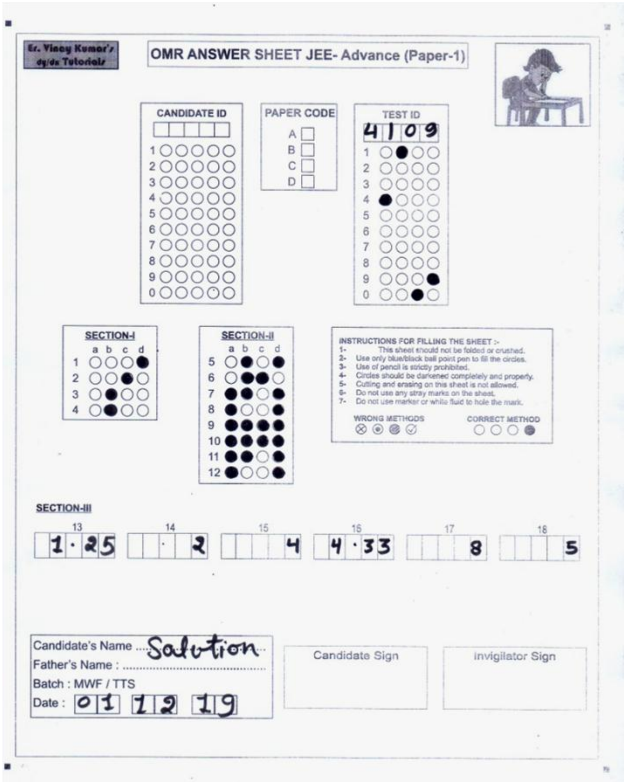

Er. Vinay Kumar's IIT/JEE Tutorials

OMR ANSWER SHEET JEE- Advance (Paper-1)

CANDIDATE ID | PAPER CODE | TEST ID: 4109

SECTION-I: 1 d, 2 c, 3 b, 4 b

SECTION-II: 5 b d, 6 b c, 7 a b d, 8 a b d, 9 a b c d, 10 a b c d, 11 a b c d, 12 a d

INSTRUCTIONS FOR FILLING THE SHEET :-
1- This sheet should not be folded or crushed.
2- Use only blue/black ball point pen to fill the circles.
3- Use of pencil is strictly prohibited.
4- Circles should be darkened completely and properly.
5- Cutting and erasing on this sheet is not allowed.
6- Do not use any stray marks on the sheet.
7- Do not use marker or white fluid to hide the mark.

WRONG METHODS | CORRECT METHOD

SECTION-III: 13: 1.25, 14: 2, 15: 4, 16: 4.33, 17: 8, 18: 5

Candidate's Name: Solution
Father's Name :
Batch : MWF / TTS
Date : 01 12 19

Candidate Sign | Invigilator Sign

Q1.

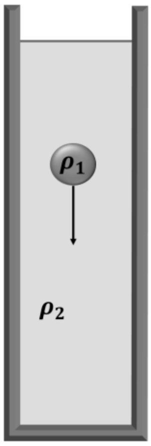
When terminal velocity appears

$mg = F_D + U \Rightarrow V\rho_1 g = k\sqrt{v} + V\rho_2 g$

$\Rightarrow k\sqrt{v} = V\rho_1 g - V\rho_2 g$

$\Rightarrow k\sqrt{v} = V(\rho_1 - \rho_2)g \Rightarrow \sqrt{v} = \dfrac{V(\rho_1-\rho_2)g}{k}$

$\Rightarrow v = \left[\dfrac{V(\rho_1-\rho_2)g}{k}\right]^2$



Q2. $\frac{1}{2}\rho v_1^2 = \rho g \frac{h}{2} \Rightarrow v_1^2 = gh$ …. (1)

$\frac{1}{2} 2\rho \cdot v_2^2 = \rho gh + 2\rho g \frac{h}{2}$

$\Rightarrow v_2^2 = 2gh$ ……….(2)

$F = \rho v^2 A \Rightarrow F_1 = \rho v_1^2 A = \rho g h A$

$\Rightarrow F_2 = 2\rho v_2^2 A = 2\rho(2gh)A \Rightarrow F_2 = 4\rho g h A$

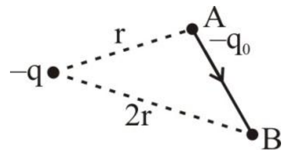
$F = F_1 + F_2 = \rho g h A + 4\rho g h A = 5\rho g h A$ ……….. (3)

Mass of liquids $= \rho_1 V_1 + \rho_2 V_2 = \rho h A_0 + 2\rho h A_0$

$= 3\rho h A_0$

Acceleration $= \dfrac{F}{M} = \dfrac{5\rho g h A}{3\rho h A_0} = \dfrac{5}{3}\dfrac{A}{A_0} g$

