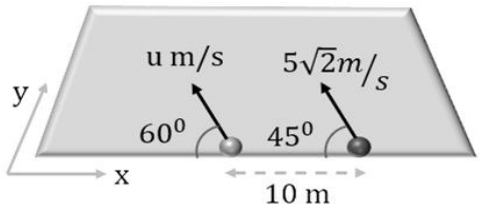
WORK SHEET

Q.1 In the figure shown, the two particles are constrained to roll on a flat horizontal surface. They are fired simultaneously. What should be the initial speed of particle *A* such that the two particles collide?

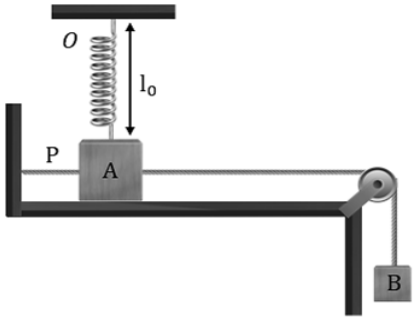


(A) $\frac{10}{\sqrt{3}}$ m/s **(B)** $\frac{20}{\sqrt{3}}$ m/s **(C)** $\frac{30}{\sqrt{3}}$ m/s **(D)** $\frac{40}{\sqrt{3}}$ m/s

Q.2 The figure below shows a uniform rod of length 30 cm having a mass of 3.0 kg. The strings as shown in the figure are pulled by constant forces of 20 N and 32 N. Find the force exerted by the 20 cm part of the rod on the 10 cm part. All the surfaces are smooth, and the strings are light.

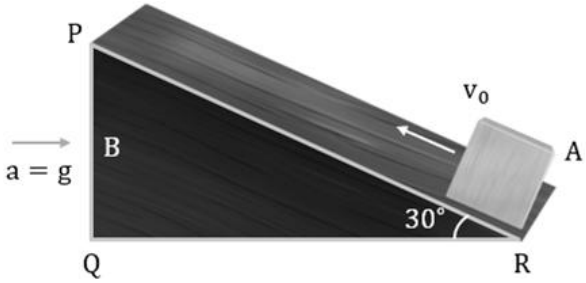
(A) 36 N **(B)** 12 N **(C)** 64 N **(D)** 24 N

Q.3 A small bar A resting on a smooth horizontal plane is attached by threads to a point P and by means of a weightless pulley, to a weight B possessing the same mass as the bar itself. The bar is also attached to a point O by means of a light non-deformed spring of length $l_0 = 50$ cm and stiffness $k = \frac{5mg}{l_0}$, where m is the mass of the bar. The thread PA having been burned, the bar starts moving to the right. Find its velocity at the moment when it breaks off the plane.



(A) $v = \sqrt{\frac{19gl_0}{64}}$ **(B)** $v = \sqrt{\frac{5}{32}gl_0}$ **(C)** $v = \sqrt{\frac{19gl_0}{32}}$ **(D)** $v = \sqrt{\frac{3gl_0}{4}}$

Q.4 Block *A* is placed on a rough wedge *B* which is placed on a smooth surface. The wedge has an angle of inclination of 30° and is imparted with a horizontal acceleration *g* towards right. Block *A* is given an initial velocity v_0 from rest. Find the coefficient of friction for which block *A* moves with constant velocity v_0 with respect to wedge ($g = 10$ m/s^2)



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

Q.5 Efficiency of a cyclic process is 50% and heat interactions are $Q_1 = +1915$ J, $Q_2 = -40$ J, $Q_3 = +125$ J and $Q_4 = -Q$ J. Find the value of Q.

(A) 1080 J **(B)** 1980 J **(C)** –1080 J **(D)** 980 J

Q.6 An ideal gas enclosed in a vertical cylindrical container supports a freely moving piston of mass M. The piston and cylinder have equal cross-sectional area A. When the piston is in equilibrium, the volume of the gas is V_0 and its pressure is P_0. The piston is slightly displaced from the equilibrium position and released. Assuming that the system is completely isolated from its surrounding, the piston executes a simple harmonic motion with frequency

(A) $\frac{1}{2\pi}\frac{V_0 M}{A^2\gamma}\left(P_0+\frac{Mg}{A}\right)$ **(B)** $\frac{1}{2\pi}\sqrt{\frac{A^2\gamma}{MV_0}\left(P_0+\frac{Mg}{A}\right)}$

(C) $\frac{1}{2\pi}\sqrt{\frac{MV_0}{A\gamma\left(P_0+\frac{Mg}{A}\right)}}$ **(D)** $\frac{1}{2\pi}\frac{A\gamma}{V_0 M}\left(P_0+\frac{Mg}{A}\right)$

