not?
11. Write any 3 rational numbers between -2 and 0.
12. Find any ten rational numbers between $\frac{-5}{6}$ *and* $\frac{5}{8}$

KENDRIYA VIDYALAYA PACHMARHI
SUMMER VACATION HOME WORK
CLASS 6TH

SCIENCE

Q 1 Make a chart in food items and their ingredient ?
Q2 Make a chart in table 1 .4 plant parts as food ?
Q3 Past a picture of chart paper- some sources of fats
(a) Plant sources
(b) Animal sources
(c) Sources of some mineral
(d) Some sources of proteins- plant sources, animal sources
Q4 Learn the diseases/ disorder caused by deficiency of vitamin and mineral?
Q5 Learn the chapter 1 and chapter 2

केन्द्रीय विद्यालय पचमढ़ी

ग्रीष्मकालीन अवकाश कार्य

कक्षा-२

विषय-हिन्दी

१. प्रतिदिन एक पेज सुलेख लिखो।(३0 दिनों तक)

२. हिन्दी वर्णमाला लिखो।

३. बारहखड़ी लिखो और याद करो।

४. ऊँट चला तथा म्याऊं म्याऊं कविता को लय के साथ याद करो.

५. ५-५ जंगली एवम पालतू जानवरों के नाम लिखो तथा उनके चित्र बनाओ/चिपकाओ।

६. भालू शेर तथा बिल्ली का मुखौटा(मास्क) बनाओ।

७. हिन्दी पाठ्य पुस्तक में अध्याय १ से ६ तक पढ़ो।

८. आ, इ, ई, उ, ऊ, ए, ऐ , ओ, औ, अं, अ: सभी मात्राओं से १०-१० शब्द लिखो।

नोट- समस्त अवकाश कार्य एक अलग कॉपी में करना है।

SOLVED EXAMPLES

1. A soap bubble is given negative charge. Its radius will

(A) Increase

(B) Decrease

(C) Remain unchanged

(D) Fluctuate

Sol. : (A) Due to repulsive force.

2. Which of the following charge is not possible

(A) $1.6 \times 10^{-18} C$

(B) $1.6 \times 10^{-19} C$

(C) $1.6 \times 10^{-20} C$

(D) None of these

Sol. : (C) $1.6 \times 10^{-20} C$, because this is $\frac{1}{10}$ of electronic charge and hence not an integral multiple.

3. Five balls numbered 1 to 5 balls suspended using separate threads. Pair (1,2), (2,4) and (4,1) show electrostatic attraction, while pair (2,3) and (4,5) show repulsion. Therefore ball 1 must be

(A) Positively charged

(B) Negatively charged

(C) Neutral

(D) Made of metal

Sol. : (C) Since 1 does not enter the list of repulsion, it is just possible that it may not be having any charge. Moreover, since ball no. 1 is being attracted by 2 and 4 both. So 2 and 4 must be similarly charged, but it is also given that 2 and 4 also attract each other. So 2 and 4 are certainly oppositely charged.

Since 1 is attracting 2, either 1 or 2 must be neutral but since 2 is already in the list of balls repelling each other, it necessarily has some charge, similarly 4 must have some charge. It means that though 1 is attracting 2 and 4 it does not have any charge.

4. If the radius of a solid and hollow copper spheres are same which one can hold greater charge

(A) Solid sphere

(B) Hollow sphere

(C) Both will hold equal charge

(D) None of these

Sol. : (C) Charge resides on the surface of conductor, since both the sphere having similar surface area so they will hold equal charge.

5. Number of electrons in one coulomb of charge will be

(A) 5.46×10^{29} (B) 6.25×10^{18}

(C) 1.6×10^{19} (D) 9×10^{11}

Sol. : (B) By using $Q = ne \Rightarrow n = \frac{Q}{e}$

$$\Rightarrow n = \frac{1}{1.6 \times 10^{-19}} = 6.25 \times 10^{18}$$

6. The current produced in wire when 10^7 electron/sec are flowing in it

(A) 1.6×10^{-26} amp

(B) 1.6×10^{12} amp

(C) 1.6×10^{26} amp

(D) 1.6×10^{-12} amp

Sol. : (D) $\mathrm{i} = \frac{\mathrm{Q}}{\mathrm{t}} = \frac{\mathrm{ne}}{\mathrm{t}} = 10^7 \times 1.6 \times 10^{-19}$

$= 1.6 \times 10^{-12}$ amp

7. Two point charges $+3\mu C$ and $+8\mu C$ repel each other with a force of 40 N.

If a charge of $-5\mu C$ is added to each of them, then the force between them will become

(A) $-10\,N$ (B) $+10\,N$

(C) $+20\,N$ (D) $-20\,N$

Sol. : (A) Initially $F = k \times \frac{3 \times 8 \times 10^{-12}}{r^2}$ and

Finally $F' = -k\,\frac{2 \times 3 \times 10^{-12}}{r^2}$

so $\frac{F'}{F} = -\frac{1}{4} \Rightarrow F' = -10\,N$

8. Two point charges $1\,\mu C$ & $5\,\mu C$ are separated by a certain distance. What will be ratio of forces acting on these two

(A) $1:5$ (B) $5:1$

(C) $1:1$ (D) 0

Sol. : (C) Both the charges will experience same force so ratio is 1:1

9. Two charges of $40\,\mu C$ and $-20\,\mu C$ are placed at a certain distance apart. They are touched and kept at the same distance. The ratio of the initial to the final force between them is

(A) $8:1$ (B) $4:1$

(C) 1 : 8 (D) 1 : 1

Sol. : (A) Since only magnitude of charges are changes that's why

$$F \propto q_1 q_2 \quad \Rightarrow \frac{F_1}{F_2} = \frac{q_1 q_2}{q'_1\,q'_2} = \frac{40 \times 20}{10 \times 10} = \frac{8}{1}$$

10. A total charge Q is broken in two parts Q_1 and Q_2 and they are placed at a distance R from each other. The maximum force of repulsion between them will occur, when

(A) $Q_2 = \frac{Q}{R}, Q_1 = Q - \frac{Q}{R}$

(B) $Q_2 = \frac{Q}{4}, Q_1 = Q - \frac{2Q}{3}$

(C) $Q_2 = \frac{Q}{4}, Q_1 = \frac{3Q}{4}$

(D) $Q_1 = \frac{Q}{2}, Q_2 = \frac{Q}{2}$

Sol. : (D) Force between charges Q_1 and Q_2

$$F = k\,\frac{Q_1 Q_2}{R^2} = k\,\frac{Q_1(Q - Q_1)}{R^2}$$

For F to be maximum, $\frac{dF}{dQ_1} = 0$

i.e., $\frac{d}{dQ_1}\left\{k\,\frac{\left(Q_1 Q - Q_1^2\right)}{R^2}\right\} = 0$

or $Q - 2Q_1 = 0, Q_1 = \frac{Q}{2}$

Hence $Q_1 = Q_2 = \frac{Q}{2}$

11. The force between two charges 0.06m apart is 5 N. If each charge is moved towards the other by 0.01m, then the force between them will become

(A) 7.20 N (B) 11.25 N

(C) 22.50 N (D) 45.00 N

Sol. : (B) Initial separation between the charges = 0.06m

Final separation between the charges = 0.04m

Since $F \propto \frac{1}{r^2} \Rightarrow \frac{F_1}{F_2} = \left(\frac{r_2}{r_1}\right)^2$

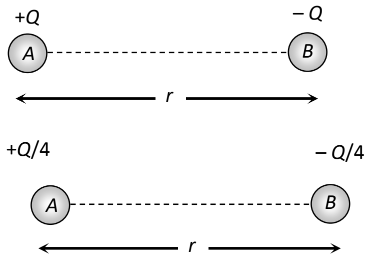
$$\Rightarrow \frac{5}{F_2} = \left(\frac{0.04}{0.06}\right)^2 = \frac{4}{9} \Rightarrow F_2 = 11.25\,N$$

12. Two charges equal in magnitude and opposite in polarity are placed at a certain distance apart and force acting between them is F. If 75% charge of one is transferred to another, then the force between the charges becomes

(A) $\frac{F}{16}$ (B) $\frac{9F}{16}$

(C) F (D) $\frac{15}{16}F$

Sol. : (A)



Initially $F = k\frac{Q^2}{r^2}$

Finally $F' = \frac{k.\left(\frac{Q}{4}\right)^2}{r^2} = \frac{F}{16}$

13. Three equal charges each +Q, placed at the corners of on equilateral triangle of side a what will be the force on any charge $\left(k = \frac{1}{4\pi\varepsilon_0}\right)$

(A) $\frac{kQ^2}{a^2}$ (B) $\frac{2kQ^2}{a^2}$

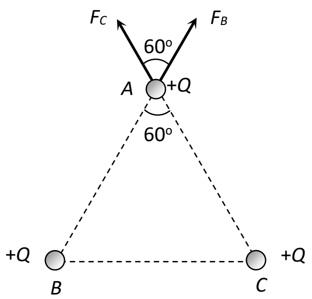
(C) $\frac{\sqrt{2}kQ^2}{a^2}$ (D) $\frac{\sqrt{3}kQ^2}{a^2}$

Sol. : (D) Suppose net force is to be calculated on the charge which is kept at A. Two charges kept at B and C are applying force on that particular charge, with direction as shown in the figure.

Since $F_b = F_c = F = k\frac{Q^2}{a^2}$

So, $F_{net} = \sqrt{F_B^2 + F_C^2 + 2F_BF_C\cos 60}$

$F_{net} = \sqrt{3}F = \frac{\sqrt{3}kQ^2}{a^2}$



14. Equal charges Q are placed at the four corners A, B, C, D of a square of length a. The magnitude of the force on the charge at B will be

(A) $\frac{3Q^2}{4\pi\varepsilon_0 a^2}$

(B) $\frac{4Q^2}{4\pi\varepsilon_0 a^2}$

(C) $\left(\frac{1+1\sqrt{2}}{2}\right)\frac{Q^2}{4\pi\varepsilon_0 a^2}$

(D) $\left(2+\frac{1}{\sqrt{2}}\right)\frac{Q^2}{4\pi\varepsilon_0 a^2}$

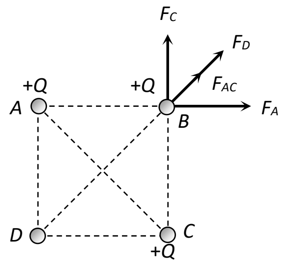
Sol. : (C) After following the guidelines mentioned above

$F_{net} = F_{AC} + F_D = \sqrt{F_A^2 + F_C^2} + F_D$

Since $F_A = F_C = \frac{kQ^2}{a^2}$ and $F_D = \frac{kQ^2}{(a\sqrt{2})^2}$

$F_{net} = \frac{\sqrt{2}kQ^2}{a^2} + \frac{kQ^2}{2a^2} = \frac{kQ^2}{a^2}\left(\sqrt{2} + \frac{1}{2}\right)$

$= \frac{Q^2}{4\pi\varepsilon_0 a^2}\left(\frac{1+2\sqrt{2}}{2}\right)$



15. Two equal charges are separated by a distance d. A third charge placed on a perpendicular bisector at x distance, will experience maximum coulomb force when

(A) $x = \frac{d}{\sqrt{2}}$ (B) $x = \frac{d}{2}$

(C) $x = \frac{d}{2\sqrt{2}}$ (D) $x = \frac{d}{2\sqrt{3}}$

Sol. : (C) Suppose third charge is similar to Q and it is q

So net force on it $F_{net} = 2F\cos\theta$

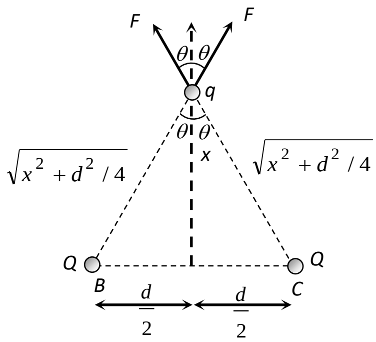
Where $F = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Qq}{\left(x^2 + \frac{d^2}{4}\right)}$

and $\cos\theta = \frac{x}{\sqrt{x^2 + \frac{d^2}{4}}}$

$\therefore$

$$F_{net} = 2 \times \frac{1}{4\pi\varepsilon_0} \cdot \frac{Qq}{\left(x^2 + \frac{d^2}{4}\right)} \times \frac{x}{\left(x^2 + \frac{d^2}{4}\right)^{1/2}}$$

$$= \frac{2Qqx}{4\pi\varepsilon_0 \left(x^2 + \frac{d^2}{4}\right)^{3/2}}$$



for F_{net} to be maximum

$\frac{dF_{net}}{dx} = 0$ i.e.

$$\frac{d}{dx}\left[\frac{2Qqx}{4\pi\varepsilon_0 \left(x^2 + \frac{d^2}{4}\right)^{3/2}}\right] = 0$$

or

$$\left[\left(x^2 + \frac{d^2}{4}\right)^{-3/2} - 3x^2\left(x^2 + \frac{d^2}{4}\right)^{-5/2}\right] = 0$$

i.e. $x = \pm \frac{d}{2\sqrt{2}}$

16. ABC is a right angle triangle in which AB = 3 cm, BC = 4 cm and $\angle ABC = \frac{\pi}{2}$. The three charges +15, +12 and – 20 e.s.u. are placed respectively on A, B and C. The force acting on B is

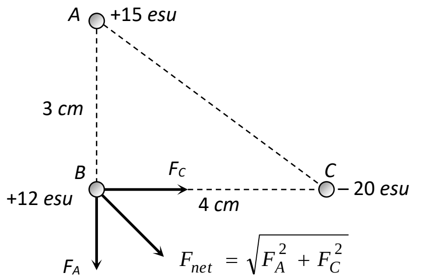
(A) 125 dynes (B) 35 dynes

(C) 25 dynes (D) Zero

Sol. : (C) Net force on B $F_{net} = \sqrt{F_A^2 + F_C^2}$

$F_A = \frac{15 \times 12}{(3)^2} = 20\ dyne$

$F_C = \frac{12 \times 20}{(4)^2} = 15\ dyne$ $F_{net} = 25\ dyne$



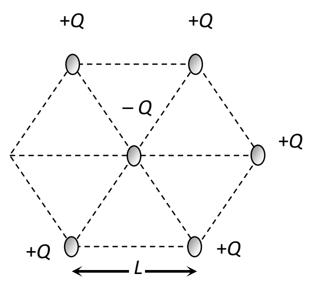
17. Five point charges each of value +Q are placed on five vertices of a regular hexagon of side L. What is the magnitude of the force on a point charge of value – q placed at the centre of the hexagon

(A) $k\frac{Q^2}{L^2}$ (B) $k\frac{Q^2}{4L^2}$

(C) Zero (D) Information is insufficient

Sol. : (A) Four charges cancels the effect of each other, so the net force on the charge placed at centre due to remaining fifth charge is

$F = k\frac{Q^2}{L^2}$



18. Two small, identical spheres having +Q and – Q charge are kept at a certain distance. F force acts between the two. If in the middle of two spheres, another similar sphere having +Q charge is kept, then it experience a force in magnitude and direction as

(A) Zero having no direction

(B) 8F towards +Q charge

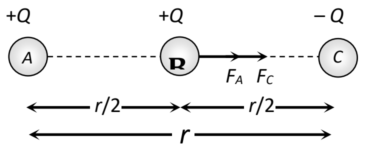
(C) 8F towards – Q charge

(D) 4F towards +Q charge

Sol. : (C) Initially, force between A and C

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

When a similar sphere B having charge +Q is kept at the mid point of line joining A and C, then Net force on B is



$F_{net} = F_A + F_C$

$= k\frac{Q^2}{(r/2)^2} + \frac{kQ^2}{(r/2)^2} = 8\frac{kQ^2}{r^2} = 8F.$

(Direction is shown in figure)

19. What is the magnitude of a point charge due to which the electric field 30 cm away has the magnitude 2 newton/coulomb

$[1/4\pi\varepsilon_0 = 9 \times 10^9\ Nm^2]$

(A) $2 \times 10^{-11} coulomb$

(B) $3 \times 10^{-11} coulomb$

(C) $5 \times 10^{-11} coulomb$

(D) $9 \times 10^{-11} coulomb$

Sol. : (A) By using $E = \frac{1}{4\pi\varepsilon_0}.\frac{Q}{r^2}$;

$2 = 9 \times 10^9 \times \frac{Q}{(30 \times 10^{-2})^2} \Rightarrow$

$Q = 2 \times 10^{-11} C$

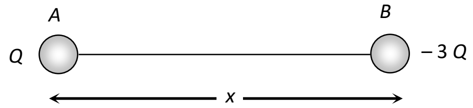
20. Two point charges Q and – 3Q are placed at some distance apart. If the electric field at the location of Q is E, then at the locality of – 3Q, it is

(A) $-E$ (B) E/3

(C) $-3E$ (D) – E/3

Sol. : (B) Let the charge Q and – 3Q be placed respectively at A and B at a distance x

Now we will determine the magnitude and direction to the field produced by charge – 3Q at A, this is E as mentioned in the Example.