Q3. $V_A = \dfrac{1}{4\pi\varepsilon_0}\dfrac{-q}{r}$



$V_B = \dfrac{1}{4\pi\varepsilon_0}\dfrac{-q}{2r}$

$\Delta V = V_B - V_A = \dfrac{1}{4\pi\varepsilon_0}\left[\dfrac{-q}{2r} - \dfrac{-q}{r}\right] = \dfrac{1}{4\pi\varepsilon_0}\dfrac{q}{r}\left[-\dfrac{1}{2}+1\right]$

$= \dfrac{1}{4\pi\varepsilon_0}\dfrac{q}{2r}$

$[W_C = -q_0 \Delta V] \Rightarrow W_C = -(-q_0)\left(\dfrac{1}{4\pi\varepsilon_0}\dfrac{q}{2r}\right)$

$\Rightarrow W_C = \dfrac{1}{4\pi\varepsilon_0}\dfrac{qq_0}{2r}$

Q4. $F = \dfrac{1}{4\pi\varepsilon_0}\dfrac{q^2}{r^2}$ ………….. (1)

$F' = \dfrac{1}{4\pi\varepsilon_0}\dfrac{q^2}{\left[\left(r-\frac{r}{2}\right)+\sqrt{4}\,\frac{r}{2}\right]^2} = \dfrac{1}{4\pi\varepsilon_0}\dfrac{q^2}{\left[\frac{r}{2}+r\right]^2}$

$= \dfrac{1}{4\pi\varepsilon_0}\dfrac{4q^2}{9r^2}$ …………. (2)

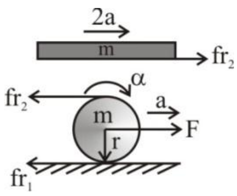
$\dfrac{(2)}{(1)} \Rightarrow \dfrac{F'}{F} = \dfrac{4q^2/9r^2}{q^2/r^2} = \dfrac{4}{9} \Rightarrow F' = \dfrac{4}{9}F$

Q5. **For plank :** $m.2a = fr_2$ ………. (1)

For cylinder $ma = F - fr_1 - fr_2$ ……… (2)

$I\alpha = fr_1 r - fr_2 r$ ………….. (3)

$a = \alpha r$ ……….. (4)



From (3) & (4) :

$\dfrac{mr^2}{2}\times\dfrac{a}{r} = (fr_1 - fr_2)\,r \Rightarrow \dfrac{ma}{2} = fr_1 - fr_2$ …… (5)

$(1)\times 2 + (2) + (3):$

$4ma + ma + \dfrac{ma}{2} = 2fr_2 + F - fr_1 - fr_2 + fr_1 - fr_2$

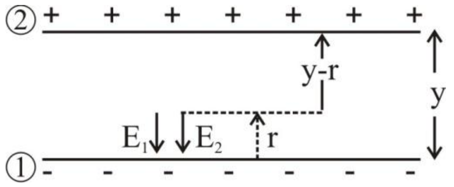
$\Rightarrow \dfrac{11\,ma}{2} = F \Rightarrow a = \dfrac{2F}{11\,m}$

Acc. of plan $= 2a = \dfrac{4F}{11\,m}$

$(1)+(5):\ 2ma + \dfrac{ma}{2} = fr_1 \Rightarrow fr_1 = \dfrac{5ma}{2}$

$$\Rightarrow \ fr_1 = \frac{5}{2} m \times \frac{2F}{11\,m} \ \Rightarrow \ fr_1 = \frac{5F}{11\,m}$$

Q6.



pot. different between A & B $= -\int_0^y \text{Fdr}$

$$E = E_1 + E_2$$

$$= \frac{1}{4\pi\varepsilon_0}\left[\frac{2\lambda}{r} + \frac{2\lambda}{(\gamma - r)}\right]$$

$$= \frac{2\lambda}{4\pi\varepsilon_0}\left[\frac{1}{r} + \frac{1}{y-r}\right]$$

$$\Delta V = -\int_0^y \frac{2\lambda}{4\pi\varepsilon_0}\left[\frac{1}{r} + \frac{1}{y-r}\right] dr$$

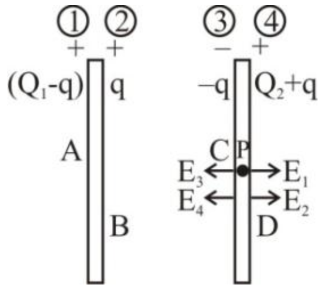
$$\Rightarrow \ = \frac{2\lambda}{4\pi\varepsilon_0}\left[\ln r - \ln (y-r)\right]_0^y$$

$$= -\frac{2\lambda}{4\pi\varepsilon_0}\left[\ln\left(\frac{r}{y-r}\right)\right]_0^y$$

$$= \frac{2\lambda}{4\pi\varepsilon_0}\left[\ln \frac{y-r}{r}\right]_0^y = \frac{2\lambda}{4\pi\varepsilon_0}\left[\ln\left(\frac{y}{r} - 1\right)\right]_0^y$$

$$= \frac{2\lambda}{4\pi\varepsilon_0}\left[\ln 0 - \ln \infty\right] \ \Rightarrow \text{non defined}$$

