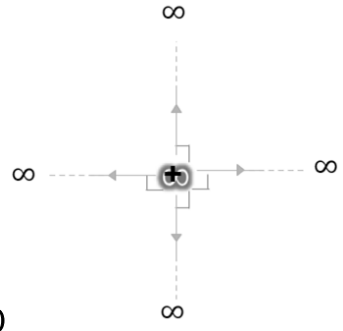
Q.1 Electric field lines of force is near an isolated charged particle.

(A) denser **(B)** rarer

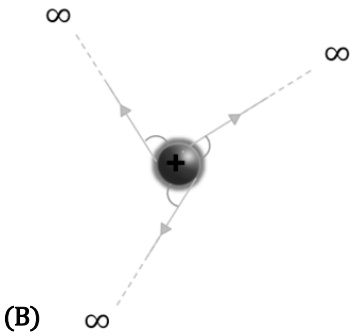
(C) denser for positive charge **(D)** rarer for negative charge

Q.2 Which of the following electric field lines configuration is correct for an isolated positive point charge?

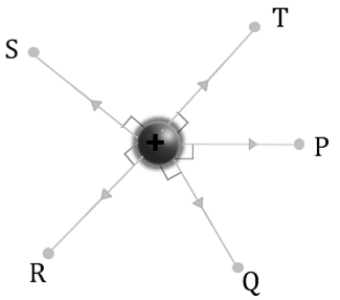
(Angles shown in the options are between the electric field lines and the tangent at the point of contact.)



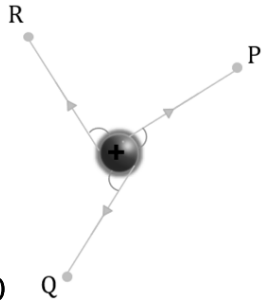
(A)



(B)

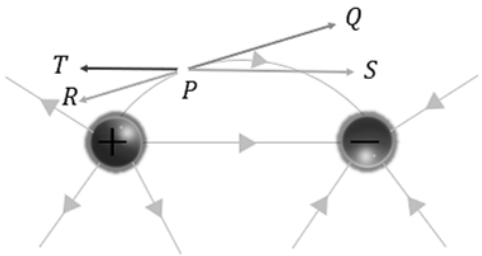


(C)



(D)

Q.3 If a negative charge is kept at point *P* in the electric field of two charges, then it will initially accelerate along

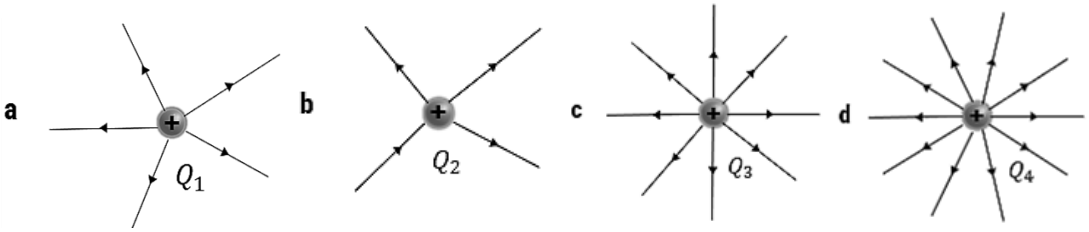


(A) PS **(B)** PT **(C)** PR **(D)** PQ

Q.4 Consider the situation shown in figure. If the lines are drawn in proportion to the charge, what is the ratio $\frac{|q_1|}{|q_2|}$?

(A) 1: 2 **(B)** 2: 1 **(C)** 3: 1 **(D)** 1: 3

Q.5 For the given electric field lines configurations, which of the following charge has greater magnitude?

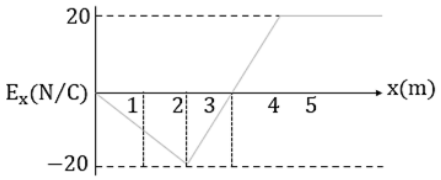


(A) Q_1 **(B)** Q_2 **(C)** Q_3 **(D)** Q_4

Q.6 A clock face has charges $-q,\ -2q,\ -3q, \ldots -12q$ fixed at the position of the corresponding numbers on the dial. The clock hands do not disturb the net field due to the point charges. Then, at what time does the hour hand point in the direction of the electric field at the centre of the dial?