$\therefore\ E = \frac{3Q}{x^2}$ (along AB directed towards negative charge)

Now field at location of – 3Q i.e.

field at B due to charge Q will be

$E' = \frac{Q}{x^2} = \frac{E}{3}$ (along AB directed away from positive charge)

21. Two charged spheres of radius R_1 and R_2 respectively are charged and joined by a wire. The ratio of electric field of the spheres is

(A) $\frac{R_1}{R_2}$ (B) $\frac{R_2}{R_1}$

(C) $\frac{R_1^2}{R_2^2}$ (D) $\frac{R_2^2}{R_1^2}$

Sol. : (B) After connection their potential becomes equal i.e.,

$k.\frac{Q_1}{R_1} = \frac{k.Q_2}{R_2}$; $\Rightarrow$ $\frac{Q_1}{Q_2} = \frac{R_1}{R_2}$

Ratio of electric field

$\frac{E_1}{E_2} = \frac{Q_1}{Q_2} \times \left(\frac{R_2}{R_1}\right)^2 = \frac{R_2}{R_1}.$

22. The number of electrons to be put on a spherical conductor of radius 0.1m to produce an electric field of 0.036 N/C just above its surface is

(A) 2.7×10^5 (B) 2.6×10^5

(C) 2.5×10^5 (D) 2.4×10^5

Sol. : (C) By using $E = k\frac{Q}{R^2}$, where R = radius of sphere

so 0.036 = $9\times10^9\times\frac{ne}{(0.1)^2}$

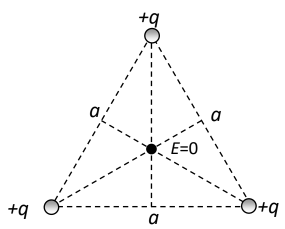
$\Rightarrow n = 2.5\times10^5$

23. Eight equal charges each +Q are kept at the corners of a cube. Net electric field at the centre will be $\left(k = \frac{1}{4\pi\varepsilon_0}\right)$

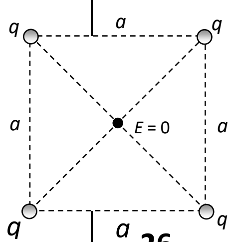
(A) $\frac{kQ}{r^2}$ (B) $\frac{8kQ}{r^2}$

(C) $\frac{2kQ}{r^2}$ (D) Zero

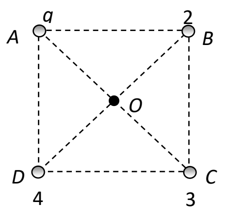
Sol. : (D) Due to the symmetry of charge. Net Electric field at centre is zero.



Equilateral triangle



Square



24. q, 2q, 3q and 4q charges are placed at the four corners A, B, C and D of a square. The field at the centre O of the square has the direction along.

(A) AB (B) CB

(C) AC (D) BD

Sol. : (B) By making the direction of electric field due to all charges at centre. Net electric field has the direction along CB

25. Equal charges Q are placed at the vertices A and B of an equilateral triangle ABC of side a. The magnitude of electric field at the point A is

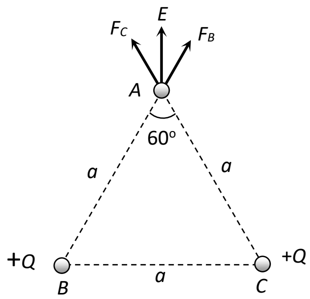
(A) $\frac{Q}{4\pi\varepsilon_0 a^2}$ (B) $\frac{\sqrt{2}Q}{4\pi\varepsilon_0 a^2}$

(C) $\frac{\sqrt{3}Q}{4\pi\varepsilon_0 a^2}$ (D) $\frac{Q}{2\pi\varepsilon_0 a^2}$

Sol. : (C) As shown in figure Net electric field at A

$$E = \sqrt{E_B^2 + E_C^2 + 2E_BE_C\cos 60}$$

$$E_B = E_C = \frac{1}{4\pi\varepsilon_0}\cdot\frac{Q}{a^2}$$



So, $E = \frac{\sqrt{3}Q}{4\pi\varepsilon_0 a^2}$

26. Potential at a point x-distance from the centre inside the conducting sphere of radius R and charged with charge Q is

(A) $\frac{Q}{R}$ (B) $\frac{Q}{x}$

(C) $\frac{Q}{x^2}$ (D) xQ

Sol. : (A) Potential inside the conductor is constant.

27. The electric potential at the surface of an atomic nucleus (Z = 50) of radius $9\times10^5\,V$ is

(A) 80 V (B) $8\times10^6\,V$

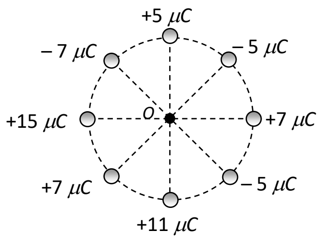
(C) 9 V (D) $9\times10^5\,V$

Sol. : (B)

$$V = 9\times10^9\times\frac{ne}{r} = 9\times10^9\times\frac{50\times1.6\times10^{-19}}{9\times10^{-15}}$$

$$= 8\times10^6\,V$$

28. Eight charges having the valves as shown are arranged symmetrically on a circle of radius 0.4m in air. Potential at centre O will be



(A) 63×10^4 *volt*

(B) 63×10^{10} *volt*

(C) 63×10^6 *volt*

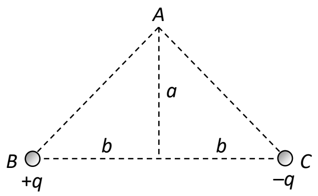
(D) Zero

Sol. : (A) Due to the principle of superposition potential at O

$$V = \frac{1}{4\pi\varepsilon_0} \times \frac{28\times10^{-6}}{0.4}$$

$$= 9\times10^9 \times \frac{28\times10^{-6}}{0.4} = 63\times10^4 \text{ volt}$$

29. As shown in the figure, charges +q and –q are placed at the vertices B and C of an isosceles triangle. The potential at the vertex A is



(A) $\frac{1}{4\pi\varepsilon_0} \cdot \frac{2q}{\sqrt{a^2+b^2}}$

(B) $\frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{\sqrt{a^2+b^2}}$

(C) $\frac{1}{4\pi\varepsilon_0} \cdot \frac{(-q)}{\sqrt{a^2+b^2}}$

(D) Zero

Sol. : (D) Potential at A = Potential due to (+q) charge + Potential due to (– q) charge

$$= \frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{\sqrt{a^2+b^2}} + \frac{1}{4\pi\varepsilon_0} \frac{(-q)}{\sqrt{a^2+b^2}} = 0$$

30. A conducting sphere of radius R is given a charge Q. consider three points B at the surface, A at centre and C at a distance R/2 from the centre. The electric potential at these points are such that

(A) $V_A = V_B = V_C$

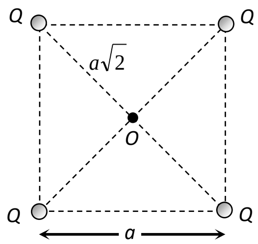
(B) $V_A = V_B \neq V_C$

(C) $V_A \neq V_B \neq V_C$

(D) $V_A \neq V_B = V_C$

Sol. : (A) Potential inside a conductor is always constant and equal to the potential at the surface.

31. Equal charges of $\frac{10}{3} \times 10^{-9}$ coulomb are lying on the corners of a square of side 8 cm. The electric potential at the point of intersection of the diagonals will be



(A) 900 V (B) $900\sqrt{2}\,V$

(C) $150\sqrt{2}\,V$ (D) $1500\sqrt{2}\,V$

Sol. : (D) Potential at the centre O

$V = 4 \times \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{a/\sqrt{2}}$ given

$Q = \frac{10}{3} \times 10^{-9} C$

$\Rightarrow a = 8\,cm = 8 \times 10^{-2} m$

$$V = 5 \times 9 \times 10^9 \times \frac{\frac{10}{3} \times 10^{-9}}{\frac{8 \times 10^{-2}}{\sqrt{2}}}$$

$= 1500\sqrt{2}\,volt$

32. A hollow metal sphere of radius 5 cm is charged such that the potential on its surface is 10 volts. The potential at the centre of the sphere is

(A) Zero

(B) 10 V

(C) Same as at a point 5 cm away from the surface

(D) Same as at a point 25 cm away from the surface

Sol. : (B) Inside the conductors potential remains same and it is equal to the potential of surface, so here potential at the centre of sphere will be 10 V

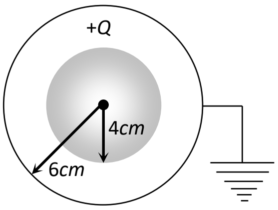
33. A sphere of 4 cm radius is suspended within a hollow sphere of 6 cm radius. The inner sphere is charged to a potential 3 e.s.u. When the outer sphere is earthed. The charge on the inner sphere is

(A) 54 e.s.u. (B) $\frac{1}{4}$ e.s.u.

(C) 30 e.s.u. (D) 36 e.s.u.

Sol. : (D) Let charge on inner sphere be +Q. charge induced on the inner surface of outer sphere will be –Q.

So potential at the surface of inner sphere (in CGS)



$3 = \frac{Q}{4} - \frac{Q}{6}$

$\Rightarrow$ $Q = 36$ e.s.u.

34. A charge Q is distributed over two concentric hollow spheres of radii r and $(R > r)$ such that the surface densities are equal. The potential at the common centre is

(A) $\frac{Q(R^2+r^2)}{4\pi\varepsilon_0(R+r)}$

(B) $\frac{Q}{R+r}$

(C) Zero

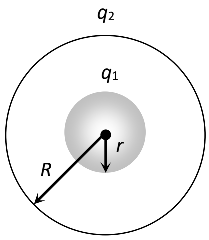
(D) $\frac{Q(R+r)}{4\pi\varepsilon_0(R^2+r^2)}$

Sol. : (D) If q_1 and q_2 are the charges on spheres of radius r and R respectively, in accordance with conservation of charge

$Q = q_1 + q_2$ ....(i)

and according to the given problem $\sigma_1 = \sigma_2$

i.e., $\frac{q_1}{4\pi r^2} = \frac{q_2}{4\pi R^2} \Rightarrow \frac{q_1}{q_2} = \frac{r^2}{R^2}$ .... (ii)



So equation (i) and (ii) gives $q_1 = \frac{Qr^2}{(R^2+r^2)}$ and $q_2 = \frac{QR^2}{(R^2+r^2)}$

Potential at common centre

$$V = \frac{1}{4\pi\varepsilon_0}\left[\frac{q_1}{r} + \frac{q_2}{R}\right]$$

$$= \frac{1}{4\pi\varepsilon_0}\left[\frac{Qr}{(R^2+r^2)} + \frac{QR}{(R^2+r^2)}\right]$$

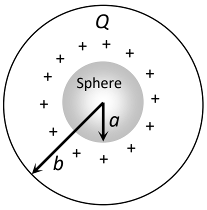
$$= \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q(R+r)}{(R^2+r^2)}$$

35. A solid conducting sphere having a charge Q is surrounded by an uncharged concentric conducting hollow spherical shell. Let the potential difference between the surface of the solid sphere and that of the outer surface of the hollow shell be V. If the shell is now given a charge of – 3Q, the new potential difference between the two surfaces is

(A) V (B) 2V

(C) 4V (D) –2V

Sol. : (A) If a and b are radii of spheres and spherical shell respectively, potential at their surfaces will be



$V_{\text{sphere}} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{a}$ and $V_{\text{shell}} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{b}$

and so according to the given problem.

$V = V_{\text{sphere}} - V_{\text{shell}} \quad = \frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{a} - \frac{1}{b}\right]$

.... (i)

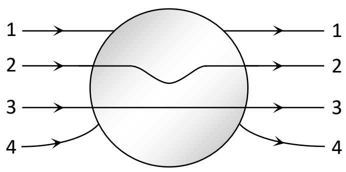
Now when the shell is given a charge –3Q the potential at its surface and also inside will change by $V_0 = \frac{1}{4\pi\varepsilon_0}\left[-\frac{3Q}{b}\right]$

So that now $V_{\text{sphere}} = \frac{1}{4\pi\varepsilon_0}\left[\frac{Q}{a} - \frac{3Q}{b}\right]$

and $V_{\text{shell}} = \frac{1}{4\pi\varepsilon_0}\left[\frac{Q}{b} - \frac{3Q}{b}\right]$ hence

$V_{\text{sphere}} - V_{\text{shell}} = \frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{a} - \frac{1}{b}\right] = V$

36. A metallic sphere is placed in a uniform electric field. The lines of force follow the path (s) shown in the figure as

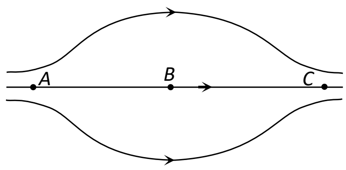


(A) 1 (B) 2

(C) 3 (D) 4

Sol. : (D) The field is zero inside a conductor and hence lines of force cannot exist inside it. Also, due to induced charges on its surface the field is distorted close to its surface and a line of force must deviate near the surface outside the sphere.

37. The figure shows some of the electric field lines corresponding to an electric field. The figure suggests



(A) $E_A > E_B > E_C$

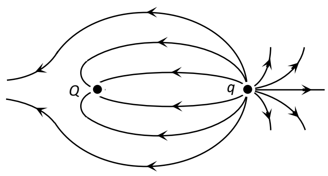
(B) $E_A = E_B = E_C$

(C) $E_A = E_C > E_B$

(D) $E_A = E_C < E_B$

Sol. : (C)

38. The lines of force of the electric field due to two charges q and Q are sketched in the figure. State if



(A) Q is positive and $|Q| > |q|$

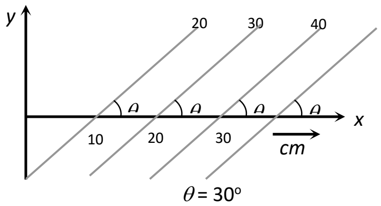
(B) Q is negative and $|Q| > |q|$

(C) q is positive and $|Q| < |q|$

(D) q is negative and $|Q| < |q|$

Sol. : (C) q is +ve because lines of force emerge from it and $|Q| < |q|$ because more lines emerge from q and less lines terminate at Q.

