Paper Code : 1001CT102116009

ALLEN CAREER INSTITUTE KOTA (RAJASTHAN)

# CLASSROOM CONTACT PROGRAMME

(Academic Session : 2016 - 2017)

## JEE (Main + Advanced) : ENTHUSIAST COURSE (PHASE : I)

**ANSWER KEY : PAPER-1** **TEST DATE : 26-06-2016**

Test Type : MINOR Test Pattern : JEE-Advanced

### PART-1 : PHYSICS

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SECTION-I | Q. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | A. | A | B | C | C | A | B,C,D | A,C,D | A,C | A,C | C,D |
| | Q. | 11 | 12 | 13 | | | | | | | |
| | A. | A,C,D | B,C | C,D | | | | | | | |
| SECTION-IV | Q. | 1 | 2 | 3 | 4 | 5 | | | | | |
| | A. | 2 | 8 | 7 | 2 | 8 | | | | | |

### PART-2 : CHEMISTRY

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SECTION-I | Q. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | A. | C | B | C | C | C | A,C | D | A,B,D | A,B,C,D | B,C |
| | Q. | 11 | 12 | 13 | | | | | | | |
| | A. | C | D | A,B,C,D | | | | | | | |
| SECTION-IV | Q. | 1 | 2 | 3 | 4 | 5 | | | | | |
| | A. | 6 | 5 | 2 | 2 | 4 | | | | | |

### PART-3 : MATHEMATICS

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SECTION-I | Q. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | A. | C | A | D | A | A | A,B,D | A,B | A,B | A,B | A,D |
| | Q. | 11 | 12 | 13 | | | | | | | |
| | A. | C,D | A,B | B,C,D | | | | | | | |
| SECTION-IV | Q. | 1 | 2 | 3 | 4 | 5 | | | | | |
| | A. | 1 | 4 | 5 | 1 | 0 | | | | | |

Paper Code : 1001CT102116010

ALLEN CAREER INSTITUTE KOTA (RAJASTHAN)

# CLASSROOM CONTACT PROGRAMME

(Academic Session : 2016 - 2017)

## JEE (Main + Advanced) : ENTHUSIAST COURSE (PHASE : I)

**ANSWER KEY : PAPER-2** **TEST DATE : 26-06-2016**

Test Type : MINOR Test Pattern : JEE-Advanced

### PART-1 : PHYSICS

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SECTION-I | Q. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | A. | A | C | B | C | B | A | A,B | B,C,D | B | A,D |
| | Q. | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | | |
| | A. | B,C | A,B,D | B,C | A,B | A | A | A | A | | |

### PART-2 : CHEMISTRY

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SECTION-I | Q. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | A. | B | C | D | D | A | B | A,B,C | A,C | A,C,D | A,B,C |
| | Q. | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | | |
| | A. | A,D | A,B,C | A,B,D | B,C,D | A | D | A | B | | |

### PART-3 : MATHEMATICS

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SECTION-I | Q. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | A. | C | D | D | B | B | Bonus | D | A,B,C | A,C | B,C,D |
| | Q. | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | | |
| | A. | A,B,C | C | B,D | C,D | A | D | B | C | | |

Paper Code : 1001CT102116009

ALLEN CAREER INSTITUTE KOTA (RAJASTHAN)

CLASSROOM CONTACT PROGRAMME
(Academic Session : 2016 - 2017)

# JEE (Main + Advanced) : ENTHUSIAST COURSE

## PHASE : I

Test Type : MINOR  Test Pattern : JEE-Advanced

## TEST DATE : 26 - 06 - 2016

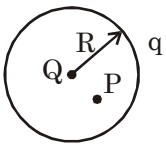
## PAPER-1

## PART-1 : PHYSICS  SOLUTION

### SECTION-I

**1. Ans. (A)**

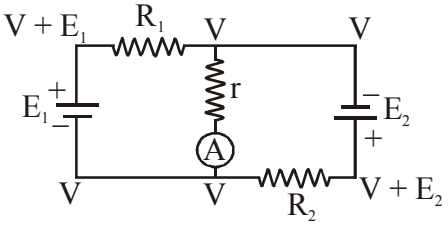
**Sol.**




$$V_P = \frac{kQ}{R}\times 2 + \frac{kq}{R} = \frac{2Q}{4\pi\varepsilon_0 R} + \frac{q}{4\pi\varepsilon_0 R}$$

**2. Ans. (B)**

**Sol.**




No, current through this branch

$$I = \frac{E_1}{R_1} = \frac{E_2}{R_2}$$

$$\frac{E_1}{E_2} = \frac{R_1}{R_2}$$

**3. Ans. (C)**

**4. Ans. (C)**

**Sol.** After switch is closed, common p.d. V would be

$$\frac{CV_0}{C+C_x}$$

$$\left[\text{common P.D.} = \frac{\text{Charge}}{\text{equivalent capacitance}}\right]$$

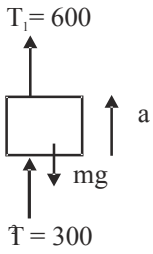
Hence, $\frac{CV_0}{C+C_x} = V$

$$\Rightarrow C_x = \frac{C(V_0 - V)}{V}$$

**5. Ans. (A)**

**Sol.** $T_1 + T_2 - mg = ma$

$600 + 300 = m\,(20)$




$$\frac{900}{20} = m$$

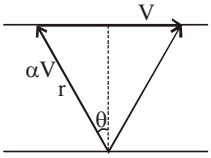
$m = 45$ kg

**6. Ans. (B, C, D)**

**Sol.** drift $= 0 \Rightarrow \alpha V \sin\theta = V$

drift $= (V - \alpha V \sin\theta)t$

$$\sin\theta = \frac{1}{\alpha} < 1$$




$\therefore \quad \alpha > 1$

for other values of $\alpha$ the swimmer reaches the other bank but with non zero drift.