(A) 8: 30 **(B)** 9: 30 **(C)** 10: 30 **(D)** 11: 30

Q.7 A graph of the x −component of the electric field as a function of x in a region of space is shown. The y and z components of the electric field are zero in this region. If the electric potential is 10 V at the origin, then potential at $x = 2$ m is

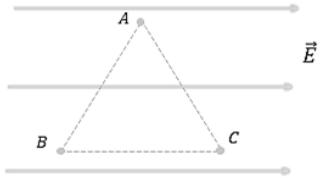


(A) 10 V **(B)** 40 V **(C)** − 10 V **(D)** 30 V

Q.8 Calculate the potential difference between points A and B in an electric field $\vec{E} = (2\hat{i} + 3\hat{j} + 4\hat{k})\ \text{NC}^{-1}$, where the position vectors of points A and B are $\vec{r}_A = (\hat{i} - 2\hat{j} + \hat{k})$ m and $\vec{r}_B = (2\hat{i} + \hat{j} - 2\hat{k})$ m respectively.

(A) −4V **(B)** −3V **(C)** −2V **(D)** −1V

Q.9 ABC is an equilateral triangle of side 2 m. If electric field $E = 10\ \text{NC}^{-1}$ then the potential difference $V_A - V_B$ is

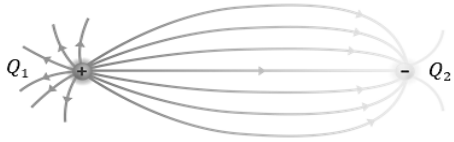


(A) 10 V **(B)** −10 V **(C)** 20 V **(D)** −20 V

Q.10 Determine the electric field strength vector if the potential of this field depends on x, y coordinates as $V = 10axy$.

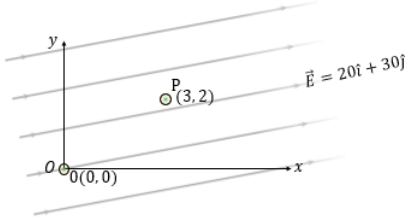
(A) $10a(y\hat{i} + x\hat{j})$ **(B)** $-10a(y\hat{i} + x\hat{j})$ **(C)** $-a(y\hat{i} + x\hat{j})$ **(D)** $-10a(x\hat{j} + y\hat{k})$

Q.11 A few electric field lines for a system of two charges Q_1 and Q_2 fixed at two different points on the $x-$ axis is shown in the figure. These lines suggest that



(A) $|Q_1| > |Q_2|$ **(B)** $|Q_1| < |Q_2|$ **(C)** $|Q_1| = |Q_2|$ **(D)** $|Q_1| \leq |Q_2|$

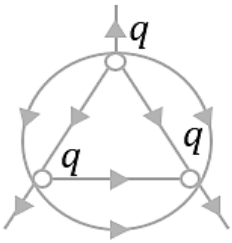
Q.12 The electric field $\vec{E} = 20\hat{i} + 30\hat{j}\ \text{NC}^{-1}$ exists in space. If the potential at origin is taken to be zero, find the potential at $P(3,2)$ m.

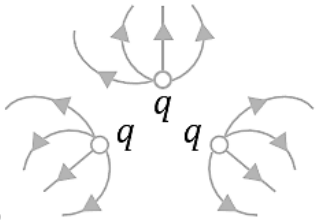


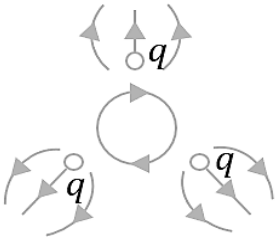
(A) 120 V **(B)** − 120 V **(C)** 150 V **(D)** − 150 V

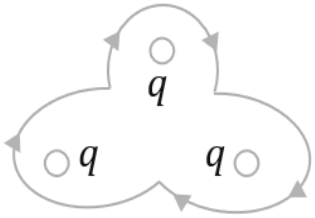
WORK SHEET

Q.1 Three positive charges of equal magnitude q are placed at the vertices of an equilateral triangle. The resulting lines of force should be sketched as

(A)


(B)


(C)


(D)


Q.2 A particle of mass $\frac{10}{7}$ kg is moving along the positive x direction. Its initial position is $x = 0$ and initial velocity is 1 m/s. The graph representing the power delivered by force vs distance travelled for the straight-line motion of the particle is given below.