39. Some equipotential surface are shown in the figure. The magnitude and direction of the electric field is



(A) 100 V/m making angle 120° with the x-axis

(B) 100 V/m making angle 60° with the x-axis

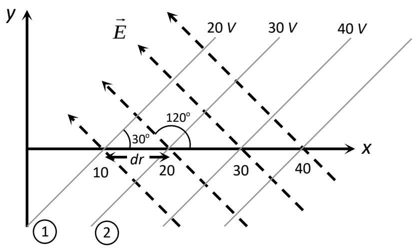
(C) 200 V/m making angle 120° with the x-axis

(D) None of the above

Sol. : (C) By using $dV = E\,dr\cos\theta$ suppose we consider line 1 and line 2 then

(30 – 20) = E cos 60° (20 – 10) × 10^{-2}

So $E = 200\ volt/m$ making in angle 120° with x-axis



40. The electric field, at a distance of 20 cm from the centre of a dielectric sphere of radius 10 cm is 100 V/m. The 'E' at 3 cm distance from the centre of sphere is

(A) 100 V/m (B) 125 V/m

(C) 120 V/m (D) Zero

Sol. : (C) For dielectric sphere i.e. for non-conducting sphere

$E_{out} = \frac{k.q}{r^2}$ and $E_{in} = \frac{kqr}{R^3}$

$E_{out} = 100\ \frac{KQ}{(20\times10^{-2})^2}$ ⇒ KQ = 100 × $(0.2)^2$

so $E_{in} = \frac{100\times(0.2)^2\times(3\times10^{-2})^2}{(10\times10^{-2})^3}$ = 120 V/m

41. In x-y co-ordinate system if potential at a point P(x, y) is given by $V = axy$; where a is a constant, if r is the distance of point P from origin then electric field at P is proportional to

(A) r (B) r^{-1}

(C) r^{-2} (D) r^2

Sol. : (A) By using $E = -\frac{dV}{dr}$

$E_x = -\frac{dV}{dx} = -ay$,

$E_y = -\frac{dV}{dy} = -ax$

Electric field at point P

$E = \sqrt{E_x^2 + E_y^2} = a\sqrt{x^2+y^2} = ar$

i.e., $E \propto r$

42. The electric potential V is given as a function of distance x (metre) by V = $(5x^2 + 10x - 9)$ volt. Value of electric field at x = 1m is

(A) – 20 V/m (B) 6 V/m

(C) 11 V/m (D) – 23 V/m

Sol. : (A) By using $E = -\frac{dV}{dx}$;

$E = -\frac{d}{dx}(5x^2 + 10x - 9) = (10x + 10)$,

at x = 1m $E = -20\ V/m$

43. A uniform electric field having a magnitude E_0 and direction along the positive X-axis exists. If the electric potential V, is zero at X = 0, then, its value at X = +x will be

(A) V(x)= $+xE_0$ (B) V(x)= $-xE_0$

(C) V(x)= x^2E_0 (D) V(x)= $-x^2E_0$

Sol. : (B) By using $E = -\frac{\Delta V}{\Delta r} = -\frac{(V_2 - V_1)}{(r_2 - r_1)}$;

$E_0 = -\frac{\{V(x) - 0\}}{x - 0}$ ⇒ V(x) = $-xE_0$

44. If the potential function is given by V = 4x + 3y, then the magnitude of electric field intensity at the point (2, 1) will be

(A) 11 (B) 5

(C) 7 (D) 1

Sol. : (B) By using i.e., $E = \sqrt{E_x^2 + E_y^2}$;

$$E_x = -\frac{dV}{dx} = -\frac{d}{dx}(4x+3y) = -4$$

and $E_y = -\frac{dV}{dy} = -\frac{d}{dy}(4x+3y) = -3$

$\therefore$ $E = \sqrt{(-4)^2 + (-3)^2} = 5\ N/C$

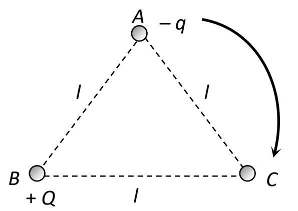
45. A charge (– q) and another charge (+Q) are kept at two points A and B respectively. Keeping the charge (+Q) fixed at B, the charge (– q) at A is moved to another point C such that ABC forms an equilateral triangle of side l. The network done in moving the charge (– q) is

(A) $\frac{1}{4\pi\varepsilon_0}\frac{Qq}{l}$ (B) $\frac{1}{4\pi\varepsilon_0}\frac{Qq}{l^2}$

(C) $\frac{1}{4\pi\varepsilon_0}Qql$ (D) Zero

Sol. : (D) Since $V_A = V_C = \frac{kQ}{l}$

so $W = q(V_C - V_A) = 0$



46. The work done in bringing a 20 coulomb charge from point A to point B for distance 0.2 m is 2 Joule. The potential difference between the two points will be (in volt)

(A) 0.2 (B) 8

(C) 0.1 (D) 0.4

Sol. : (C) $W = Q.\Delta V \Rightarrow 2 = 20 \times \Delta V$

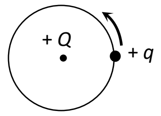
$\Rightarrow \Delta V = 0.1$ volt

47. A charge +q is revolving around a stationary +Q in a circle of radius r. If the force between charges is F then the work done of this motion will be

(A) F × r (B) $F \times 2\pi r$

(C) $\frac{F}{2\pi r}$ (D) 0

Sol. : (D) Since +q charge is moving on an equipotential surface so work done is zero.

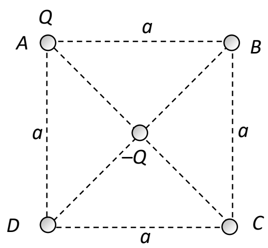


48. Four equal charge Q are placed at the four corners of a body of side 'a' each. Work done in removing a charge – Q from its centre to infinity is

(A) 0 (B) $\frac{\sqrt{2}Q^2}{4\pi\varepsilon_0 a}$

(C) $\frac{\sqrt{2}Q^2}{\pi\varepsilon_0 a}$ (D) $\frac{Q^2}{2\pi\varepsilon_0 a}$

Sol. : (C) We know that work done in moving a charge is W = QΔV



Here $W = Q(V_0 - V_\infty)$ $\because$ $V_\infty = 0$

$\therefore$ W = Q × V_0

Also

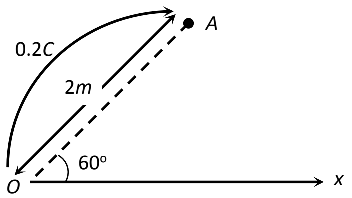
$$V_0 = 4 \times \frac{1}{4\pi\varepsilon_0} . \frac{Q}{a/\sqrt{2}} = \frac{4\sqrt{2}Q}{4\pi\varepsilon_0 a} = \frac{\sqrt{2}Q}{\pi\varepsilon_0 a}$$

So, $W = \frac{\sqrt{2}Q^2}{\pi\varepsilon_0 a}$

49. There is an electric field E in x-direction. If the work done in moving a charge 0.2 C through a distance of 2 metres along a line making an angle 60° with the x-axis is 4J, what is the value of E

(A) 4 N/C (B) 8 N/C

(C) $\sqrt{3}\ N/C$ (D) 20 N/C



Sol. : (D) By using $W = q \times \Delta V$ and $\Delta V = E\Delta r\cos\theta$

So, $W = qE\,\Delta r\cos\theta$

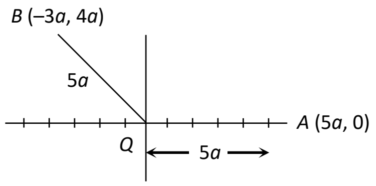
$W = 4j = 0.2 \times E \times 2 \times \cos 60$

$\Rightarrow$ E = 20 N/C

50. An electric charge of 20 μC is situated at the origin of X-Y co-ordinate system. The potential difference between the points. (5a, 0) and (– 3a, 4a) will be

(A) a (B) 2a

(C) Zero (D) $\frac{a}{\sqrt{2}}$



Sol. : (C) $V_A = \frac{kQ}{5a}$ and $V_B = \frac{kQ}{5a}$

$\therefore$ $V_A - V_B = 0$

51. Two identical thin rings each of radius R, are coaxially placed a distance R apart. If Q_1 and Q_2 are respectively the charges uniformly spread on the two rings, the work done in moving a charge q from the centre of one ring to that of the other is

(A) Zero

(B) $\frac{q(Q_1 - Q_2)(\sqrt{2}-1)}{4\pi\varepsilon_0 R\sqrt{2}}$

(C) $\frac{q(Q_1 + Q_2)\sqrt{2}}{4\pi\varepsilon_0 R}$

(D) $\frac{q\left(\frac{Q_1}{Q_2}\right)(\sqrt{2}-1)}{4\pi\varepsilon_0 R\sqrt{2}}$

Sol. : (B) Potential at the centre of first ring

$$V_A = \frac{Q_1}{4\pi\varepsilon_0 R} + \frac{Q_2}{4\pi\varepsilon_0\sqrt{R^2 + R^2}}$$

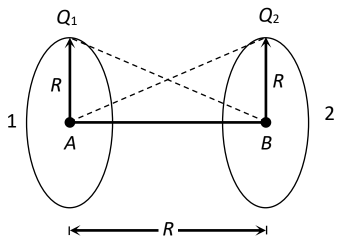
Potential at the centre of second ring

$$V_B = \frac{Q_2}{4\pi\varepsilon_0 R} + \frac{Q_1}{4\pi\varepsilon_0\sqrt{R^2 + R^2}}$$

Potential difference between the two centres

$$V_A - V_B = \frac{(\sqrt{2}-1)(Q_1 - Q_2)}{4\pi\varepsilon_0 R\sqrt{2}}$$

$\therefore$ Work done $W = \frac{q(\sqrt{2}-1)(Q_1 - Q_2)}{4\pi\varepsilon_0 R\sqrt{2}}$



52. A charge q is placed at the centre of the line joining two equal charges Q. The system of the three charges will be in equilibrium. If q is equal to

(A) $-\frac{Q}{2}$ (B) $-\frac{Q}{4}$

(C) $+\frac{Q}{4}$ (D) $+\frac{Q}{2}$

Sol. : (B) By using Tricky formula

$$q = Q\left(\frac{x/2}{x}\right)^2$$

$\Rightarrow$ $q = \frac{Q}{4}$ since q should be negative so $q = -\frac{Q}{4}$.

53. Two point charges +4q and +q are placed at a distance L apart. A third charge Q is so placed that all the three charges are in equilibrium. Then location and magnitude of third charge will be

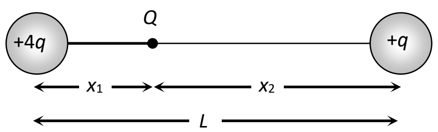
(A) At a distance $\frac{L}{3}$ from +4q charge, $\frac{4q}{9}$

(B) At a distance $\frac{L}{3}$ from +4q charge, $-\frac{4q}{9}$

(C) At a distance $\frac{2L}{3}$ from +4q charge, $-\frac{4q}{9}$

(D) At a distance $\frac{2L}{3}$ from +q charge, $+\frac{4q}{9}$

Sol. : (C) Let third charge be placed at a distance x_1 from +4q charge as shown



Now $x_1 = \frac{L}{1+\sqrt{\frac{q}{4q}}} = \frac{2L}{3} \Rightarrow x_2 = \frac{L}{3}$

For equilibrium of q,

$$Q = +4q\left(\frac{L/3}{L}\right)^2 = \frac{4q}{9} \Rightarrow Q = -\frac{4q}{9}.$$

54. A drop of 10^{-6} kg water carries 10^{-6} C charge. What electric field should be applied to balance it's weight (assume g = 10 m/sec^2)

(A) $10\ V/m$, Upward

(B) $10\ V/m$, Downward

(C) 0.1 V/m Downward

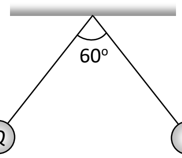
(D) $0.1 V/m$, Upward

Sol. : (A) In equilibrium QE = mg

$$E = \frac{mg}{Q} = \frac{10^{-6}\times 10}{10^{-6}}$$

= 10 V/m; Since charge is positive so electric field will be upward.

55. Two small spherical balls each carrying a charge Q = 10 μC (10 micro-coulomb) are suspended by two insulating threads of equal lengths 1 m each, from a point fixed in the ceiling. It is found that in equilibrium threads are separated by an angle 60° between them, as shown in the figure. What is the tension in the threads. (Given : $\frac{1}{(4\pi\varepsilon_0)} = 9\times 10^9\ Nm/C^2$)



(A) 18 N

(B) 1.8 N

(C) 0.18 N

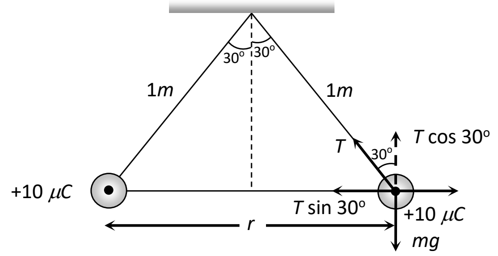
(D) None of these

Sol. : (B) From the geometry of figure

r = 1m

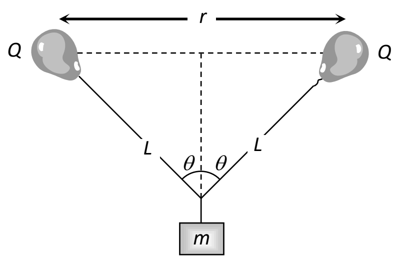
In the condition of equilibrium $T\sin 30^o = F_e$

$$T\times\frac{1}{2} = 9\times 10^9 . \frac{(10\times 10^{-6})^2}{1^2}$$



$\Rightarrow$ T= 1.8 N

56. Two similar balloons filled with helium gas are tied to L m long strings. A body of mass m is tied to another ends of the strings. The balloons float on air at distance r. If the amount of charge on the balloons is same then the magnitude of charge on each balloon will be



(A) $\left[\dfrac{mgr^2}{2k}\tan\theta\right]^{1/2}$ (B) $\left[\dfrac{2k}{mgr^2}\tan\theta\right]^{1/2}$

(C) $\left[\dfrac{mgr}{2k}\cot\theta\right]^{1/2}$ (D) $\left[\dfrac{2k}{mgr}\tan\theta\right]^{1/2}$

Sol. : (A) In equilibrium

$2R = mg$ .... (i) $F_e = T\sin\theta$ .... (ii)

$R = T\cos\theta$ .... (iii)

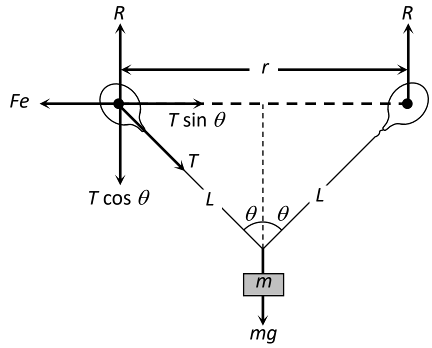
From equation (i) and (iii)

$2T\cos\theta = mg$ .... (iv)

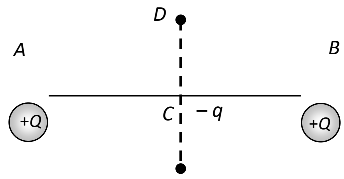
Dividing equation (ii) by equation (iv)

$$\frac{1}{2}\tan\theta = \frac{F_e}{mg} \Rightarrow \frac{1}{2}\tan\theta = \frac{k\dfrac{Q^2}{r^2}}{mg}$$

$$\Rightarrow \theta = \left(\frac{mgr^2}{2k}\tan\theta\right)^{1/2}$$



57. Two similar charges of +Q as shown in figure are placed at points A and B. – q charge is placed at point C midway between A and B. – q charge will oscillate if



(A) It is moved towards A

(B) It is moved towards B

(C) It is moved along CD

(D) Distance between A and B is reduced

Sol. : (C) When – q charge displaced along CD, a restoring force act on it which causes oscillation.

58. Two charges 9e and 3e are placed at a distance r. The distance of the point where the electric field intensity will be zero is

(A) $\dfrac{r}{\left(\sqrt{3}+1\right)}$ from 9e charge

(B) $\dfrac{r}{1+\sqrt{1/\ 3}}$ from 9e charge

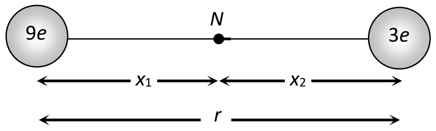
(C) $\dfrac{r}{\left(1-\sqrt{3}\right)}$ from 3e charge

(D) $\dfrac{r}{1+\sqrt{1/\ 3}}$ from 3e charge

Sol. : (B) Suppose neutral point is obtained at a distance x_1 from charge 9e and x_2 from charge 3e

By using $x_1 = \frac{x}{1+\sqrt{\frac{Q_2}{Q_1}}} = \frac{r}{1+\sqrt{\frac{3e}{9e}}}$

$= \frac{r}{\left(1+\frac{1}{\sqrt{3}}\right)}$



59. Two point charges – Q and 2Q are separated by a distance R, neutral point will be obtained at

(A) A distance of $\frac{R}{(\sqrt{2}-1)}$ from – Q charge and lies between the charges.

(B) A distance of $\frac{R}{(\sqrt{2}-1)}$ from – Q charge on the left side of it

(C) A distance of $\frac{R}{(\sqrt{2}-1)}$ from 2Q charge on the right side of it

(D) A point on the line which passes perpendicularly through the centre of the line joining – Q and 2Q charge.

