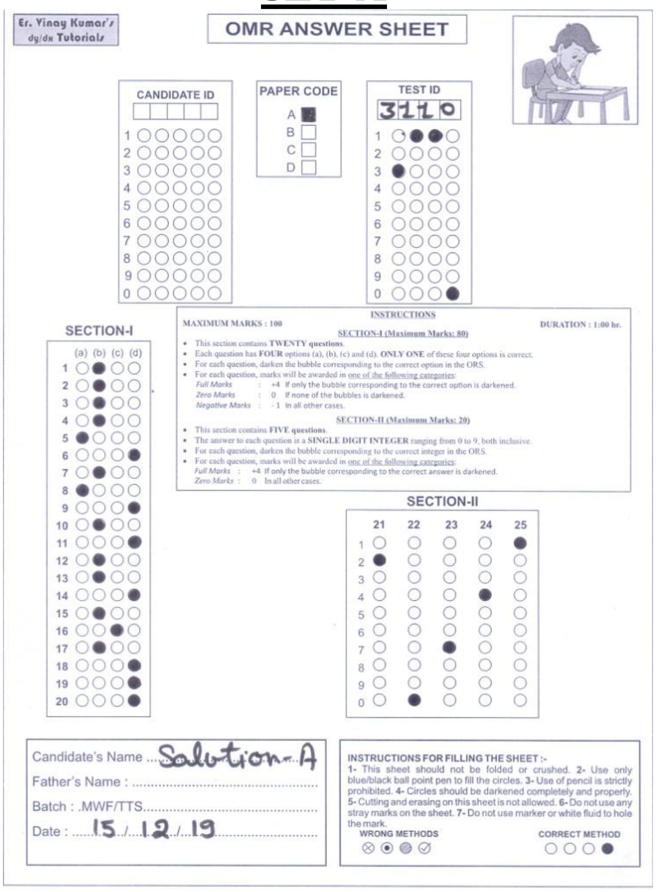
SET-A


Er. Vinay Kumar's dy/dx Tutorials

OMR ANSWER SHEET

CANDIDATE ID | PAPER CODE: A | TEST ID: 3110

SECTION-I

Q	Answer
1	(b)
2	(b)
3	(b)
4	(b)
5	(a)
6	(d)
7	(b)
8	(a)
9	(d)
10	(b)
11	(d)
12	(b)
13	(b)
14	(d)
15	(b)
16	(c)
17	(b)
18	(d)
19	(d)
20	(d)

SECTION-II

Q	21	22	23	24	25
Answer	2	0	7	4	1

INSTRUCTIONS

MAXIMUM MARKS : 100 DURATION : 1:00 hr.

SECTION-I (Maximum Marks: 80)

- This section contains TWENTY questions.
- Each question has FOUR options (a), (b), (c) and (d). ONLY ONE of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories:
  Full Marks : +4 If only the bubble corresponding to the correct option is darkened.
  Zero Marks : 0 If none of the bubbles is darkened.
  Negative Marks : -1 In all other cases.

SECTION-II (Maximum Marks: 20)

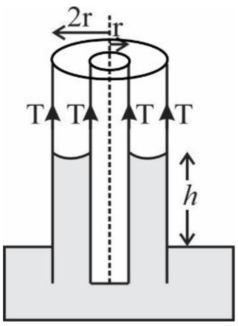
- This section contains FIVE questions.
- The answer to each question is a SINGLE DIGIT INTEGER ranging from 0 to 9, both inclusive.
- For each question, darken the bubble corresponding to the correct integer in the ORS.
- For each question, marks will be awarded in one of the following categories:
  Full Marks : +4 If only the bubble corresponding to the correct answer is darkened.
  Zero Marks : 0 In all other cases.

Candidate's Name : Solution-A
Father's Name :
Batch : MWF/TTS
Date : 15/12/19

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 hole the mark.

WRONG METHODS | CORRECT METHOD

Q1.