The velocity of a particle $at\ x = 10$ m is:

(A) $3\sqrt{2}$ m/s **(B)** 2 m/s **(C)** 4 m/s **(D)** $\frac{100}{3}$ m/s

Q.3 A particle is projected from the ground with an initial speed u at an angle θ with horizontal. The average velocity of the particle between its point of projection and the highest point of its trajectory is

(A) $\frac{u}{2}\sqrt{1+\cos^2\theta}$ **(B)** $\frac{u}{2}\sqrt{1+2\cos^2\theta}$ **(C)** $\frac{u}{2}\sqrt{1+3\cos^2\theta}$ **(D)** $\frac{u}{2}\sqrt{1+4\cos^2\theta}$

Q.4 A sphere of radius 0.1 m and mass 8π kg is attached to the lower end of a steel wire of length 5.0 m and diameter 10^{-3} m. The wire is suspended from 5.22 m high ceiling of a room. When the sphere is made to swing as a simple pendulum, it just grazes the floor at its lowest point. Calculate the velocity of the sphere at the lowest position. Young's modulus of steel is 1.994×10^{11} N/m^2.

(A) 2.2 m/s **(B)** 4.4 m/s **(C)** 8.8 m/s **(D)** 12.2 m/s

Q.5 A layer of ice 0.15 m thick has formed on the surface of a deep pond. If the temperature of the upper surface of ice is constant and equal to that of the air which is -12° C, the time taken to increase the thickness of the ice layer by 0.2 mm is?

[Given: latent heat of ice $= 80$ cal/g density of ice $= 0.91\,\frac{\text{g}}{\text{cm}^3}$ thermal conductivity of ice $= 0.5\,\frac{\text{cal}}{\text{s m K}}$]

(A) 182.68 s **(B)** 364.24 s **(C)** 546.35 s **(D)** 300.55 s

Q.6 A sinusoidal wave travels along a taut string of linear mass density 0.1 g/cm. The particles oscillate along the $y-$ direction and the wave moves in the positive $x-$direction. The amplitude and frequency of oscillation are 2 mm and 50 Hz respectively. The minimum distance between two particles oscillating in the same phase is 4 m. The tension in the string is

(A) 4000 N **(B)** 400 N **(C)** 45 N **(D)** 250 N

Q.7 An ice cube of mass M_0 is given a velocity v_0 on a rough horizontal surface with a coefficient of friction μ. The block is at its melting point and latent heat of fusion of ice is L. The block receives heat only due to the friction forces and all work is converted into heat. Find the mass (M_t) of the remaining ice block after time t.

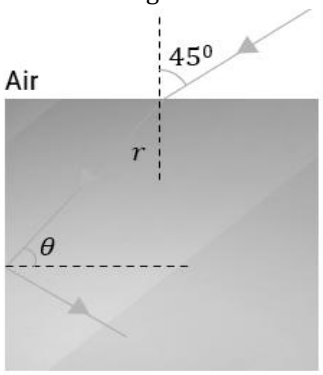
(A) $M_t = M_0 e^{-\frac{2\mu g}{L}\left(v_0 t+\frac{1}{2}\mu g t^2\right)}$ **(B)** $M_t = M_0 e^{-\frac{\mu g}{L}\left(v_0 t-\frac{1}{2}\mu g t^2\right)}$

(C) $M_t = M_0 e^{-\frac{3\mu}{L}\left(v_0 t - \frac{1}{2}\mu g t^2\right)}$ **(D)** $M_t = M_0 e^{-\frac{2\mu g}{L}\left(v_0 t - \mu g t^2\right)}$