Sol. : (B) As already we discussed neutral point will be obtained on the side of charge which is smaller in magnitude i.e. it will obtained on the left side of – Q charge and at a distance.

$l = \frac{R}{\sqrt{\frac{2Q}{Q}}-1} \Rightarrow l = \frac{R}{(\sqrt{2}-1)}$

60. A charge of + 4μC is kept at a distance of 50 cm from a charge of – 6μC. Find the two points where the potential is zero

(A) Internal point lies at a distance of 20 cm from 4μC charge and external point lies at a distance of 100 cm from 4μC charge.

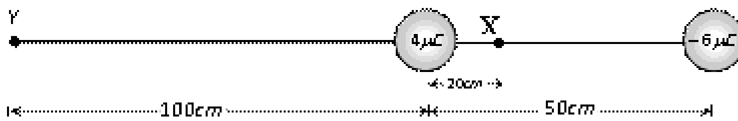
(B) Internal point lies at a distance of 30 cm from 4μC charge and external point lies at a distance of 100 cm from 4μC charge

(C) Potential is zero only at 20 cm from 4μC charge between the two charges

(D) Potential is zero only at 20 cm from – 6μC charge between the two charges

Sol. : (A) For internal point X, $x_1 = \frac{x}{\left(\frac{Q_2}{Q_1}+1\right)} = \frac{50}{\frac{6}{4}+1} = 20\,cm$

and for external point Y, $x_1 = \frac{x}{\left(\frac{Q_2}{Q_1}-1\right)} = \frac{50}{\frac{6}{4}-1} = 100\ cm$



61. If the distance of separation between two charges is increased, the electrical potential energy of the system

(A) May increases or decrease

(B) Decreases

(C) Increase

(D) Remain the same

Sol. : (A) Since we know potential energy $U = k.\frac{Q_1Q_2}{r}$

As r increases, U decreases in magnitude. However depending upon the fact whether both charges are similar or disimilar, U may increase or decrease.

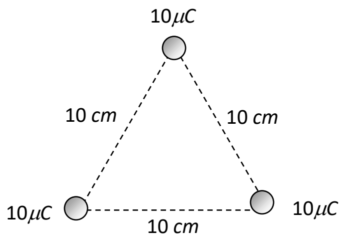
62. Three particles, each having a charge of 10μC are placed at the corners of an equilateral triangle of side 10cm. The electrostatic potential energy of the system is (Given $\frac{1}{4\pi\varepsilon_0} = 9\times10^9\ N-m^2/C^2$)

(A) Zero (B) Infinite

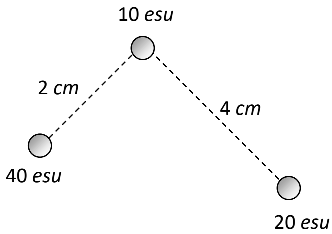
(C) 27 J (D) 100 J

Sol. : (C) Potential energy of the system,

$$U = 9\times10^9\left[\frac{(10\times10^{-6})^2}{0.1}\times3\right] = 27\ \text{J}$$



63. A charge 10 e.s.u. is placed at a distance of 2 cm from a charge 40 e.s.u. and 4 cm from another charge of 20 e.s.u. The potential energy of the charge 10 e.s.u. is (in ergs)



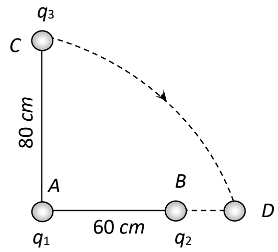
(A) 87.5 (B) 112.5

(C) 150 (D) 250

Sol. : (D) Potential energy of 10 e.s.u. charge is

$$U = \frac{10\times40}{2} + \frac{10\times20}{4} = 250\ erg.$$

64. In figure are shown charges $q_1 = +2\times10^{-8}$ C and $q_2 = -0.4\times10^{-8}$ C. A charge $q_3 = 0.2\times10^{-8}$ C in moved along the arc of a circle from C to D. The potential energy of q_3



(A) Will increase approximately by 76%

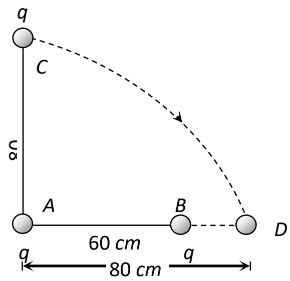
(B) Will decreases approximately by 76%

(C) Will remain same

(D) Will increases approximately by 12%

Sol. : (B) Initial potential energy of q_3

$$U_i = \left(\frac{q_1q_3}{0.8} + \frac{q_2q_3}{1}\right)\times9\times10^9$$



Final potential energy of q_3

$$U_f = \left(\frac{q_1q_3}{0.8} + \frac{q_2q_3}{0.2}\right)\times9\times10^9$$

Change in potential energy = $U_f - U_i$

Now percentage change in potential energy $= \frac{U_f - U_i}{u_i}\times100$

$$= \frac{q_2q_3\left(\frac{1}{0.2}-1\right)\times100}{q_3\left(\frac{q_1}{0.8}+\frac{q_2}{1}\right)}$$ On putting the values $\simeq -76\%$

65. An electron (mass = $9.1\times10^{-31}\ kg$ and charge = $1.6\times10^{-19}\ coul.$) is sent in an electric field of intensity $1\times10^6\ V/m$. How long would it take for the electron, starting from rest, to attain one–tenth the velocity of light

(A) $1.7\times10^{-12}\ sec$

(B) $1.7\times10^{-6}\ sec$

(C) $1.7\times10^{-8}\ sec$

(D) $1.7\times10^{-10}\ sec$

Sol. : (B) By using $v=\frac{QEt}{m}$

$\Rightarrow \frac{1}{10}\times3\times10^{8}=\frac{(1.6\times10^{-19})\times10^{6}\times t}{9.1\times10^{-31}}$

$\Rightarrow t=1.7\times10^{-10}\ sec.$

66. Two protons are placed $10^{-10}m$ apart. If they are repelled, what will be the kinetic energy of each proton at very large distance

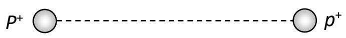
(A) $23\times10^{-19}\ J$

(B) $11.5\times10^{-19}\ J$

(C) $2.56\times10^{-19}\ J$

(D) $2.56\times10^{-28}\ J$

Sol. : (D) Potential energy of the system when protons are separated by a distance of 10^{-10} m is



$U=\frac{9\times10^{9}\times(1.6\times10^{-19})^2}{10^{-10}}=23\times10^{-19}\ J$

According to law of conservation of energy at very larger distance, this energy is equally distributed in both the protons as their kinetic energy hence K.E. of each proton will be $11.5\times10^{-19}\ J.$

67. A particle A has a charge +q and particle B has charge +4q with each of them having the same mass m. When allowed to fall from rest through the same electrical potential difference, the ratio of their speeds $\frac{v_A}{v_B}$ will becomes

(A) 2 : 1 (B) 1 : 2

(C) 1 : 4 (D) 4 : 1

Sol. : (B) We know that kinetic energy $K=\frac{1}{2}mv^2=QV$. Since, m and V are same so, $v^2\propto Q$

$\Rightarrow \frac{v_A}{v_B}=\sqrt{\frac{Q_A}{Q_B}}=\sqrt{\frac{q}{4q}}=\frac{1}{2}.$

68. How much kinetic energy will be gained by an $\alpha-$particle in going from a point at 70 V to another point at 50 V

(A) 40 eV (B) 40 keV

(C) 40 MeV (D) 0 eV

Sol. : (A) Kinetic energy $K=Q\Delta V$

$\Rightarrow K=(2e)(70-50)V=40\ eV$

69. If the magnitude of intensity of electric field at a distance x on axial line and at a distance y on equatorial line on a given dipole are equal, then x : y is

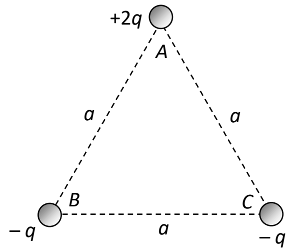
(A) 1 : 1 (B) $1:\sqrt{2}$

(C) 1 : 2 (D) $\sqrt[3]{2}:1$

Sol. : (D) According to the question

$\frac{1}{4\pi\varepsilon_0}.\frac{2p}{x^3}=\frac{1}{4\pi\varepsilon_0}.\frac{p}{y^3}\ \Rightarrow \frac{x}{y}=(2)^{1/3}:1$

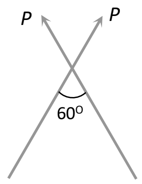
70. Three charges of (+2q), (– q) and (– q) are placed at the corners A, B and C of an equilateral triangle of side a as shown in the adjoining figure. Then the dipole moment of this combination is



(A) qa (B) Zero

(C) $qa\sqrt{3}$ (D) $\frac{2}{\sqrt{3}}qa$

Sol. : (C) The charge +2q can be broken in +q, +q. Now as shown in figure we have two equal dipoles inclined at an angle of 60°. Therefore resultant dipole moment will be



$p_{net} = \sqrt{p^2 + p^2 + 2pp\cos 60}$

$= \sqrt{3}p$

$= \sqrt{3}\,qa$

71. An electric dipole is placed along the x-axis at the origin O. A point P is at a distance of 20 cm from this origin such that OP makes an angle $\frac{\pi}{3}$ with the x-axis. If the electric field at P makes an angle θ with x-axis, the value of θ would be

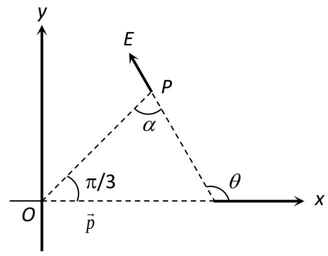
(A) $\frac{\pi}{3}$

(B) $\frac{\pi}{3} + \tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$

(C) $\frac{2\pi}{3}$

(D) $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$

Sol. : (B) According to question we can draw following figure.



As we have discussed earlier in theory

$\theta = \frac{\pi}{3} + \alpha$

$\tan\alpha = \frac{1}{2}\tan\frac{\pi}{3} \Rightarrow \alpha = \tan^{-1}\frac{\sqrt{3}}{2}$

So, $\theta = \frac{\pi}{3} + \tan^{-1}\frac{\sqrt{3}}{2}$

72. An electric dipole in a uniform electric field experiences

(A) Force and torque both

(B) Force but no torque

(C) Torque but no force

(D) No force and no torque

Sol. : (C) In uniform electric field $F_{net} = 0$, $\tau_{net} \neq 0$

73. Two opposite and equal charges 4×10^{-8} coulomb when placed 2×10^{-2} cm away, form a dipole. If this dipole is placed in an external electric field 4×10^{8} newton/coulomb, the value of maximum torque and the work done in rotating it through 180° will be

(A) 64×10^{-4} Nm and 64×10^{-4} J

(B) 32×10^{-4} Nm and 32×10^{-4} J

(C) 64×10^{-4} Nm and 32×10^{-4} J

(D) 32×10^{-4} Nm and 64×10^{-4} J

Sol. : (D) $\tau_{max} = pE$ and $W_{max} = 2pE$

$\because$ $p = Q \times 2l = 4 \times 10^{-8} \times 2 \times 10^{-2} \times 10^{-2} = 8 \times 10^{-12}$ C-m

So, $\tau_{max} = 8 \times 10^{-12} \times 4 \times 10^{8} = 32 \times 10^{-4}$ N-m

and $W_{max} = 2 \times 32 \times 10^{-4} = 64 \times 10^{-4}$ J

74. A point charge placed at any point on the axis of an electric dipole at some large distance experiences a force F.

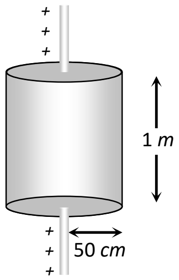
The force acting on the point charge when it's distance from the dipole is doubled is

(A) F (B) $\frac{F}{2}$

(C) $\frac{F}{4}$ (D) $\frac{F}{8}$

Sol. : (D) Force acting on a point charge in dipole field varies as $F \propto \frac{1}{r^3}$ where r is the distance of point charge from the centre of dipole. Hence if r makes double so new force $F' = \frac{F}{8}$.

75. Electric charge is uniformly distributed along a long straight wire of radius 1 mm. The charge per cm length of the wire is Q coulomb. Another cylindrical surface of radius 50 cm and length 1 m symmetrically encloses the wire as shown in the figure. The total electric flux passing through the cylindrical surface is



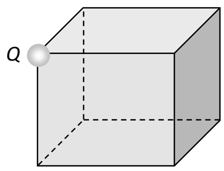
(A) $\frac{Q}{\varepsilon_0}$ (B) $\frac{100\ Q}{\varepsilon_0}$

(C) $\frac{10\ Q}{(\pi\varepsilon_0)}$ (D) $\frac{100\ Q}{(\pi\varepsilon_0)}$

Sol. : (B) Given that charge per cm length of the wire is Q. Since 100 cm length of the wire is enclosed so $Q_{enc} = 100\ Q$

$\Rightarrow$ Electric flux emerging through cylindrical surface $\phi = \frac{100\ Q}{\varepsilon_0}$.

76. A charge Q is situated at the corner A of a cube, the electric flux through the one face of the cube is



(A) $\frac{Q}{6\varepsilon_0}$ (B) $\frac{Q}{8\varepsilon_0}$

(C) $\frac{Q}{24\,\varepsilon_0}$ (D) $\frac{Q}{2\varepsilon_0}$

Sol. : (C) For the charge at the corner, we require eight cube to symmetrically enclose it in a Gaussian surface. The total flux $\phi_T = \frac{Q}{\varepsilon_0}$. Therefore the flux through one cube will be $\phi_{cube} = \frac{Q}{8\varepsilon_0}$. The cube has six faces and flux linked with three faces (through A) is zero, so flux linked with remaining three faces will $\frac{\phi}{8\varepsilon_0}$. Now as the remaining three are identical so flux linked with each of the three faces will be $= \frac{1}{3} \times \left[\frac{1}{8}\left(\frac{Q}{\varepsilon_0}\right)\right] = \frac{1}{24}\frac{Q}{\varepsilon_0}$.

77. A square of side 20 cm is enclosed by a surface of sphere of 80 cm radius. Square and sphere have the same centre. Four charges $+ 2 \times 10^{-6}$ C, $- 5 \times 10^{-6}$ C, $- 3 \times 10^{-6}$ C, $+6 \times 10^{-6}$ C are located at the four corners of a square, then out going total flux from spherical surface in N–m^2/C will be

(A) Zero

(B) $(16\ \pi) \times 10^{-6}$

(C) $(8\pi) \times 10^{-6}$

(D) $36\pi \times 10^{-6}$

Sol. : (A) Since charge enclosed by Gaussian surface is

$\phi_{enc.} = (2\times10^{-6} - 5\times10^{-6} - 3\times10^{-6} + 6\times10^{-6}) = 0$

so $\phi = 0$

78. In a region of space, the electric field is in the x-direction and proportional to x, i.e., $\vec{E} = E_0 x\hat{i}$. Consider an imaginary cubical volume of edge a, with its edges parallel to the axes of coordinates. The charge inside this cube is

(A) Zero (B) $\varepsilon_0 E_0 a^3$

(C) $\frac{1}{\varepsilon_0} E_0 a^3$ (D) $\frac{1}{6}\varepsilon_0 E_0 a^2$

Sol. : (B) The field at the face ABCD

= $E_0 x_0 \hat{i}$.

$\therefore$ Flux over the face ABCD = – $(E_0 x_0)a^2$

The negative sign arises as the field is directed into the cube.

The field at the face EFGH

= $E_0(x_0 + a)\hat{i}$.

$\therefore$ Flux over the face EFGH

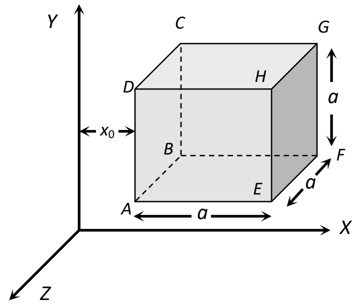
= $E_0(x_0 + a)a^2$

The flux over the other four faces is zero as the field is parallel to the surfaces.

$\therefore$ Total flux over the cube $= E_0 a^2 = \frac{1}{2} q$

where q is the total charge inside the cube.

$\therefore\ q = \varepsilon_0 E_0 a^3$.