Weight of liquid rise = Force created by surface tension

$$[\pi(2r)^2 - \pi r^2]\, h\rho g = T \times [2\pi(2r) + 2\pi r] \;\Rightarrow$$

$$[3\pi r^2\, h\rho g = 6\pi r \cdot T \;\Rightarrow\; h = \frac{2T}{r\rho g}$$

Q2. $\Delta U = U_f \sim U_i = (n^{1/3} - 1)\, 4\pi b^2 T = \left(\frac{b}{a} - 1\right) 4\pi b^2 T$

$$= b\left(\frac{1}{a} - \frac{1}{b}\right) 4\pi b^2 T \;=\; \left(\frac{1}{a} - \frac{1}{b}\right) 4\pi b^3 T$$

ΔU is converted into kinetic energy

$$\frac{1}{2} m v^2 = \left(\frac{1}{a} - \frac{1}{b}\right) 4\pi b^3 T$$

$$\Rightarrow \quad \frac{1}{2}\cdot\frac{4}{3}\pi b^3 \rho \cdot v^2 = \left(\frac{1}{a} - \frac{1}{b}\right) 4\pi b^3 T$$

$$\Rightarrow \quad v = \left[\frac{6T}{\rho}\left(\frac{1}{a} - \frac{1}{b}\right)\right]^{1/2}$$

Q3. $h\rho g = \dfrac{2T\cos\theta}{r}$ .... (1)

$a = \pi r^2 \;\Rightarrow\; r = \sqrt{\dfrac{a}{\pi}}$ .... (2)

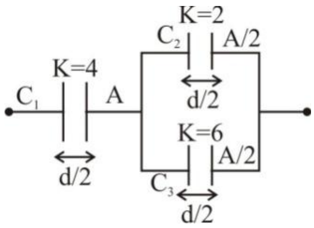
from (1) & (2):

$$h\rho g = \frac{2T\cos\theta}{\sqrt{a/\pi}} \;\Rightarrow\; h \propto \frac{1}{\sqrt{a}}$$

$$\Rightarrow \frac{h_2}{h_1} = \sqrt{\frac{a_1}{a_2}} \;\Rightarrow\; \frac{h_2}{h} = \sqrt{\frac{a}{4a}} \;\Rightarrow\; h_2 = h/2$$

Q4. $C_1 = \dfrac{\varepsilon_0 \times 4 \times A}{d/2} = \dfrac{3\varepsilon_0 A}{d}$

$C_2 = \dfrac{\varepsilon_0 \times 2 \times A/2}{d/2} = \dfrac{2\varepsilon_0 A}{d}$



$$C_3 = \frac{\varepsilon_0 \times 6 \times A/2}{d/2} = \frac{6\varepsilon_0 A}{d}$$

$$C_{23} = C_2 + C_3 = \frac{2\varepsilon_0 A}{d} + \frac{6\varepsilon_0 A}{d} = \frac{8\varepsilon_0 A}{d}$$

$$\frac{1}{C_{123}} = \frac{1}{C_1} + \frac{1}{C_{23}} = \frac{d}{8\varepsilon_0 A} + \frac{d}{8\varepsilon_0 A} = \frac{d}{4\varepsilon_0 A}$$

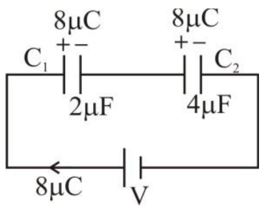
$$\frac{1}{C_{123}} = \frac{4\varepsilon_0 A}{d}$$

Q5. Max. charge capacity of $2\mu F$ & $4\mu C$

$= 2 \times 4 = 8\mu C$

Max. charge capacity of $4\mu F$ & $4V$

$= 4 \times 4 = 16\mu C$



The charge should be flown in the circuit equal to $8\mu C$

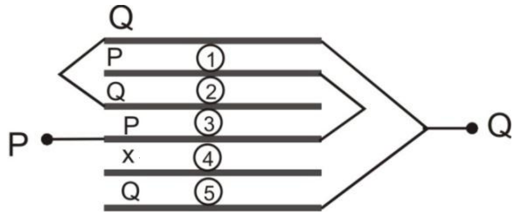
pot. on $C_1 \;\Rightarrow\; V_1 = \dfrac{8}{2} = 4V$ &

Pot. on $C_2 \;\Rightarrow\; V_2 = \dfrac{8}{2} = 2V$

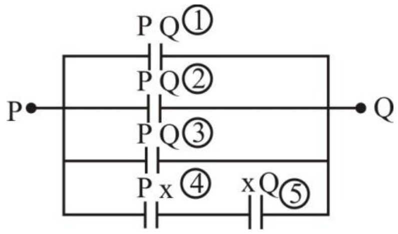
Max. voltage can be given

$\Rightarrow \quad V = V_1 + V_2 = 4 + 2 = 6V$

Q6.