Q.8 One surface of a biconvex lens having focal length 40 cm is silvered. The radius of the curvature of the other surface is 60 cm. At what distance from the silvered lens should an object be placed to obtain a real image magnified three times? ($\mu_g = 1.5$)

(A) 10 cm **(B)** 11.4 cm **(C)** 12 cm **(D)** 12.4 cm

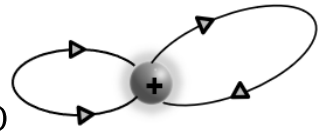
Q.9 For the given incident ray as shown in the figure, the condition for total internal reflection will be satisfied if the refractive index of the block is greater than



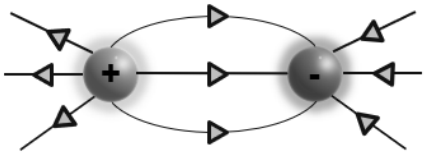
(A) $\frac{\sqrt{3}+1}{2}$ **(B)** $\sqrt{\frac{5}{2}}$ **(C)** $\sqrt{\frac{3}{2}}$ **(D)** $\sqrt{\frac{7}{2}}$

Q.10 Which of the following electric field lines configuration is correct?

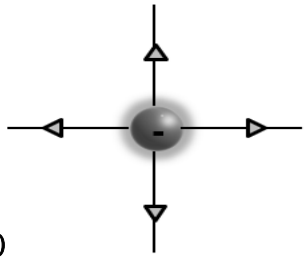
(A)



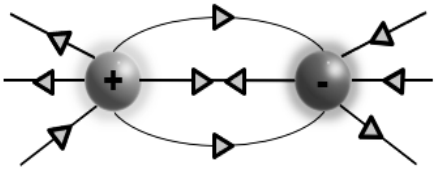
(B)



(C)



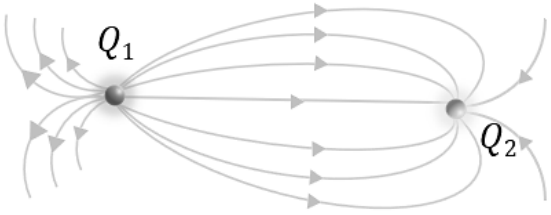
(D)



Q.11 In a car race on straight road, car A takes time t less than car B at the finish and passes finishing point with a speed v more than that of car B. Both cars start from rest and travel with constant acceleration α and β respectively. Then v is equal

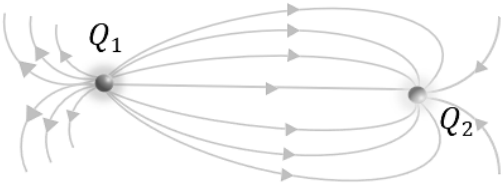
(A) $(\sqrt{2\alpha\beta})t$ **(B)** $(\sqrt{\alpha\beta})t$ **(C)** $\left(\frac{\alpha+\beta}{2}\right)t$ **(D)** $\left(\frac{2\alpha+\beta}{\alpha+\beta}\right)t$

Q.12 The electric field lines for a system of two charges Q_1 and Q_2 fixed at two different points on the $x-$axis are as shown in the figure. Then $\frac{Q_1}{Q_2}$ might be



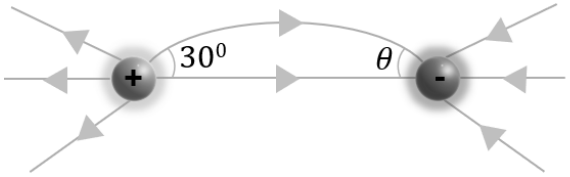
(A) 13/9 **(B)** 9/13
(C) 1 **(D)** impossible to determine

Q.13 A few electric field lines for a system of two charges Q_1 and Q_2 fixed at two different points on the $x-$axis are shown in the figure. These lines suggest that



(A) $|Q_1| > |Q_2|$ **(B)** $|Q_1| < |Q_2|$ **(C)** $|Q_1| = |Q_2|$ **(D)** $|Q_1| \leq |Q_2|$