79. Eight drops of mercury of same radius and having same charge coalesce to form a big drop. Capacitance of big drop relative to that of small drop will be

(A) 16 times (B) 8 times

(C) 4 times (D) 2 times

Sol. : (D) By using relation $C = n^{1/3}.c$

$\Rightarrow\ C = (8)^{1/3}.c = 2c$

80. Two spheres A and B of radius 4 cm and 6 cm are given charges of $80\,\mu C$ and $40\,\mu C$ respectively. If they are connected by a fine wire, the amount of charge flowing from one to the other is

(A) $20\,\mu C$ from A to B

(B) $16\,\mu C$ from A to B

(C) $32\,\mu C$ from B to A

(D) $32\,\mu C$ from A to B

Sol. : (D) Total charge $Q = 80 + 40 = 120\ \mu C$. By using the formula $Q_1' = Q\left[\frac{r_1}{r_1 + r_2}\right]$.

New charge on sphere A is

$Q_A' = Q\left[\frac{r_A}{r_A + r_B}\right] = 120\left[\frac{4}{4+6}\right] = 48\ \mu C$.

Initially it was $80\ \mu C$, i.e., $32\ \mu C$ charge flows from A to B.

81. Two insulated metallic spheres of $3\mu F$ and $5\mu F$ capacitances are charged to $300\ V$ and $500\ V$ respectively. The energy loss, when they are connected by a wire, is

(A) $0.012\ J$ (B) $0.0218\ J$

(C) $0.0375\ J$ (D) $3.75\ J$

Sol. : (C) By using

$\Delta U = \frac{C_1 C_2}{2(C_1 + C_2)}(V_1 - V_2)^2$;

$\Delta U = 0.375\ J$

82. 64 small drops of mercury, each of radius r and charge q coalesce to form a big drop. The ratio of the surface density of charge of each small drop with that of the big drop is

(A) 1 : 64 (B) 64 : 1

(C) 4 : 1 (D) 1 : 4

Sol. : (D) $\frac{\sigma_{Small}}{\sigma_{Big}} = \frac{q/4\pi r^2}{Q/4\pi R^2} = \left(\frac{q}{Q}\right)\left(\frac{R}{r}\right)^2$;

since $R = n^{1/3}r$ and $Q = nq$

So $\frac{\sigma_{Small}}{\sigma_{Big}} = \frac{1}{n^{1/3}} \Rightarrow \frac{\sigma_{Small}}{\sigma_{Big}} = \frac{1}{4}$

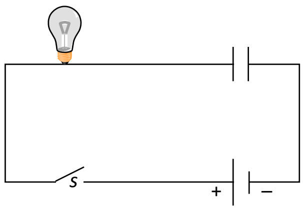
83. The capacity of pure capacitor is 1 farad. In D.C. circuit, its effective resistance will be

(A) Zero (B) Infinite

(C) 1 ohm (D) $\frac{1}{2}ohm$

Sol. : (B) Capacitor does not work in D.C. for D.C. it's effective resistance is infinite i.e. it blocks the current to flow in the circuit.

84. A light bulb, a capacitor and a battery are connected together as shown here, with switch S initially open. When the switch S is closed, which one of the following is true



(A) The bulb will light up for an instant when the capacitor starts charging

(B) The bulb will light up when the capacitor is fully charged

(C) The bulb will not light up at all

(D) The bulb will light up and go off at regular intervals

Sol. : (A) Current through the circuit can flow only for the small time of charging, once capacitor get's charged it blocks the current through the circuit and bulb will go off.

85. Capacity of a parallel plate condenser is 10μF when the distance between its plates is $8\,cm$. If the distance between the plates is reduced to 4cm, its capacity will be

(A) 10μF (B) 15μF

(C) 20μF (D) 40μF

Sol. : (C) $C = \frac{\varepsilon_0 A}{d} \propto \frac{1}{d}$ $\therefore$ $\frac{C_1}{C_2} = \frac{d_2}{d_1}$

or $C_2 = \frac{d_1}{d_2} \times C_1 = \frac{8}{4} \times 10 = 20\,\mu F$

86. What is the area of the plates of a $3F$ parallel plate capacitor, if the separation between the plates is $5\,mm$

(A) $1.694 \times 10^9\, m^2$

(B) $4.529 \times 10^9\, m^2$

(C) $9.281 \times 10^9\, m^2$

(D) $12.981 \times 10^9\, m^2$

Sol. : (A) By using the relation $C = \frac{\varepsilon_0 A}{d}$

$$\Rightarrow A = \frac{Cd}{\varepsilon_0} = \frac{3 \times 5 \times 10^{-3}}{8.85 \times 10^{-12}}$$

$$= 1.694 \times 10^9 m^2.$$

87. A spherical capacitor consists of two concentric spherical conductors. The inner one of radius R_1 maintained at potential V_1 and the outer conductor of radius R_2 at potential V_2. The potential at a point P at a distance x from the centre (where $R_2 > x > R_1$) is

(A) $\frac{V_1 - V_2}{R_2 - R_1}(x - R_1)$

(B) $\frac{V_1R_1(R_2 - x) + V_2R_2(x - R_1)}{(R_2 - R_1)x}$

(C) $V_1 + \frac{V_2 x}{(R_2 - R_1)}$

(D) $\frac{(V_1 + V_2)}{(R_1 + R_2)} x$

Sol. : (B) Let Q_1 and Q_2 be the charges on the inner and the outer sphere respectively. Now V_1 is the total potential on the sphere of radius R₁,

So, $V_1 = \frac{Q_1}{R_1} + \frac{Q_2}{R_2}$ .... (i)

and V_2 is the total potential on the surface of sphere of radius R_2,

So, $V_2 = \frac{Q_2}{R_2} + \frac{Q_1}{R_2}$ .... (ii)

If V be the potential at point P which lies at a distance x from the common centre then

$$V = \frac{Q_1}{x} + \frac{Q_2}{R_2} = \frac{Q_1}{x} + V_1 - \frac{Q_1}{R_1}$$

$$= Q_1\left(\frac{1}{x} - \frac{1}{R_1}\right) + V_1 = \frac{Q_1(R_1 - x)}{xR_1} + V_1$$

........(iii)

Substracting (ii) from (i)

$$V_1 - V_2 = \frac{Q_1}{R_1} - \frac{Q_2}{R_2}$$

$$\Rightarrow (V_1 - V_2)R_1R_2 = R_2Q_1 - R_1Q_1$$

$$\Rightarrow Q_1 = \frac{(V_1 - V_2)R_1R_2}{R_2 - R_1}$$

Now substituting it in equation (iii), we have

$$V = \frac{(R_1 - x)(V_1 - V_2)R_1R_2}{xR_1(R_2 - R_1)} + V_1$$

$$\Rightarrow V = \frac{V_1R_1(R_2 - x) + V_2R_2(x - R_1)}{x(R_2 - R_1)}$$

88. The diameter of each plate of an air capacitor is 4 cm. To make the capacity of this plate capacitor equal to that of 20 cm diameter sphere, the distance between the plates will be

(A) $4 \times 10^{-3}\, m$ (B) $1 \times 10^{-3}\, m$

(C) 1 cm (D) $1 \times 10^{-3}\, cm$

Sol. : (B) According to the question

$$\frac{\varepsilon_0 A}{d} = 4\pi\varepsilon_0 R$$

$$\Rightarrow \ d = \frac{A}{4\pi R} = \frac{\pi(2\times10^{-2})^2}{4\pi\times10\times10^{-2}}$$

$$= 1\times10^{-3}\ m.$$

89. A spherical condenser has inner and outer spheres of radii a and b respectively. The space between the two is filled with air. The difference between the capacities of two condensers formed when outer sphere is earthed and when inner sphere is earthed will be

(A) Zero

(B) $4\pi\varepsilon_0 a$

(C) $4\pi\varepsilon_0 b$

(D) $4\pi\varepsilon_0 a\left(\frac{b}{b-a}\right)$

Sol. : (C) Capacitance when outer sphere is earthed $C_1 = 4\pi\varepsilon_0 . \frac{ab}{b-a}$ and capacitance when inner sphere is earthed $C_2 = 4\pi\varepsilon_0 . \frac{b^2}{b-a}$. Hence $C_2 - C_1 = 4\pi\varepsilon_0 . b$

90. After charging a capacitor of capacitance $4\mu F$ upto a potential 400 V, its plates are connected with a resistance of $1 k\Omega$. The heat produced in the resistance will be

(A) 0.16 J (B) 1.28 J

(C) 0.64 J (D) 0.32 J

Sol. : (D) This is the discharging condition of capacitor and in this condition energy released

$$U = \frac{1}{2}CV^2$$

$$= \frac{1}{2} \times 4 \times 10^{-6} \times (400)^2 = 0.32\,J \ = 0.32\ J.$$

91. The amount of work done in increasing the voltage across the plates of a capacitor from $5V$ to $10V$ is W. The work done in increasing it from $10V$ to $15V$ will be

(A) 0.6 W (B) W

(C) 1.25 W (D) 1.67 W

Sol. : (D) As we know that work done $= U_{final} - U_{initial} = \frac{1}{2}C(V_2^2 - V_1^2)$

When potential difference increases from $5V$ to $10V$ then

$W = \frac{1}{2}C(10^2 - 5^2)$ ....(i)

When potential difference increases from $10V$ to $15V$ then

$W' = \frac{1}{2}C(15^2 - 10^2)$ ....(ii)

On solving equation (i) and (ii) we get $W' = 1.67\,W.$

92. The mean electric energy density between the plates of a charged capacitor is (here Q = Charge on the capacitor and A = Area of the capacitor plate)

(A) $\frac{Q^2}{2\varepsilon_0 A^2}$

(B) $\frac{Q}{2\varepsilon_0 A^2}$

(C) $\frac{Q^2}{2\varepsilon_0 A}$

(D) None of these

Sol. : (A) Energy density $= \frac{1}{2}\varepsilon_0 E^2 = \frac{1}{2}\varepsilon_0 \left(\frac{Q}{A\varepsilon_0}\right)^2 = \frac{Q^2}{2\varepsilon_0 A^2}$.

93. Plate separation of a $15\,\mu F$ capacitor is 2 mm. A dielectric slab (K = 2) of thickness 1 mm is inserted between the plates. Then new capacitance is given by

(A) $15\,\mu F$ (B) $20\,\mu F$

(C) $30\,\mu F$ (D) $25\,\mu F$

Sol. : (B) Given $C = \frac{\varepsilon_0 A}{d} = 15\,\mu F$ ....(i)

Then by using $C' = \frac{\varepsilon_0 A}{d - t + \frac{t}{K}} = \frac{\varepsilon_0 A}{2\times 10^{-3} - 10^{-3} + \frac{10^{-3}}{2}}$

$= \frac{2}{3}\times \varepsilon_0 A \times 10^3$; From equation (i) $C' = 20\,\mu F.$

94. There is an air filled $1\,pF$ parallel plate capacitor. When the plate separation is doubled and the space is filled with wax, the capacitance increases to $2\,pF$. The dielectric constant of wax is

(A) 2 (B) 4

(C) 6 (D) 8

Sol. : (B) Given that capacitance $C = 1\,pF$

After doubling the separation between the plates $C' = \frac{C}{2}$

and when dielectric medium of dielectric constant k filled between the plates then $C' = \frac{KC}{2}$

According to the question, $C' = \frac{KC}{2} = 2$

$\Rightarrow K = 4.$

95. If a slab of insulating material $4\times 10^{-5}\,m$ thick is introduced between the plate of a parallel plate capacitor, the distance between the plates has to be increased by $3.5\times 10^{-5}\,m$ to restore the capacity to original value. Then the dielectric constant of the material of slab is

(A) 10 (B) 12

(C) 6 (D) 8

Sol. : (D) By using $K = \frac{t}{t - d'}$;

here $t = 4\times 10^{-5}\,m$; $d' = 3.5\times 10^{-5}\,m$

$\Rightarrow \quad K = \dfrac{4 \times 10^{-5}}{4 \times 10^{-5} - 3.5 \times 10^{-5}}$ = 8

96. The force between the plates of a parallel plate capacitor of capacitance C and distance of separation of the plates d with a potential difference V between the plates, is

(A) $\dfrac{CV^2}{2d}$ (B) $\dfrac{C^2V^2}{2d^2}$

(C) $\dfrac{C^2V^2}{d^2}$ (D) $\dfrac{V^2d}{C}$

Sol. : (A) Since $F = \dfrac{Q^2}{2\varepsilon_0 A}$

$\Rightarrow F = \dfrac{C^2V^2}{2\varepsilon_0 A} = \dfrac{CV^2}{2d}$.

97. A capacitor when filled with a dielectric $K = 3$ has charge Q_0, voltage V_0 and field E_0. If the dielectric is replaced with another one having K = 9, the new values of charge, voltage and field will be respectively

(A) $3Q_0, 3V_0, 3E_0$

(B) $Q_0, 3V_0, 3E_0$

(C) $Q_0, \dfrac{V_0}{3}, 3E_0$

(D) $Q_0, \dfrac{V_0}{3}, \dfrac{E_0}{3}$

Sol. : (D) Suppose, charge, potential difference and electric field for capacitor without dielectric medium are Q, V and E respectively

With dielectric medium of $K = 3$

Charge $Q_0 = Q$

With dielectric medium of $K = 9$

Charge $Q' = Q = Q_0$

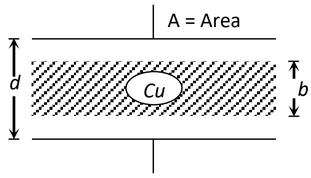
Potential difference $V_0 = \dfrac{V}{3}$

Electric field $E_0 = \dfrac{E}{3}$

Potential difference $V' = \dfrac{V}{9} = \dfrac{V_0}{3}$

Electric field $E' = \dfrac{E}{9} = \dfrac{E_0}{3}$.

98. A slab of copper of thickness b is inserted in between the plates of parallel plate capacitor as shown in the figure. The separation between the plates is d. If $b = \dfrac{d}{2}$ then the ratio of capacities of the capacitor after and before inserting the slab will be



(A) $\sqrt{2} : 1$ (B) 2 : 1

(C) 1 : 1 (D) $1 : \sqrt{2}$

Sol. : (B) Capacitance before inserting the slab $C = \dfrac{\varepsilon_0 A}{d}$ and capacitance after inserting the slab $C' = \dfrac{\varepsilon_0 A}{d - t}$.

Where $t = b = \dfrac{d}{2}$ so $C' = \dfrac{2\varepsilon_0 A}{d}$

hence, $\dfrac{C'}{C} = \dfrac{2}{1}$.