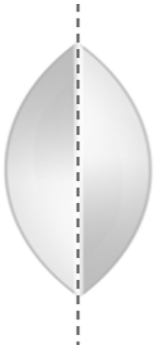
Q.7 A student is performing the experiment on the resonance column. The diameter of the column tube is 4 cm. The frequency of the tuning fork is 512 Hz. The air temperature is 38 °C in which the speed of sound is 336 m/s. The zero of the meter scale coincides with the top end of the resonance column tube. When the first resonance occurs, the reading of the water level in the column is

(A) 14.0 cm **(B)** 16.4 cm **(C)** 15.2 cm **(D)** 17.6 cm

Q.8 A biconvex thin lens is prepared from a glass of refractive index $\frac{3}{2}$. The two bounding surfaces have equal radii of 25 cm each. One of the surfaces is silvered from outside to make it reflecting. Where should an object be placed before this lens so that the image coincides with the object?

(A) 25 cm **(B)** 6.25 cm **(C)** 12.5 cm **(D)** 11.25 cm

Q.9 An equi-convex lens of focal length $'f'$ is cut into two parts along its principal axis, then

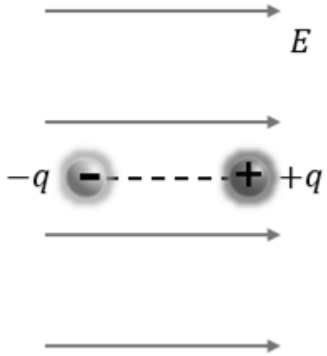


(A) Refractive index of the lens changes
(B) The radius of curvature of the lens changes
(C) The intensity of the image formed by each part will be reduced to half
(D) The intensity of the image formed by each part will become twice

Q.10 A gun of mass m_1 fires a bullet of mass m_2 with a horizontal speed v_0. The gun is fitted with a concave mirror of focal length f facing towards a receding bullet. Find the speed of separation of the bullet and the image just after the gun was fired.

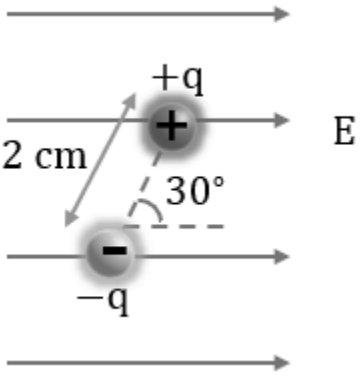
(A) $2\left(1+\frac{m_1}{m_2}\right)v_o$ **(B)** $2(1+m_1m_2)v_o$ **(C)** $2\left(1+\frac{m_2}{m_1}\right)v_o$ **(D)** $2\left(\frac{m_2}{m_1}\right)v_o$

Q.11 An electric dipole has the magnitude of its charge as q and its dipole moment is p. It is placed in a uniform electric field E. If its dipole moment is along the direction of the field, the net force acting on it and its potential energy are respectively



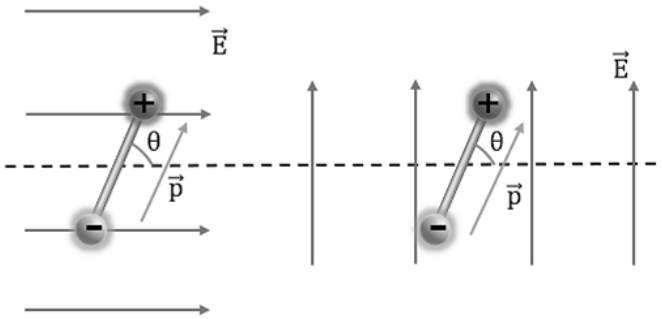
(A) 2qE and minimum **(B)** qE and Pe **(C)** Zero and minimum **(D)** qE and maximum

Q.12 An electric dipole of length 2 cm is placed with its axis making an angle of 30° to a uniform electric field having intensity 10^5 N/C. If it experiences a torque of $10\sqrt{3}$ N − m, then the potential energy of the dipole is



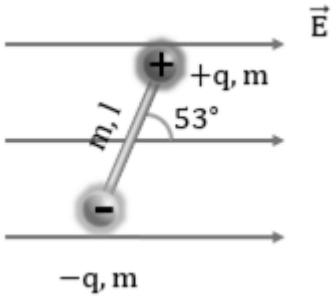
(A) −10 J **(B)** −20 J **(C)** −30 J **(D)** −40 J

Q.13 An electric dipole has a fixed dipole moment $\vec{p}$, which makes an angle θ with respect to x − axis. When system is subjected to an electric field $\overrightarrow{E_1} = \sqrt{3}E\,\hat{i}$, it experiences a torque $\overrightarrow{\tau_1} = -\tau\,\hat{k}$. When subjected to another electric field $\overrightarrow{E_2} = E\,\hat{j}$, it experiences a torque $\overrightarrow{\tau_2} = -\overrightarrow{\tau_1}$. The angle θ is



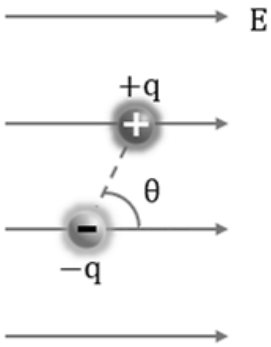
(A) 60° **(B)** 30° **(C)** 90° **(D)** 45°

Q.14 Find the work required to rotate the system of charges (+q, −q) connected by rod of mass m and length l by an angle of 180°.