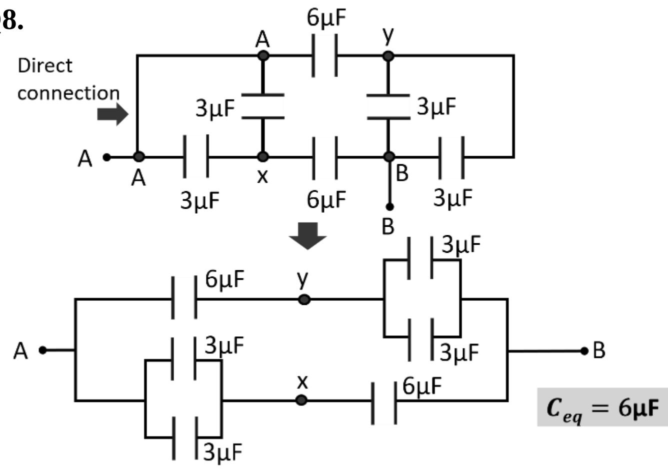


Equivalent circuit :

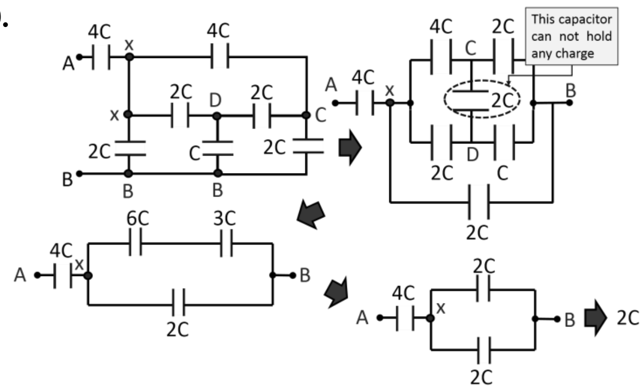


$$C_{eq} = C + C + C + \frac{C}{2} = \frac{7C}{2} = \frac{7\in_0 A}{2d}$$

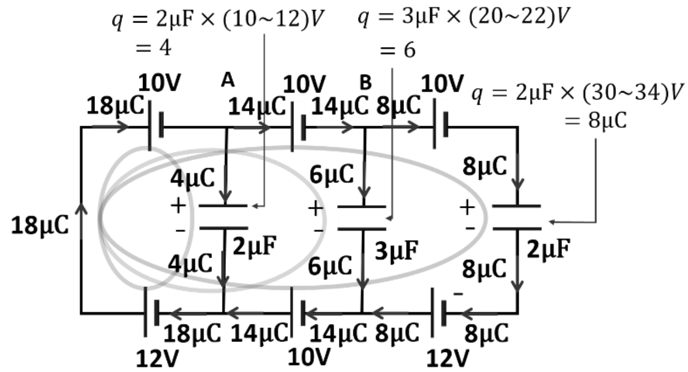
Q8.



Q9.



Q10.



Q11.

$$m = \frac{V_o}{V}$$

$$\Rightarrow m = \frac{500}{150}$$

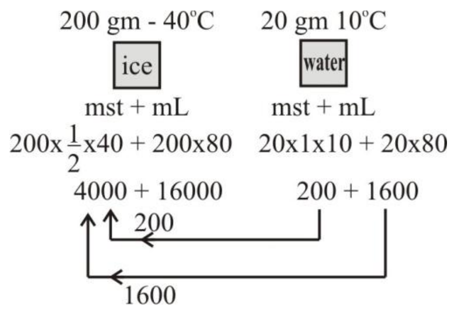
$$\Rightarrow m = 3.33 \Rightarrow m = 4$$

$$n = \frac{C_o}{C} \times m$$

$$\Rightarrow n = \frac{4}{1} \times 4 \Rightarrow n = 16$$

$$N = m \times n = 4 \times 16 = 64$$

Q12.



The above process shows that water reaches 0ºC and finally freezes. But since mst of ice still remains it does not reaches 0ºC hence final mixture has only ice at temperature lower than 0ºC. Let the temp. of final mixture be tºC.