99. The capacity of a parallel plate condenser is C_0. If a dielectric of relative permitivity ε_r and thickness equal to one fourth the plate separation is placed between the plates, then its capacity becomes C. The value of $\dfrac{C}{C_0}$ will be

(A) $\dfrac{5\varepsilon_r}{4\varepsilon_r + 1}$ (B) $\dfrac{4\varepsilon_r}{3\varepsilon_r + 1}$

(C) $\dfrac{3\varepsilon_r}{2\varepsilon_r + 1}$ (D) $\dfrac{2\varepsilon_r}{\varepsilon_r + 1}$

Sol. : (B) Initially capacitance $C_0 = \frac{\varepsilon_0 A}{d}$ .....(i)

Finally capacitance $C = \frac{\varepsilon_0 A}{d - \frac{d}{4} + \frac{d/4}{\varepsilon_r}}$ .....(ii)

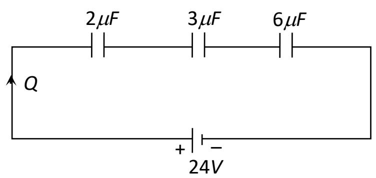
By dividing equation (ii) by equation (i) $\frac{C}{C_0} = \frac{4\varepsilon_r}{3\varepsilon_r + 1}$

100. Three capacitors of 2μ f, 3μ f and 6μ f are joined in series and the combination is charged by means of a 24 volt battery. The potential difference between the plates of the 6μ f capacitor is

(A) 4 volts (B) 6 volts

(C) 8 volts (D) 10 volts

Sol. : (A) Equivalent capacitance of the network is $\frac{1}{C_{eq}} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6}$

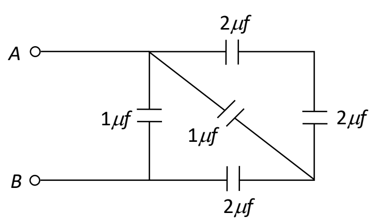


$C_{eq} = 1\mu F$

Charge supplied by battery Q = C_{eq}.V $\Rightarrow$ 1 × 24 = 24 μC

Hence potential difference across 6μ F capacitor $= \frac{24}{6} = 4\,volt.$

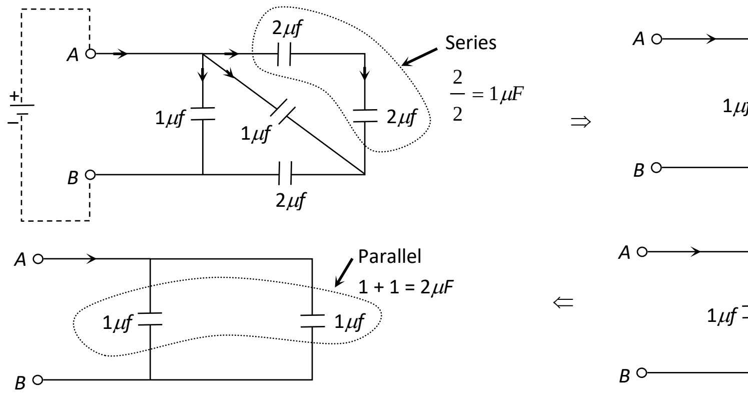
101. Five capacitors are connected as shown in the figure. The equivalent capacitance between the point A and B is



(A) 1 μ f (B) 2 μ f

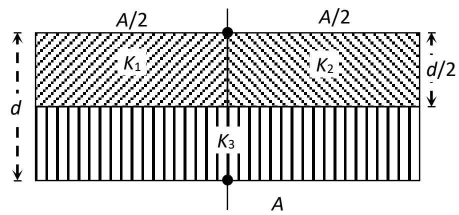
(C) 3 μ f (D) 4 μ f

Sol. : (B)



Hence equivalent capacitance between A and B is 2μF.

102. A parallel plate capacitor of area A, plate separation d and capacitance C is filled with three different dielectric materials having dielectric constants K_1, K_2 and K_3 as shown in fig. If a single dielectric material is to be used to have the same capacitance C in this capacitor, then its dielectric constant K is given by



A = Area of plates

(A) $\frac{1}{K} = \frac{1}{K_1} + \frac{1}{K_2} + \frac{1}{2K_3}$

(B) $\frac{1}{K} = \frac{1}{K_1 + K_2} + \frac{1}{2K_3}$

(C) $K = \frac{K_1 K_2}{K_1 + K_2} + 2K_3$

(D) $K = K_1 + K_2 + 2K_3$

Sol. : (B) The effective capacitance is given by

$$\frac{1}{C_{eq}} = \frac{d}{\varepsilon_0 A}\left[\frac{1}{2K_3} + \frac{1}{(K_1 + K_2)}\right]$$

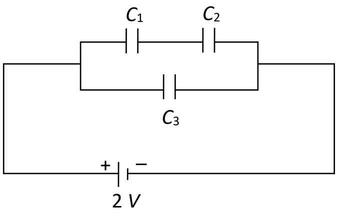
The capacitance of capacitor with single dielectric of dielectric constant K is $C = \frac{K\varepsilon_0 A}{d}$

According to question $C_{eq} = C$

i.e., $\dfrac{\varepsilon_0 A}{d\left[\frac{1}{2K_3} + \frac{1}{K_1 + K_2}\right]} = \dfrac{K\varepsilon_0 A}{d}$

$\Rightarrow \frac{1}{K} = \frac{1}{2K_3} + \frac{1}{K_1 + K_2}$.

103. Two capacitors C_1 = 2μF and C_2 = 6μF in series, are connected in parallel to a third capacitor C_3 = 4μF. This arrangement is then connected to a battery of e.m.f. = 2 V, as shown in the fig. How much energy is lost by the battery in charging the capacitors?



(A) $22 \times 10^{-6}\, J$ (B) $11 \times 10^{-6}\, J$

(C) $\left(\frac{32}{3}\right) \times 10^{-6}\, J$ (D) $\left(\frac{16}{3}\right) \times 10^{-6}\, J$

Sol. : (B) Equivalent capacitance

$$C_{eq} = \frac{C_1 C_2}{C_1 + C_2} + C_3 = \frac{2 \times 6}{8} + 4 = 5.5\mu F$$

$$\therefore U = \frac{1}{2} C_{eq}.V^2 = \frac{1}{2} \times 5.5 \times (2)^2$$

$$= 11 \times 10^{-6} J$$

104. Given a number of capacitors labelled as 8μF, 250 V. Find the minimum number of capacitors needed to get an arrangement equivalent to 16 μF, 1000 V

(A) 4 (B) 16

(C) 32 (D) 64

Sol. : (C) Let C = 8 μF, C′ = 16 μF and V = 250 volt, V′ = 1000 V

Suppose m rows of given capacitors are connected in parallel which each row contains n capacitor then

Potential difference across each capacitors $V = \frac{V'}{n}$ and equivalent capacitance of network $C' = \frac{mC}{n}$.

On putting the values, we get n = 4 and m = 8. Hence total capacitors = m × n = 8 × 4 = 32.

Short Trick: For such type of problem number of capacitors $n = \frac{C'}{C} \times \left(\frac{V'}{V}\right)^2$.

Here $n = \frac{16}{8}\left(\frac{1000}{250}\right)^2 = 32$

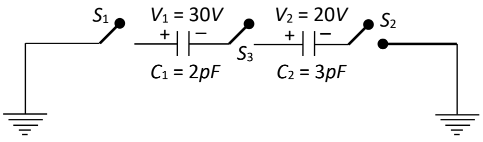
105. Ten capacitors are joined in parallel and charged with a battery up to a potential V. They are then disconnected from battery and joined again in series then the potential of this combination will be

(A) V (B) 10 V

(C) 5 V (D) 2 V

Sol. : (B) By using the formula $V' = nV \Rightarrow V' = 10\,V.$

106. For the circuit shown, which of the following statements is true



(A) With S_1 closed, V_1 = 15 V, V_2 = 20 V

(B) With S_3 closed, $V_1 = V_2$ = 25 V

(C) With S_1 and S_2 closed $V_1 = V_2 = 0$

(D) With S_1 and S_3 closed V_1 = 30 V, V_2 = 20 V

Sol. : (D) When S_3 is closed, due to attraction with opposite charge, no flow of charge takes place through S_3. Therefore, potential difference across capacitor plates remains unchanged or V_1 = 30 V and V_2 = 20 V.

Alternate Sol. :

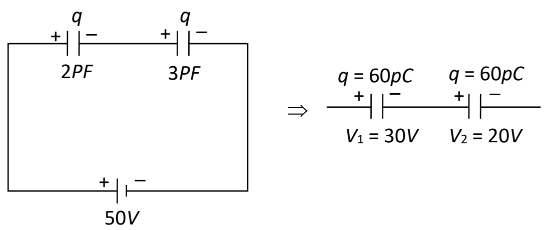
Charges on the capacitors are– $q_1 = (30)(2) = 60\,pC$,

$q_2 = (20)(3) = 60\,pC$ or

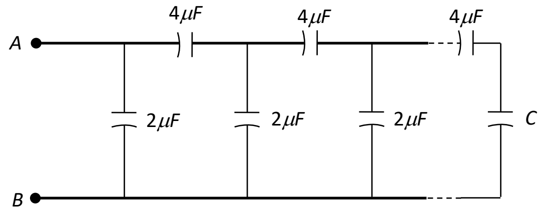
$q_1 = q_2 = q\,(\text{say})$

The situation is similar as the two capacitors in series are first charged with a battery of emf 50 V and then disconnected.

When S_3 is closed, V_1 = 30 V and V_2 = 20 V.



107. A finite ladder is constructed by connecting several sections of $2\mu F, 4\mu F$ capacitor combinations as shown in the figure. It is terminated by a capacitor of capacitance C. What value should be chosen for C, such that the equivalent capacitance of the ladder between the points A and B becomes independent of the number of sections in between



(A) $4\mu F$ (B) $2\mu F$

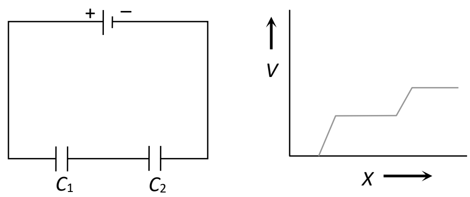
(C) $18\ \mu F$ (D) $6\ \mu F$

Sol. : (A) By using formula

$$C = \frac{C_2}{2}\left[\sqrt{1 + 4\left(\frac{C_1}{C_2}\right)} + 1\right]; \quad C_1 = 4\mu F,\ C_2 = 2\mu F$$

We get $C = 4\,\mu F.$

108. Figure shows two capacitors connected in series and joined to a battery. The graph shows the variation in potential as one moves from left to right on the branch containing the capacitors.



(A) $C_1 > C_2$

(B) $C_1 = C_2$

(C) $C_1 < C_2$

(D) The information is insufficient to decide the relation between C_1 and C_2

Sol. : (C) According to graph we can say that potential difference across the capacitor C_1 is more than that across

C_2. Since charge Q is same i.e., $Q = C_1V_1 = C_2V_2$

$\Rightarrow \dfrac{C_1}{C_2} = \dfrac{V_2}{V_1}$

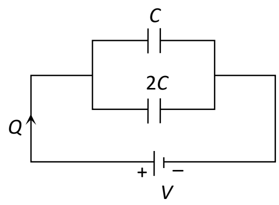
$\Rightarrow \quad C_1 < C_2 \qquad (V_1 > V_2)$.

109. Two condensers of capacity C and 2C are connected in parallel and these are charged upto V volt. If the battery is removed and dielectric medium of constant K is put between the plates of first condenser, then the potential at each condenser is

(A) $\dfrac{V}{K+2}$ (B) $2+\dfrac{K}{3V}$

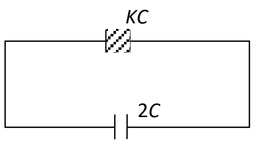
(C) $\dfrac{2V}{K+2}$ (D) $\dfrac{3V}{K+2}$

Sol. : (D) Initially



Equivalent capacitance of the system $C_{eq} = 3C$

Total charge $Q = (3C)V$



Finally

Equivalent capacitance of the system $C_{eq} = KC + 2C$

Hence common potential

$$V = \frac{Q}{(KC+2C)} = \frac{3CV}{(K+2)C} = \frac{3V}{K+2}.$$

110. Condenser A has a capacity of 15 μF when it is filled with a medium of dielectric constant 15. Another condenser B has a capacity 1 μF with air between the plates. Both are charged separately by a battery of 100V. after charging, both are connected in parallel without the battery and the dielectric material being removed. The common potential now is

(A) 400V (B) 800V

(C) 1200V (D) 1600V

Sol. : (B) Charge on capacitor A is given by

$Q_1 = 15\times10^{-6}\times100 = 15\times10^{-4}\,C$

Charge on capacitor B is given by

$Q_2 = 1\times10^{-6}\times100 = 10^{-4}\,C$

Capacity of capacitor A after removing dielectric

$= \dfrac{15\times10^{-6}}{15} = 1\mu F$

Now when both capacitors are connected in parallel their equivalent capacitance will be $C_{eq} = 1+1 = 2\mu F$

So common potential

$$= \frac{(15\times10^{-4})+(1\times10^{-4})}{2\times10^{-6}} = 800\ V.$$

111. A capacitor of $20\,\mu F$ is charged upto 500V is connected in parallel with another capacitor of $10\,\mu F$ which is charged upto 200V. The common potential is

(A) 500V (B) 400V

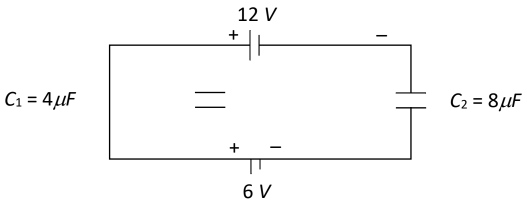
(C) 300V (D) 200V

Sol. : (B) By using $V = \dfrac{C_1V_1 + C_2V_2}{C_1V_2}$;

C_1 = 20 μF, V_1 = 500 V, C_2 = 10 μF and V_2 = 200 V

$$V = \frac{20\times500 + 10\times200}{20+10} = 400\ V.$$

112. In the circuit shown



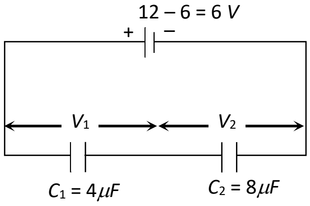
(A) The charge on C_2 is greater than that of C_1

(B) The charge on C_2 is smaller than that of C_1

(C) The potential drop across C_1 is smaller than C_2

(D) The potential drop across C_1 is greater than C_2

Sol. : (D) Given circuit can be redrawn as follows



$C_{eq} = \frac{4 \times 8}{12} = \frac{8}{3}\mu F$

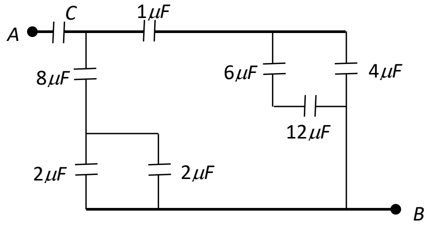
So $Q = \frac{8}{3} \times 6 = 16\,\mu C$

Hence potential difference

$V_1 = \frac{16}{4} = 4 volt$ and $V_2 = \frac{16}{8} = 2\,volt$

i.e. $V_1 > V_2$

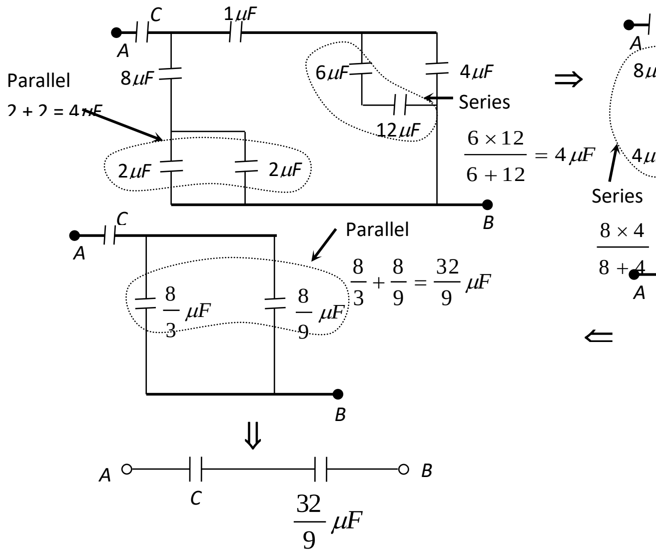
113. In the following figure the resultant capacitance between A and B is $1\mu F$. The capacitance C is



(A) $\frac{32}{11}\mu F$ (B) $\frac{11}{32}\mu F$

(C) $\frac{23}{32}\mu F$ (D) $\frac{32}{23}\mu F$

Sol. : (D) Given network can be simplified as follows



Given that equivalent capacitance between A and B i.e., $C_{AB} = 1\mu F$

But $C_{AB} = \frac{C \times \frac{32}{9}}{C + \frac{32}{9}}$ hence

$\frac{C \times \frac{32}{9}}{C + \frac{32}{9}} = 1 \Rightarrow C = \frac{32}{23}\mu F.$

114. A $1\mu F$ capacitor and a $2\mu F$ capacitor are connected in parallel across a 1200 volts line. The charged capacitors are then disconnected from the line and from each other. These two capacitors are now connected to each other in parallel with terminals of unlike signs together. The charges on the capacitors will now be

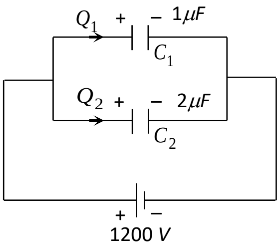
(A) $1800\ \mu C$ each

(B) $400\ \mu C$ and $800\ \mu C$

(C) $800\ \mu C$ and $400\ \mu C$

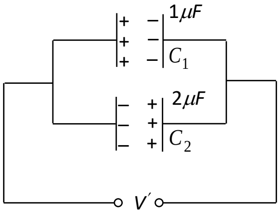
(D) $800\ \mu C$ and $800\ \mu C$

Sol. : (B) Initially charge on capacitors can be calculated as follows



$Q_1 = 1 \times 1200 = 1200\ \mu C$ and $Q_2 = 2 \times 1200 = 2400\ \mu C$

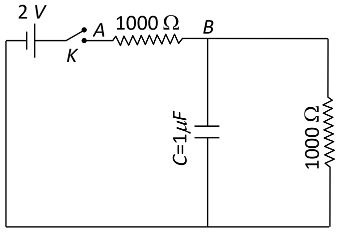
Finally when battery is disconnected and unlike plates are connected together then common potential $V' = \dfrac{Q_2 - Q_1}{C_1 + C_2} = \dfrac{2400 - 1200}{1 + 2} = 400\ V$



Hence, New charge on C_1 is $1 \times 400 = 400\ \mu C$

And New charge on C_2 is $2 \times 400 = 800\ \mu C.$

115. When the key K is pressed at time $t = 0$. Which of the following statements about the current i in the resistor AB of the adjoining circuit is true



(A) $i = 2mA$ at all t

(B) i oscillates between 1mA and 2mA

(C) i = 1mA at all t

(D) At t = 0, i = 2mA and with time it goes to 1mA

Sol. : (D) At $t = 0$ whole current passes through capacitance; so effective resistance of circuit is $1000\ \Omega$ and current $i = \dfrac{2}{1000} = 2 \times 10^{-3} A = 2mA$.