Q.14 For the given electric field lines configuration of two charges, the value of the angle θ is



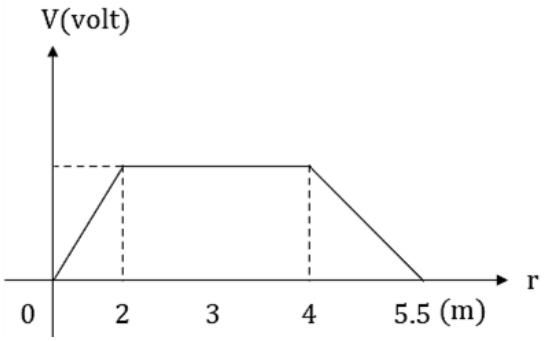
(A) 15° **(B)** 30° **(C)** 45° **(D)** 60°

Q.15 The potential at a point x (measured in μm) due to some charges situated on the $x-axis$ is given by $V(x) = \frac{20}{(x^2-4)}$, then electric field intensity at x = 4 μm is given by

(A) $\frac{5}{3}$ V/μm and in the negative $x-$ direction. **(B)** $\frac{5}{3}$ V/μm and in the positive $x-$ direction
(C) $\frac{10}{9}$ V/μm and in the negative $x-$ direction **(D)** $\frac{10}{9}$ V/μm and in the positive $x-$ direction

Q.16 The electric potential (V) in volts varies with x (in meters) according to the relation $V = 5 + 4x^2$. The force experienced by a negative charge of 2 μC located at x = 0.5 m is
(A) 6×10^{-6} N **(B)** 4×10^{-6} N **(C)** 2×10^{-6} N **(D)** 8×10^{-6} N

Q.17 The variation of electric potential (V) with distance (r) from a fixed point is as shown in the figure. Electric field intensity (in V/m) at r = 1 m, 3 m and 4.5 m are respectively



(A) $-2,\ 1,\ \frac{8}{3}$ **(B)** $-2,\ 0,\ \frac{8}{3}$ **(C)** $2,\ 0,\ -\frac{8}{3}$ **(D)** $+8,\ -1,\ -\frac{4}{3}$

Q.18 Electric potential is given by $V = 6x - 8xy^2 - 8y + 6yz - 4z^2$ then electric force acting on 2 C charge placed at origin will be
(A) 10 N **(B)** 20 N **(C)** 8 N **(D)** 6 N

Q.19 Electric potential in a region is varying according to the relation $V = \frac{3x^2}{2} - \frac{y^2}{4}$, where x and y are in meter and V is in volt. Electric field intensity in N/C at a point (1 m, 2 m) is

(A) $3\hat{i} - \hat{j}$ **(B)** $-3\hat{i} + \hat{j}$ **(C)** $6\hat{i} - 2\hat{j}$ **(D)** $-6\hat{i} + 2\hat{j}$

Q.20 Two waves travelling in opposite directions produce a standing wave. The individual wave functions are given by $y_1 = 4\sin(3x - 2t)$ cmand $y_2 = 4\sin(3x + 2t)$ cm, where x and y are in cm then:

(A) The maximum displacement of the motion at $x = 2.3$ cmis 4.6 cm

(B) The maximum displacement of the motion at $x = 2.3$ cm is 5.32 cm

(C) Nodes are formed at x values given by $0, \frac{\pi}{3}, \frac{2\pi}{3}, \pi, \frac{4\pi}{3}$, ...

(D) Antinodes are formed at x values given by $0, \frac{\pi}{6}, \frac{\pi}{2}, \frac{5\pi}{6}, \frac{7\pi}{6}$ ...

ANSWER KEY

Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(A)	(A)	(C)	(D)	(D)	(B)	(D)	(D)	(B)	(B)
Q.	11	12								
Sol.	(A)	(B)								
WORK SHEET										
Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(C)	(C)	(C)	(C)	(B)	(B)	(B)	(B)	(C)	(C)
Q.	11	12	13	14	15	16	17	18	19	20
Sol.	(B)	(A)	(A)	(B)	(D)	(D)	(B)	(B)	(B)	(A), (C), (D)