Heat given = Heat taken

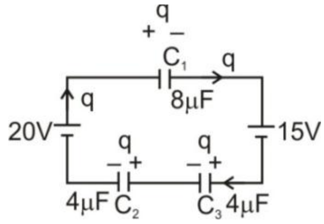
$$\Rightarrow 20 \times 1 \times (10 - 0) + 20 \times 80 + 20 \times \frac{1}{2} \times (0^o - t)$$

$$200 \times \frac{1}{2} \times [t - (-40)]$$

$\Rightarrow$ 200 + 1600 –10t = 100t + 4000

$\Rightarrow$ 110 t = – 1200 $\Rightarrow$ t = – 20ºC

Q15. Charge on each capacitor is same as all the capacitors are in series in the loop :



$$\frac{q}{8}+15+\frac{q}{4}+\frac{q}{4}-20=0$$

$$\Rightarrow \quad \frac{5q}{8}=5 \quad \Rightarrow \quad q=8\mu C$$

Q16. $\alpha_1\, l_1 = \alpha_2\, l_2$

$\Rightarrow 1.6\times10^{-5}\times 80 = 2.0\times10^{-5}\times l_2$

$\Rightarrow l_2 = \dfrac{1.6\times10^{-5}\times 80}{2.0\times10^{-5}}$

$\Rightarrow \boldsymbol{l_2 = 64cm}$

Q18. (a) Field due to polarization always opposes the external field.

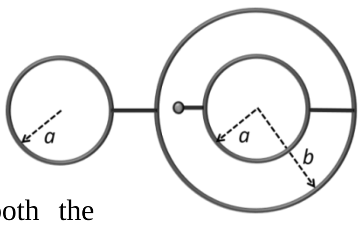
(b) Induce charges on the dielectric are bound charges which are not free hence they can not neutralize any charge.

(c) External field (not the induced field) should exceed the dielectric strength to ionize the dielectric.

(d) This option is correct.

Q19. (d) Field becomes half as potential remains same but distance is doubled $\left(\boldsymbol{E=\frac{V}{d}}\right)$.

Q20. Only outer spheres hold charges therefore capacitance is given by outer spheres only and both the outer spheres are equipotential.

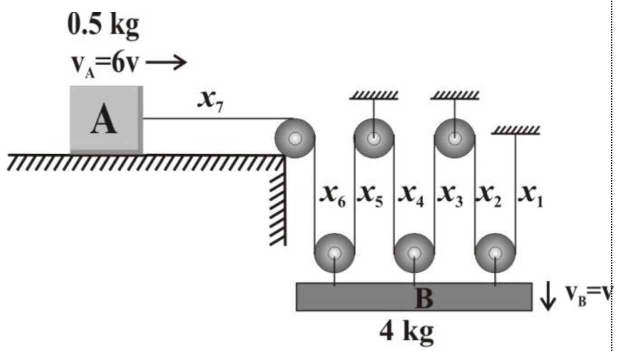


$C = C_1 + C_2$

$= 4\pi\epsilon_0 a + 4\pi\epsilon_0 b$

$\Rightarrow \boldsymbol{C = 4\pi\epsilon_0(a+b)}$

Q21. $x_1+x_2+x_3+x_4+x_5+x_6+x_7=l$



$$v_B+v_B+v_B+v_B+v_B+v_B-v_A=0$$

$v_A=6v_B$

if $v_B= v \Rightarrow v_A=6v$

$$M\vec{v}_0 = m_1\vec{v}_1 + m_2\vec{v}_2$$

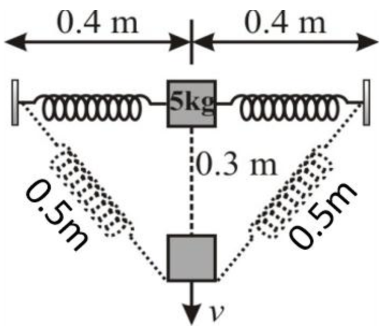
$$\Rightarrow (0.5+4)\vec{v}_0 = (0.5\times 6v)i + (4\times v)(-j)$$

$$\Rightarrow 4.5\vec{v}_0 = 3vi - 4vj$$

$$\Rightarrow 4.5v_0 = 5v \Rightarrow v_0 = \frac{5}{4.5}v = \frac{5}{4.5}\times 1.8$$

$$\Rightarrow v_0 = 2m/s$$

Q22.