After sufficient time, steady state is reached; then there is no current in capacitor branch; so effective resistance of circuit is $1000 + 1000 = 2000\ \Omega$ and current $i = \dfrac{2}{2000} = 1 \times 10^{-3} A = 1mA$ i.e., current is $2mA$ at $t = 0$ and with time it goes to $1mA$.

116. The plates of a capacitor are charged to a potential difference of 320 volts and are then connected across a resistor. The potential difference across the capacitor decays exponentially with time. After 1 second the potential difference between the plates of the capacitor is 240 volts, then after 2 and 3 seconds the potential difference between the plates will be

(A) 200 and 180 volts

(B) 180 and 135 volts

(C) 160 and 80 volts

(D) 140 and 20 volts

Sol. : (B) During discharging potential difference across the capacitor falls exponentially as $V = V_0 e^{-\lambda t}$ ($\lambda = 1/RC$)

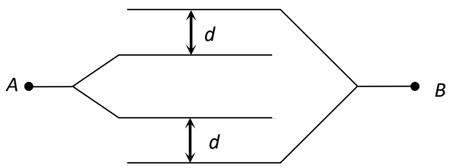
Where V = Instantaneous P.D. and V_0 = max. P.D. across capacitor

After 1 second $V_1 = 320\,(e^{-\lambda}) \Rightarrow 240 = 320\,(e^{-\lambda}) \Rightarrow e^{-\lambda} = \frac{3}{4}$

After 2 seconds $V_2 = 320\,(e^{-\lambda})^2 \Rightarrow 320 \times \left(\frac{3}{4}\right)^2 = 180\ volt$

After 3 seconds $V_3 = 320\,(e^{-\lambda})^3 = 320 \times \left(\frac{3}{4}\right)^3 = 135\ volt$

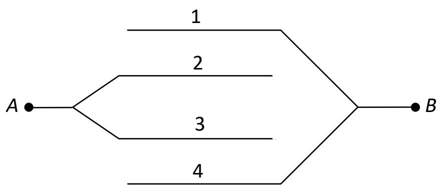
117. Four plates are arranged as shown in the diagram. If area of each plate is A and the distance between two neighbouring parallel plates is d, then the capacitance of this system between A and B will be



(A) $\frac{4\varepsilon_0 A}{d}$ (B) $\frac{3\varepsilon_0 A}{d}$

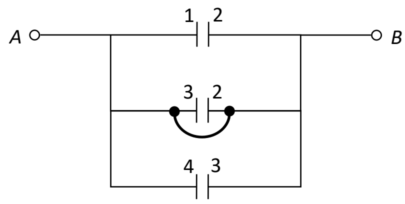
(C) $\frac{2\varepsilon_0 A}{d}$ (D) $\frac{\varepsilon_0 A}{d}$

Sol. : (C) To solve such type of problem following guidelines should be follows

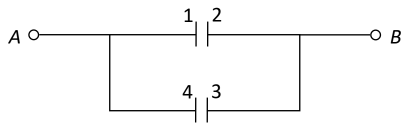


Guideline 1. Mark the number (1,2,3........) on the plates

Guideline 2. Rearrange the diagram as shown below



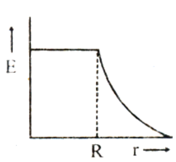
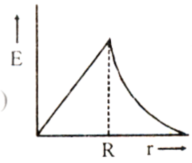
Guideline 3. Since middle capacitor having plates 2, 3 is short circuited so it should be eliminated from the circuit

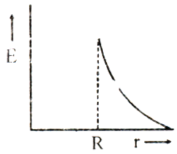
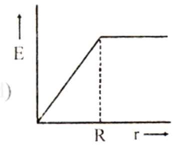


Hence equivalent capacitance between A and B $C_{AB} = 2\frac{\varepsilon_0 A}{d}$

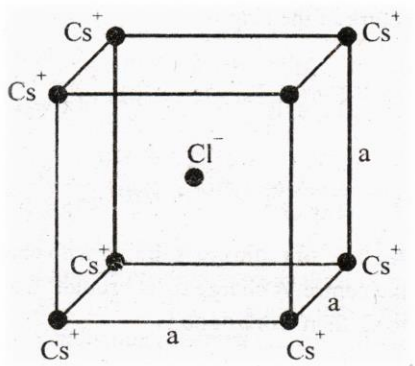
Practice sheet

1. The electric field due to a uniformly charged non-conducting sphere of radius R as a function of the distance from its centre is represented graphically by. **[2004]**

(A) 
(B) 

(C) 
(D) 

2. In the basic CsCl crystal structure, Cs^+ and Cl^- ions are arranged in a bcc configuration as shown in the figure. The net electrostatic force exerted by the eight Cs^+ ions on the Cl^- ion is. **[2004]**



(A) $\frac{1}{4\pi\varepsilon_0}\frac{4e^2}{3a^2}$ (B) $\frac{1}{4\pi\varepsilon_0}\frac{16e^2}{3a^2}$

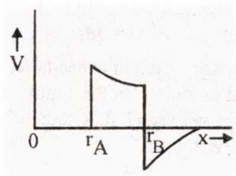
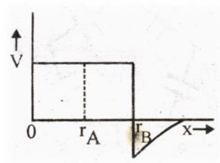
(C) $\frac{1}{4\pi\varepsilon_0}\frac{32e^2}{3a^2}$ (D) Zero

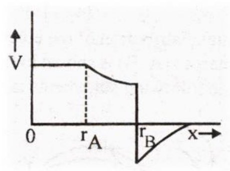
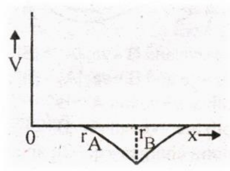
:ing plates having surface charge densities $+\sigma$ and $-\sigma$ respectively, are separated by a small distance. The medium between the plates is vacuum. If ε_0 is the dielectric permittivity of vacuum then the electric field in the region between the plates is. **[2005]**

(A) 0 volt/m (B) $\sigma/2\varepsilon_0$ volt/m

(C) σ/ε_0 volt/m (D) $2\sigma/\varepsilon_0$ volt/m

4. Two concentric conducting thin spherical shells A and B having radii r_A and r_B ($r_B > r_A$) are charged to Q_A and $-Q_B$ ($|Q_B|>|Q_A|$). The electrical field along a line. (passing through the centre) is. **[2005]**

(A) 
(B) 

(C) 
(D) 

5. A particle having charge q and mass m is projected with velocity $\vec{V} = 2\hat{i} - 3\hat{j}$ in a uniform electric field $\vec{V} = E_0.\hat{j}$. Change in momentum $|\Delta\vec{p}|$ during any time interval t is given by. **[2005]**

(A) $\sqrt{qE_0t}$ (B) qE_0t

(C) $\frac{qE_0t}{m}$ (D) Zero

6. Two parallel large thin metal sheets have equal surface charge densities.

(σ=26.4×10^{-12} c/m^2) of opposite signs. The electric field between these sheets is. **[2006]**

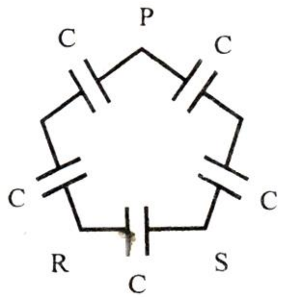
(A) 1.5 N/C

(B) 1.5×10^{-10} N/C

(C) 3 N/C

(D) 3×10^{-10} N/C

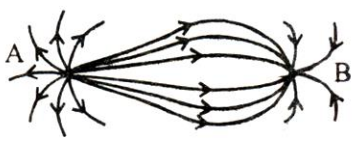
7. Five capacitors, each of capacitance value curve connected as shown in the figure. The ratio of capacitance between P & r, and the capacitance between P & Q, is. **[2006]**



(A) 3 : 1 (B) 5 : 2

(C) 2 : 3 (D) 1 : 1

8. The spatial distribution of the electric field due to two charges (A, B) is shown in figure. Which one of the following statements is correct? **[2006]**



(A) A is +ve and B –ve; |A|>|B|

(B) A is –ve and B +ve; |A|=|B|:

(C) Both are +ve but A > B

(D) Both are –ve but A > B

9. Three point charges +q, –2q and +q are placed at point (x = 0, y = a, z = 0), (x = 0, y = 0, z = 0) and (x = a, y = 0, z = 0) respectively. The magnitude and direction of the electric dipole moment vector of this charge assembly are. **[2008]**

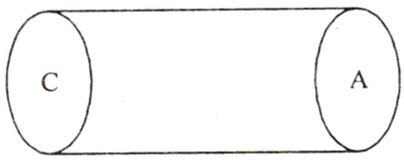
(A) $\sqrt{2}$qa along + y direction

(B) $\sqrt{2}$qa along the line joining points (x = 0, y = 0, z = 0) and (x = a, y = a, z = 0)

(C) qa along the line joining points (x = 0, y = 0, z = 0) and (x = a, y = a, z = 0)

(D) $\sqrt{2}$qa along + x direction

10. A hollow cylinder has charge q C within it. If ϕ is the electric flux in unit of voltmeter associated with the curved surface B, the flux linked with the plane surface A in unit of voltmeter will be**.** **[2008]**



(A) $\frac{1}{2}\left(\frac{q}{\varepsilon_0}-\phi\right)$ (B) $\frac{q}{2\varepsilon_0}$

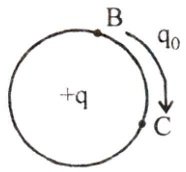
(C) $\frac{q}{\varepsilon_0}$ (D) $\frac{q}{\varepsilon_0}-\phi$

11. Charge q is uniformly distributed over a thin half ring of radius R. The electric field at the centre of the ring is. **[2008]**

(A) $\frac{q}{2\pi^2\varepsilon_0 R^2}$ (B) $\frac{q}{4\pi^2\varepsilon_0 R^2}$

(C) $-\frac{q}{4\pi\varepsilon_0 R^2}$ (D) $\frac{q}{2\pi\varepsilon_0 R^2}$

12. A circle of radius R is drawn with charge + q at the centre. A charge q_0 is brought from point B to C, then work done is. **[2009]**



(A) Positive (B) Negative

(C) Zero (D) Infinite

13. The electric field at a distance r from the centre in the space between two concentric metallic spherical shells of radii r_1 and r_2 carrying charge Q_1 and Q_2 is ($r_1 < r < r_2$) **[2009]**

(A) $\dfrac{Q_1+Q_2}{4\pi\in_0 (r_1+r_2)^2}$ (B) $\dfrac{Q_1+Q_2}{4\pi\in_0 r^2}$

(C) $\dfrac{Q_1}{4\pi\in_0 r^2}$ (D) $\dfrac{Q_2}{4\pi\in_0 r^2}$

14. A parallel plate air capacitor has a capacitance C. When it is half filled with a dielectric of dielectric constant 5, the percentage increase in the capacitance will be. **[2009]**

(A) 400% (B) 66.6%

(C) 33.3% (D) 200%

15. The potential at a point P due to an electric dipole is 1.8×10^5V. If P is at a distance of 50 cm apart from the centre O of the dipole and if CP makes an angle 60º with the positive side of the axial line of the dipole, what is the moment of the dipole? **[2010]**

(A) 10 C–m (B) 10^{-3} C–m

(C) 10^{-4} C–m (D) 10^{-5} C–m

16. A capacitor is charged by using a battery which is then disconnected. A dielectric slab is introduced between the plates which results in. **[2010]**

(A) Increase in the potential difference across the plates and reduction in stored energy but no change in the charge on the plates

(B) Decrease in the potential difference across the plates and reduction in the stored energy but no change in the charge on the plates

(C) Reduction of charge on the plates and increase of potential difference across the plates

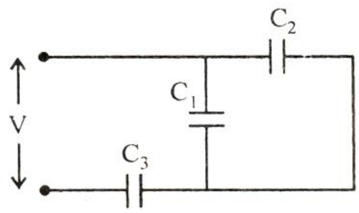
(D) Increase in stored energy but no change in potential difference across the plates

17. The maximum electric field that can be held in air without producing ionisation of air is 10^7 V/m. The maximum potential therefore, to which a conducting sphere of radius 0.10 m can be charged in air is. **[2010]**

(A) 10^9 V (B) 10^8 V

(C) 10^7 V (D) 10^6 V

18. Three capacitors C_1, C_2 and C_3 are connected as shown in the figure to a battery of V volt. If the capacitor C_3 breaks down electrically the change in total charge on the combination of capacitors is**. [2010]**



(A) $(C_1+C_2)\, V[1-C_3/(C_1+C_2+C_3)]$

(B) $(C_1+C_2)\, V[1-(C_1+C_2)/(C_1+C_2+C_3)]$

(C) $(C_1+C_2)\, V[1+C_3/(C_1+C_2+C_3)]$

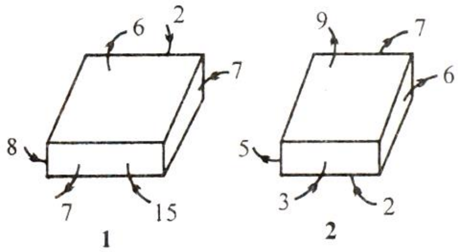
(D) $(C_1+C_2)\, V[1-C_2/(C_1+C_2+C_3)]$

19. Two charges of magnitude +q and –3q are placed 100 cm apart. The distance from +q between the charges where the electrostatic potential is zero is. **[2011]**

(A) 25 cm (B) 50 cm

(C) 75 cm (D) 80 cm

20. The figure shows two situations in which a Gaussian cube sits in an electric field. The arrows and values indicate the directions and magnitudes (in N–m^2/C) of the electric fields. What is the net charge (in the two situations) inside the cube? **[2011]**



(A) (1) negative (2) positive

(B) (1) negative (2) zero

(C) (1) positive (2) positive

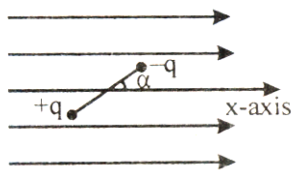
(D) (1) positive (2) zero

21. If a dipole of dipole moment $\vec{p}$ is placed in a uniform electric field $\vec{E}$, then torque acting on it is given by. **[2012]**

(A) $\vec{\tau} = \vec{p}.\vec{E}$ (B) $\vec{\tau} = \vec{p} \times \vec{E}$

(C) $\vec{\tau} = \vec{p} + \vec{E}$ (D) $\vec{\tau} = \vec{p} - \vec{E}$

22. There exists a non-uniform electric field along x-axis as shown in the figure below. The field increases at a uniform rate along +ve x-axis. A dipole is placed inside the field as shown. Which one of the following is correct for the dipole? **[2012]**



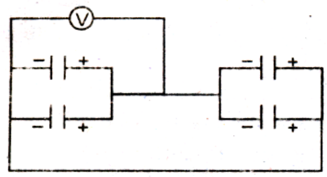
(A) Dipole moves along positive x-axis and undergoes a clockwise rotation