(A) $\frac{4}{5}\ qlE$ **(B)** $\frac{7}{5}\ qlE$ **(C)** $\frac{6}{5}\ qlE$ **(D)** $\frac{3}{10}\ q$lE

Q.15 What should be the orientation of an electric dipole in a uniform electric field that corresponds to stable equilibrium?



(A) θ = 90° **(B)** θ = 180° **(C)** θ = 30° **(D)** θ = 0°

Q.16 A positive point charge q is fixed at origin. A short dipole with a dipole moment p is placed along the x −axis far away from the origin with p pointing along the +x −axis. The kinetic energy of the dipole when it reaches distance d from origin is

(A) $\frac{3qp}{8\pi\epsilon_0 d^2}$ **(B)** $\frac{qp}{4\pi\epsilon_0 d^2}$ **(C)** $\frac{2qp}{4\pi\epsilon_0 d^2}$ **(D)** $\frac{qp}{16\pi\epsilon_0 d^2}$

Q.17 An electric dipole is placed at a distance x from center O on the axis of a charged ring of radius R and charge Q uniformly distributed over it. What is the work done in rotating the dipole through 180°?

(A) $\frac{aqQx}{2\pi\varepsilon_0(R^2+x^2)^{\frac{3}{2}}}$ **(B)** $\frac{aqQx}{\pi\varepsilon_0(R^2+x^2)^{\frac{3}{2}}}$ **(C)** $aqQx(R^2+x^2)$ **(D)** zero

Q.18 An electric dipole of dipole moment $\vec{p} = (2.0\hat{i} + 3.0\hat{j})\mu$ C $-$ m is placed in a uniform electric field $\vec{E} = \left(3.0\hat{i} + 2.0\hat{k}\right) \times 10^5$ N/C

(A) The torque that $\vec{E}$ exertes on $\vec{p}$ is $\left(0.6\hat{i} - 0.4\hat{j} - 0.9\hat{k}\right)$ N $-$ m

(B) The potential energy of the dipole is $-$ 0.6 J

(C) The potential energy of the dipole is $+$ 0.6 J

(D) If the dipole is rotated in the electric field, the maximum potential energy of the dipole is 1.3 J

Q.19 The figure given below shows four orientations of an electric dipole in an external electric field.

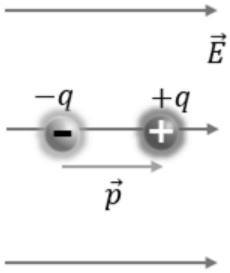
(A) Potential energy of the dipole is greater for orientations (1) and (3) than (2) and (4)

(B) If the dipole rotates from orientation (1) to (2),then the work done on the dipole by field is positive

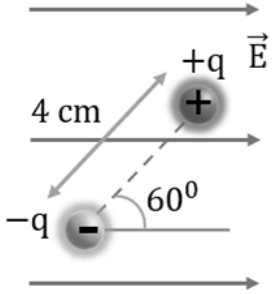
(C) If the dipole rotates from orientation(1) to (2)then the work done on the dipole by field is Negative

(D) Work done to rotate dipole from (1) to (2) is same as work done to rotate dipole from (1) and(4)

Q.20 Two-point charges of 3.2×10^{-19} C and -3.2×10^{-19} C are separated from each other by 2.4×10^{-10} m. The dipole is situated in a uniform electric field of intensity 4×10^5 V/m. The work done in rotating the dipole by 180° is p $\times 10^{-24}$ J. Find the value of p.



Q.21 An electric dipole of length 4 cm, when placed with its axis making an angle of 60° with a uniform electric field, experiences a torque of $4\sqrt{3}$ Nm. Find the potential energy of the dipole, if the dipole has charges of $\pm$8 nC (in J)



ANSWER KEY

WORK SHEET										
Q.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Sol.	(A)	(D)	(C)	(D)	(D)	(B)	(B)	(C)	(C)	(C)
Q.	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Sol.	(C)	(C)	(B)	(C)	(D)	(B)	(B)	(A). (B), (D)	(A). (B), (D)	
Q.	21									
Sol.										