$W = \Delta KE$

Initial extension of each spring :

$T = kx_1 \Rightarrow 50 = 500\times x_1 \Rightarrow x_1 = 0.1\text{m}$

Original length of spring = 0.4 – 0.1 = 0.3 m

Final extension of each spring $\Rightarrow x_2$=0.5 – 0.3 = 0.2m (0.5 m is the final length of each spring after extension)

$$W_{mg} + 2W_s = KE_f - KE_i$$

$$\Rightarrow 5\times10\times0.3 - 2\times\frac{1}{2}k\,(x_2^2 - x_1^2) = \frac{1}{2}mv^2 - 0$$

$$\Rightarrow 15 - 500\,(0.2^2 - 0.1^2) = \frac{1}{2}\times5\times v^2$$

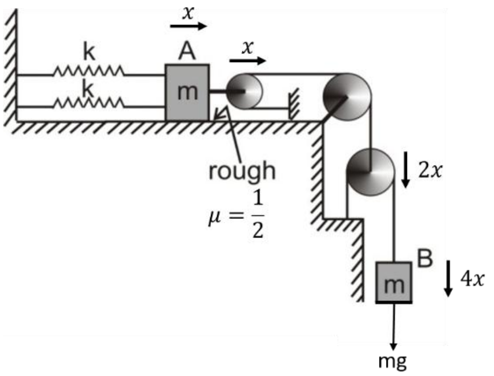
$$\Rightarrow 0 = \frac{1}{2}\times5\times v^2 \Rightarrow v = 0\text{ m/s}$$

Q23.

$$W = \Delta kE$$

$$W_{mg} + W_{fr} + W_s = kE_f - kE_i$$

$$mg \cdot 4x - \frac{1}{2} \times mgx - \frac{1}{2}kx^2 - \frac{1}{2}kx^2 = 0 - 0$$



$$\Rightarrow \frac{7mgx}{2} = kx^2 \quad \Rightarrow \quad \frac{7mgx}{2} = \frac{mg}{2} \times x^2 \quad \Rightarrow \quad x = 7m$$

Q24. Common potential on circuit after connection of switch

$$V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2} = \frac{4 \times 0 + 12 \times 16}{4 + 12} = \frac{12 \times 16}{16} = 12V$$

charge on $4\mu F \;\Rightarrow\; q = 4 \times 12 = 48\mu C$

$$U_i = \frac{1}{2} \times 12 \times (16)^2 + 0 = 6 \times (16)^2 = 1536J$$

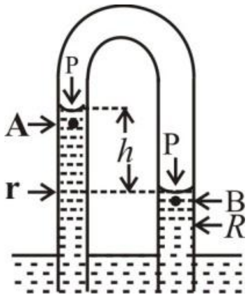
$$U_f = \frac{1}{2}C_1V^2 + \frac{1}{2}C_1V^2$$

$$= \frac{1}{2}(C_1 + C_2)V^2 = \frac{1}{2} \times (12 + 4) \times 12^2 = 8 \times (12)^2 = 1152J$$

energy lost $\Rightarrow \quad U_f \sim U_i = 1152 \sim 1536 = 384J$

Fraction of energy lost $= \dfrac{U_f \sim U_i}{U_i} = \dfrac{384}{1536} = \dfrac{1}{4}$

Q25.



$$P_A = P - \frac{2T}{r} \;\ldots\ldots\ldots\; (1)$$

$$P_B = P - \frac{2T}{R} \;\ldots\ldots\ldots\; (2)$$

$$P_A + h\rho g = P_B$$

$$h\rho g = P_B - P_A \quad \Rightarrow \quad h\rho g = \left(P - \frac{2T}{R}\right) - \left(P - \frac{2T}{r}\right)$$

$$\Rightarrow \quad h\rho g = 2T\left(\frac{1}{r} - \frac{1}{R}\right)$$

$$\Rightarrow \quad h \times 0.7 \times 1000 \times 10$$

$$\Rightarrow \quad h = \frac{2 \times 70 \times \frac{1}{2}}{0.7 \times 1000 \times 10} = 0.01\,\text{m} = 1\,\text{cm}$$