(B) Dipole moves along negative x-axis and undergoes a clockwise rotation

(C) Dipole moves along positive x-axis and undergoes a anticlockwise rotation

(D) Dipole moves along negative x-axis and undergoes a anticlockwise rotation

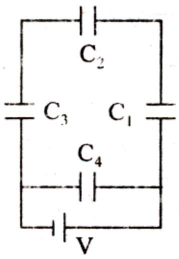
23. The four capacitors, each of 25 μF are connected as shown in figure. The de voltmeter reads 200 V. The charge on each plate of capacitor is **[2012]**



(A) $\pm 2 \times 10^{-3}$ C (B) $\pm 5 \times 10^{-3}$ C

(C) $\pm 2 \times 10^{-2}$ C (D) $\pm 5 \times 10^{-2}$ C

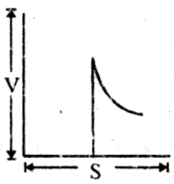
24. A network of four capacitors of capacity equal to C_1=C, C_2=2C, C_3=3C and C_4=4C are conducted to a battery as shown in the figure. The ratio of the charges on C_2 and C_4 is. **[2012]**

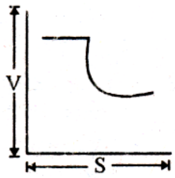


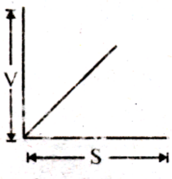
(A) 4/7 (B) 3/22

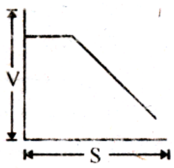
(C) 7/4 (D) 22/3

25. In a hollow spherical shell, potential (V) changes with respect to distance (s) from centre as. **[2013]**

(A) 

(B) 

(C) 

(D) 

26. Two point charges +q and –q are held fixed at (–d, 0) and (d, 0) respectively of a x-y coordinate system. Then **[2013]**

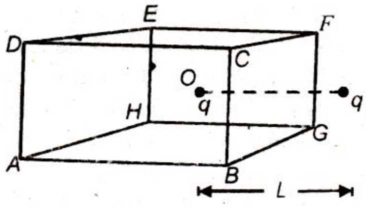
(A) The electric field E at all points on the axis has the same direction

(B) Work has to be done in bringing a test charge from $\propto$ to the orgin

(C) Electric field at all points on y-axis is along x-axis

(D) The dipole moment is 2qd along the x-axis

27. A charged particle q is placed at the centre O of cube of length L (A B C D E F G H). Another same charge q is placed at a distance L from O. Then the electric flux through ABCD is. **[2013]**



(A) $q/4\pi\in_0 L$ (B) zero

(C) $q/2\pi\in_0 L$ (D) $q/3\pi\in_0 L$

ANSWERS

ASSERTION-REASON

Read the assertion and reason carefully to mark the correct option out of the options given below:

(A) **If both assertion and reason are true and the reason is the correct explanation of the assertion.**

(B) **If both assertion and reason are true but reason is not the correct explanation of the assertion.**

(C) **If assertion is true but reason is false.**

(D) **If the assertion and reason both are false.**

(E) **If assertion is false but reason is true.**

1. **Assertion :** Dielectric breakdown occurs under the influence of an intense light beam.

Reason : Electromagnetic radiations exert pressure.

2. **Assertion :** When charges are shared between any two bodies, no charge is really lost, but some loss of energy does occur.

Reason : Some energy disappears in the form of heat, sparking etc.

3. **Assertion :** Annihilation of electron and positron is an example of decay of charges.

Reason : In the process of annihilation an electron and a positron combine to give a gamma particle.

4. **Assertion :** Surface of a symmetrical conductor can be treated as equipotential surface.

Reason : Charges can easily flow in a conductor.

5. **Assertion :** The capacity of a given conductor remains same even if charge is varied on it.

Reason : Capacitance depends upon nearly medium as well as size and shape of conductor.

6. **Assertion :** A charged capacitor is disconnected from a battery. Now if its plate are separated farther, the potential energy will fall.

Reason : Energy stored in a capacitor is equal to the work done in charging it.

7. **Assertion :** Charge is invariant.

Reason : Charge does not depends on speed of frame of reference.

8. **Assertion :** Mass of ion is slightly differed from its element.

Reason : Ion is formed, when some electrons are removed or added so mass changes.

9. **Assertion :** Charge is quantized

Reason : Charge, which is less than 1 C is not possible

10. **Assertion :** If a point charge q is placed in front of an infinite grounded conducting plane surface, the point charge will experience a force.

Reason : This force is due to the induced charge on the conducting surface which is at zero potential.

11. **Assertion :** The surface charge densities of two spherical conductors of different radii are equal. Then the electric field intensities near their surface are also equal.

Reason : Surface charge density is equal to charge per unit area.

12. **Assertion :** Three equal charges are situated on a circle of radius r such that they form on equilateral triangle, then the electric field intensity at the centre is zero.

Reason : The force on unit positive charge at the centre, due to the three equal charges are represented by the three sides of a triangle taken in the same order. Therefore, electric field intensity at centre is zero.

13. **Assertion :** On going away from a point charge or a small electric dipole, electric field decreases at the same rate in both the cases.

Reason : Electric field is inversely proportional to square of distance from the charge or an electric dipole.

14. **Assertion :** The whole charge of a conductor cannot be transferred to another isolated conductor.

Reason : The total transfer of charge from one to another is not possible.

15. **Assertion :** Conductors having equal positive charge and volume, must also have same potential.

Reason : Potential depends only on charge and volume of conductor.

16. **Assertion :** At a point in space, the electric field points towards north. In the region, surrounding this point the rate of change of potential will be zero along the east and west.

Reason : Electric field due to a charge is the space around the charge.

17. **Assertion :** A point charge is brought in an electric field. The field at a nearby point will increase, whatever be the nature of the charge.

Reason : The electric field is independent of the nature of charge.

18. **Assertion :** The force with which one plate of a parallel plate capacitor is attracted towards the other plate is equal to square of surface density per ε per unit area.

Reason : The electric field due to one charged plate of the capacitor at the location of the other is equal to surface density per ε.

19. **Assertion :** The lightening conductor at the top of high building has sharp pointed ends.

Reason : The surface density of charge at sharp points is very high resulting in setting up of electric wind.

20. **Assertion :** Circuit containing capacitors should be handled cautiously even when there is no current.

Reason : The capacitors are very delicate and so quickly break down.

21. **Assertion :** The tyres of aircraft's are slightly conducting.

Reason : If a conductor is connected to ground, the extra charge induced on conductor will flow to ground.

22. **Assertion :** A bird perches on a high power line and nothing happens to the bird.

Reason : The level of bird is very high from the ground.

ANSWERS

HOLIDAY HOMEWORK SCIENCE

1 . Identify simple problems we are facing in our daily routine or in our surrounding and provide innovative solution for it. you may take help from your parents and other elders .

2. Make or design your own toy with help of card bord or waste material (For help visit Arvind Gupta Toys from Trash on YouTube)

3. Maintain a daily log book of your screen time (use of mobile or Watching TV) and write down purpose .

4. Write down an article on advantages and disadvantages of Mobile Phones in our daily life .

5. plant a tree in flowerpot and write down your daily observations about plant growth

VECTOR

1. A truck travelling due north at 20 *m/s* turns west and travels at the same speed. The change in its velocity be

[UPSEAT 1999]

(a) 40 *m/s N–W* (b) $20\sqrt{2}$ *m/s N–W*

(c) 40 *m/s S–W* (d) $20\sqrt{2}$ *m/s S–W*

2. If the sum of two unit vectors is a unit vector, then magnitude of difference is **[CPMT 1995; CBSE PMT 1989]**

(a) $\sqrt{2}$ (b) $\sqrt{3}$

(c) $1/\sqrt{2}$ (d) $\sqrt{5}$

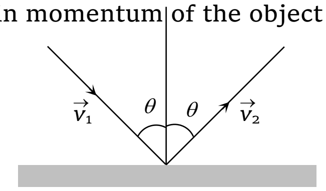
3. An object of *m kg* with speed of *v m/s* strikes a wall at an angle θ and rebounds at the same speed and same angle. The magnitude of the change in momentum of the object will be

(a) $2m\,v\cos\theta$

(b) $2\,m\,v\sin\theta$

(c) 0

(d) $2\,m\,v$



4. Two forces, each of magnitude *F* have a resultant of the same magnitude *F*. The angle between the two forces is

[CBSE PMT 1990]

(a) 45° (b) 120°

(c) 150° (d) 60°

5. For the resultant of the two vectors to be maximum, what must be the angle between them

(a) 0° (b) 60°

(c) 90° (d) 180°

6. A particle is simultaneously acted by two forces equal to 4 *N* and 3 *N*. The net force on the particle is **[CPMT 1979]**

(a) 7 *N* (b) 5 *N*

(c) 1 *N* (d) Between 1 *N* and 7 *N*

7. Two vectors $\vec{A}$ and $\vec{B}$ lie in a plane, another vector $\vec{C}$ lies outside this plane, then the resultant of these three vectors *i.e.,* $\vec{A}+\vec{B}+\vec{C}$ **[CPMT 1983]**

(a) Can be zero

(b) Cannot be zero

(c) Lies in the plane containing $\vec{A}+\vec{B}$

(d) Lies in the plane containing $\vec{C}$

8. If the resultant of the two forces has a magnitude smaller than the magnitude of larger force, the two forces must be

(a) Different both in magnitude and direction

(b) Mutually perpendicular to one another

(c) Possess extremely small magnitude

(d) Point in opposite directions

9. If $|\vec{A}-\vec{B}|=|\vec{A}|=|\vec{B}|,$ the angle between $\vec{A}$ and $\vec{B}$ is

(a) 60° (b) 0°

(c) 120° (d) 90°

10. Let the angle between two nonzero vectors $\vec{A}$ and $\vec{B}$ be 120° and resultant be $\vec{C}$

(a) $\vec{C}$ must be equal to $|\vec{A}-\vec{B}|$

(b) $\vec{C}$ must be less than $|\vec{A}-\vec{B}|$

(c) $\vec{C}$ must be greater than $|\vec{A}-\vec{B}|$

(d) $\vec{C}$ may be equal to $|\vec{A}-\vec{B}|$

11. The magnitude of vector $\vec{A}, \vec{B}$ and $\vec{C}$ are respectively 12, 5 and 13 units and $\vec{A}+\vec{B}=\vec{C}$ then the angle between $\vec{A}$ and $\vec{B}$ is **[CPMT 1997]**

(a) 0 (b) π

(c) $\pi/2$ (d) $\pi/4$

12. A particle has displacement of 12 *m* towards east and 5 *m* towards north then 6 *m* vertically upward. The sum of these displacements is **[AIIMS 1998]**

(a) 12 (b) 10.04 *m*

(c) 14.31 *m* (d) None of these

13. The three vectors $\vec{A}=3\hat{i}-2\hat{j}+\hat{k}$, $\vec{B}=\hat{i}-3\hat{j}+5\hat{k}$ and $\vec{C}=2\hat{i}+\hat{j}-4\hat{k}$ form

(a) An equilateral triangle (b) Isosceles triangle

(c) A right angled triangle (d) No triangle

14. Following sets of three forces act on a body. Whose resultant cannot be zero **[CPMT 1985]**

(a) 10, 10, 10 (b) 10, 10, 20

(c) 10, 20, 23 (d) 10, 20, 40

15. When three forces of 50 *N*, 30 *N* and 15 *N* act on a body, then the body is

(a) At rest

(b) Moving with a uniform velocity

(c) In equilibrium

(d) Moving with an acceleration

16. The sum of two forces acting at a point is 16 *N*. If the resultant force is 8 *N* and its direction is perpendicular to minimum force then the forces are **[CPMT 1997]**

(a) 6 *N* and 10 *N* (b) 8 *N* and 8 *N*

(c) 4 *N* and 12 *N* (d) 2 *N* and 14 *N*

17. The resultant of two vectors *A* and *B* is perpendicular to the vector *A* and its magnitude is equal to half the magnitude of vector *B*. The angle between *A* and *B* is

(a) 120° (b) 150°

(c) 135° (d) None of these

18. What is the angle between $\vec{P}$ and the resultant of $(\vec{P}+\vec{Q})$ and $(\vec{P}-\vec{Q})$

(a) Zero (b) $\tan^{-1}(P/Q)$

(c) $\tan^{-1}(Q/P)$ (d) $\tan^{-1}(P-Q)/(P+Q)$

19. The resultant of $\vec{P}$ and $\vec{Q}$ is perpendicular to $\vec{P}$. What is the angle between $\vec{P}$ and $\vec{Q}$

(a) $\cos^{-1}(P/Q)$ (b) $\cos^{-1}(-P/Q)$

(c) $\sin^{-1}(P/Q)$ (d) $\sin^{-1}(-P/Q)$

20. Maximum and minimum magnitudes of the resultant of two vectors of magnitudes *P* and *Q* are in the ratio $3:1$. Which of the following relations is true

(a) $P=2Q$ (b) $P=Q$

(c) $PQ=1$ (d) None of these

21. Two forces, F_1 and F_2 are acting on a body. One force is double that of the other force and the resultant is equal to the greater force. Then the angle between the two forces is

(a) $\cos^{-1}(1/2)$ (b) $\cos^{-1}(-1/2)$

(c) $\cos^{-1}(-1/4)$ (d) $\cos^{-1}(1/4)$

22. A plane is revolving around the earth with a speed of 100 *km/hr* at a constant height from the surface of earth. The change in the velocity as it travels half circle is

[RPET 1998; KCET 2000]

(a) 200 *km/hr* (b) 150 *km/hr*

(c) $100\sqrt{2}\, km/hr$ (d) 0

23. What displacement must be added to the displacement $25\hat{i}-6\hat{j}\ m$ to give a displacement of 7.0 *m* pointing in the *x*- direction

(a) $18\hat{i}-6\hat{j}$ (b) $32\hat{i}-13\hat{j}$

(c) $-18\hat{i}+6\hat{j}$ (d) $-25\hat{i}+13\hat{j}$

24. While travelling from one station to another, a car travels 75 *km* North, 60 *km* North-east and 20 *km* East. The minimum distance between the two stations is **[AFMC 1993]**

(a) 72 *km* (b) 112 *km*

(c) 132 *km* (d) 155 *km*

25. Two forces $\vec{F}_1 = 5\hat{i}+10\hat{j}-20\hat{k}$ and $\vec{F}_2 = 10\hat{i}-5\hat{j}-15\hat{k}$ act on a single point. The angle between $\vec{F}_1$ and $\vec{F}_2$ is nearly

[AMU 1995]

(a) 30° (b) 45°

(c) 60° (d) 90°

26. Two forces 3*N* and 2 *N* are at an angle θ such that the resultant is *R*. The first force is now increased to 6*N* and the resultant become 2*R*. The value of θ is **[HP PMT 2000]**

(a) 30° (b) 60°

(c) 90° (d) 120°

27. If $|\vec{A}+\vec{B}| = |\vec{A}| + |\vec{B}|$, then angle between $\vec{A}$ and $\vec{B}$ will be

[CBSE PMT 2001]

(a) 90° (b) 120°

(c) 0° (d) 60°

28. The maximum and minimum magnitude of the resultant of two given vectors are 17 *units* and 7 *unit* respectively. If these two vectors are at right angles to each other, the magnitude of their resultant is **[Kerala CET (Engg.) 2000]**

(a) 14 (b) 16

(c) 18 (d) 13

29. The vector sum of two forces is perpendicular to their vector differences. In that case, the forces **[CBSE PMT 2003]**

(a) Are equal to each other in magnitude

(b) Are not equal to each other in magnitude

(c) Cannot be predicted

(d) Are equal to each other

30. *y* component of velocity is 20 and *x* component of velocity is 10. The direction of motion of the body with the horizontal at this instant is **[Manipal 2003]**

(a) $\tan^{-1}(2)$ (b) $\tan^{-1}(1/2)$

(c) 45° (d) 0°

31. Two vectors $\vec{A}$ and $\vec{B}$ are such that $\vec{A}+\vec{B}=\vec{A}-\vec{B}$. Then

[AMU (Med.) 2000]

(a) $\vec{A}.\vec{B}=0$ (b) $\vec{A}\times\vec{B}=0$

(c) $\vec{A}=0$ (d) $\vec{B}=0$