Q9.



$$E_1 + E_2 = E_3 + E_4$$

$$\frac{Q_1 - q}{2\varepsilon_0 A} + \frac{q}{2\varepsilon_0 A} = \frac{q}{2\varepsilon_0 A} + \frac{Q_2 + q}{2}$$

$$\Rightarrow \ Q_1 - q + q = q + Q_2 + q$$

$$2q = Q_1 - Q_2 \ \Rightarrow \ q = \frac{Q_1 - Q_2}{2}$$

Charge on A

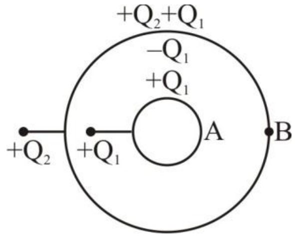
$$\Rightarrow \ Q_1 - q = Q_1 - \left(\frac{Q_1 - Q_2}{2}\right) = \frac{Q_1 + Q_2}{2}$$

Charge on B $\Rightarrow \ q = \frac{Q_1 - Q_2}{2}$

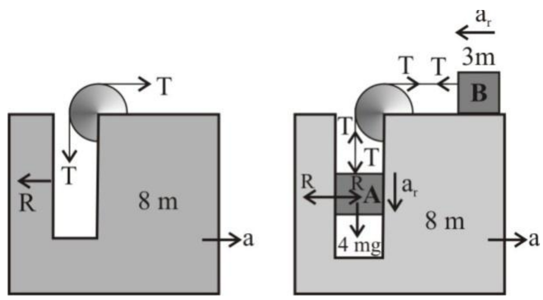
Charge on $C = -q = -\left(\frac{Q_1 - Q_2}{2}\right) = \frac{Q_2 - Q_1}{2}$

Charge on $D = Q_2 + q = Q_2 + \left(\frac{Q_1 - Q_2}{2}\right) = \frac{Q_1 + Q_2}{2}$

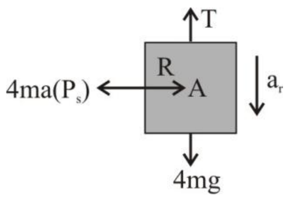
Q11.



Q13.

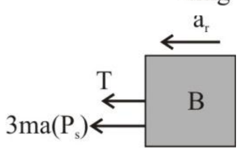


8ma = T –R ....(1)



$4ma_r = 4mg - T$ .....(2)

R = 4ma .... (3)



$3ma_r = T + 3ma$ ....(4)

from eq. (1) & (3) 8ma = T – 4 ma

$\Rightarrow$ 12 ma = T .... (5)

$(2)\times 3 - (4)\times 4$: 12 ma_r = 12 mg – 3T

12 mar = 4T + 12 ma

–   –   –

0 = – 7T + 12 mg – 12 ma

$\Rightarrow \ 7T = 12mg - 12ma$ .... (6)

from (5) & (6) : 7 (12 ma) = 12 mg – 12 ma

$7a = g - a \ \Rightarrow \ 8a = g$

$\Rightarrow \ a = g/8 = 10/8 = 5/4 m/s^2 = 1, 25 m/s^2$

Q14. $y^2+y-x=0 \Rightarrow \; 2y\dfrac{dy}{dt}+\dfrac{dy}{dt}-\dfrac{dx}{dt}=0$

$\Rightarrow \; 2y\cdot v_y+v_y-v_x=0$

$\Rightarrow \; v_y(2y+1)=v_x$ ....(1)

differentiating eq. (1) with time :

$$\frac{dv_y}{dt}(2y+1)+v_y\left(2\frac{dy}{dt}\right)=\frac{dv_x}{dt}$$

$\Rightarrow \; a_y(2y+1)+2v_y^2=a_x$ ....(2)

at (0, 0) $a_y = 0$, $a_x = 4$ from eq. (2)

$0\times(2y+1)+2v_y^2=4$

$\Rightarrow \; v_y^2=2 \;\Rightarrow\; v_y=\sqrt{2}\ m/s$

from eq. (1) $v_y(2y+1)+v_x \;\Rightarrow$ at (0, 0)

$\sqrt{2}(2\times0+1)=v_x \;\Rightarrow\; v_x=\sqrt{2}\ m/s$

$v=\sqrt{v_x^2+v_y^2}=\sqrt{(\sqrt{2})^2+(\sqrt{2})^2}=2m/s$

Q15. $\vec{v}=\vec{u}+\vec{a}t$

$\vec{v}_1^{'}=\vec{v}_1+\vec{a}t$

$\Rightarrow \; v_1i-(gj)t$

$\Rightarrow v_1i-(gt)j$ ….. (1)

$\vec{v}_2^{'}=\vec{v}_2+\vec{a}t=-v_2i-gj\,t \;=\; -v_2i-gt\;j$

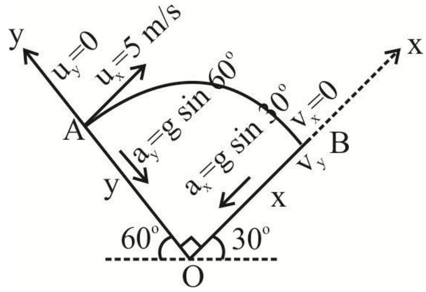
$\vec{v}_1^{'}\perp\vec{v}_2^{'}\Rightarrow(v_1i-gt\;j)\cdot(-v_2i-gtj)=0$

$\Rightarrow \; -v_1v_2+g^2t^2=0\Rightarrow \; t=\sqrt{\dfrac{v_1v_2}{g^2}}$

$=\dfrac{\sqrt{v_1v_2}}{g}$

$t=\dfrac{\sqrt{20\times80}}{10}=\dfrac{\sqrt{1600}}{10}=\dfrac{40}{10}=4\sec$

Q16



$v_x=u_x+a_x\,t$

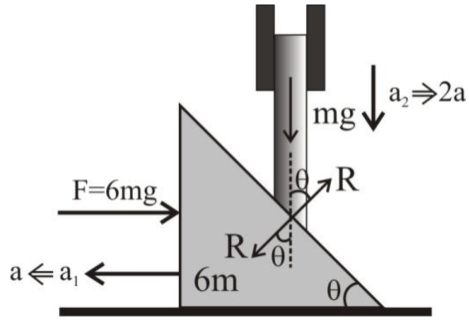
$\Rightarrow \; 0=5-g\sin30^o\times t$

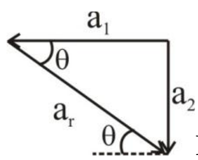
$5=10\times\dfrac{1}{2}\times t \;\;\Rightarrow\;\; t=1\sec.$

$y=u_yt \;+\; \dfrac{1}{2}u_yt^2 \;\;\Rightarrow\;\; OA=0+\dfrac{1}{2}(g\sin60^o)\times1^2$

$=\dfrac{1}{2}\times10\times\dfrac{\sqrt{3}}{2}=2.5\sqrt{3}$ **=4.33m**

Q17.





Relation between a_1&a_2 :

$\tan\theta=\dfrac{a_2}{a_1}$

$\Rightarrow \; 2=\dfrac{a_2}{a_1} \;\Rightarrow\; a_2=2a_1$

if a_1 = a then a_2=2a

on the piston : $m2a=mg-R\cos\theta$

$\Rightarrow \; 2ma=mg-R\dfrac{1}{\sqrt{5}}$ ....(1)

on the wedge : $6ma_1=R\sin\theta-6mg$

$\Rightarrow \; 6ma=R\dfrac{2}{\sqrt{5}}-6mg$ ....(2)

$(1)\times2+(2):10ma=-4mg$

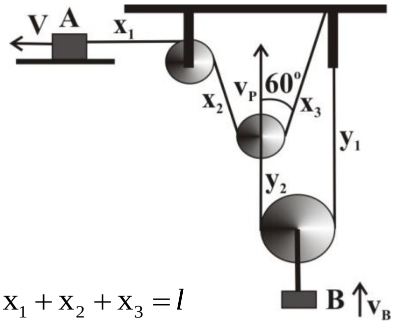
$\Rightarrow \; a=-\dfrac{4}{10}g=-\dfrac{4}{10}\times10=-4m/s^2$

$\Rightarrow \; 4m/s^2$ towards right

acc. of piston $\Rightarrow$

$=2a=2\times(-4)=-8m/s^2 \;\Rightarrow\; 8m/s^2$ upward

Q18.



$x_1 + x_2 + x_3 = l$

$v - v_P \cos 60^o - v_P \cos 60^o = 0$

$\Rightarrow \quad v - \frac{v_P}{2} - \frac{v_P}{2} = 0$

$\Rightarrow \quad v = v_P$ .....(1)

$y_1 + y_2 = l'$

$\Rightarrow \quad -v_B + (v_P - v_B) = 0$

$\Rightarrow \quad v_P = 2v_B$ ....(2)

from (1) & (2) : $v = 2v_B$

$\Rightarrow \quad v_B = v/2 \Rightarrow \quad v_B = \frac{10}{2} = 5 m/s$