**7. Ans. (A, C, D)**

**Sol.** $C_1V + C_2V = C_1V_1 + C_2V_2$

(charge conservation)

$$V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$$

Heat $= U_1 - U_2$

$$= \left(\frac{1}{2}C_1V_1^2 + \frac{1}{2}C_2V_2^2\right) - \frac{1}{2}(C_1 + C_2)V^2$$

**8. Ans. (A, C)**

**Sol.** $TV_A + TV_B = 2TV_C$ (string constrain)

$V_A + V_B = 2V_C : V_C = \frac{V_A + V_B}{2}$

$a_A + a_B = 2a_C$

$a_C = \frac{a_A + a_B}{2}$

**9. Ans. (A, C)**

**Sol.** a.c.

$v = t^2 - 3t + 2$ m/s

$a = 2t - 3$ m/s

a and v will have opposite sign if

$t < 1$ or $1.5 < t < 2$

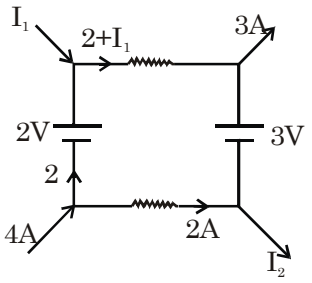
**10. Ans. (C, D)**

**Sol.** Electric field inside a a conductor is zero Apply Guass law.

**11. Ans. (A,C,D)**

**12. Ans. (B,C)**

**Sol.**




$I_1 + 4 = 3 + I_2$

$I_1 + 1 = I_2$ ... (i)

$2 - 3(2 + I_1) - 3 + 6 = 0$

$2 - 6 - 3I_1 + 3 = 0$

$I_1 = -\frac{1}{3}$ A

$I_2 = \frac{2}{3}$

**13. Ans. (C,D)**

**Sol.** $\frac{R}{R_1 + R_2} = \frac{L/4}{3L/4} \Rightarrow R_1 + R_2 = 3R$ ... (i)

$\frac{R + R_1}{R_2} = \frac{2L/3}{L/3} \Rightarrow R + R_1 = 2R_2$ ... (ii)

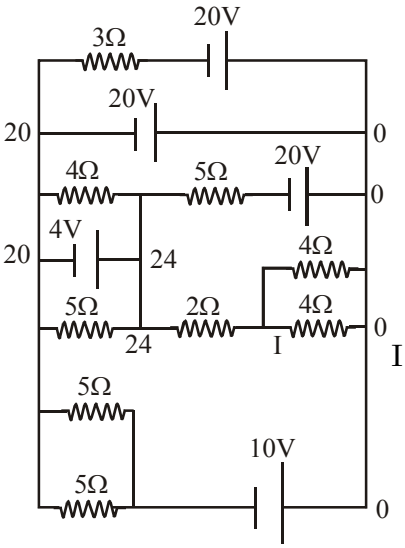
Solving equation (i) and (ii) we get

$R_1 = \frac{5R}{3}$; $R_2 = \frac{4R}{3}$

## SECTION-IV

**1. Ans. 2**

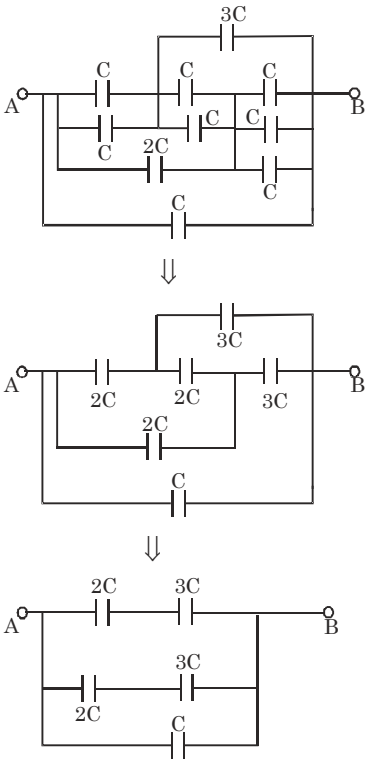
**Sol.**




I = 2A

**2. Ans. 8**

**Sol.**

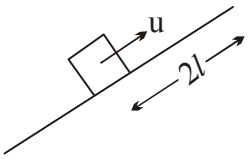



**3. Ans. 7**

**Sol.** $v^2 = u^2 = 2$ as

$0 - u^2 = 2[-g(\mu \cos\theta + \sin\theta)] \times 2l$ (i)

$v^2 - u^2 = 2$ as



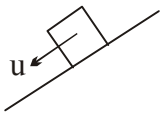

$0 - u^2 = 2[-g(\mu \cos\theta - \sin\theta)] \times 3l$ (ii)

from eq. (i) & (ii) $\mu \cos\theta = 5 \sin\theta$

& $u^2 = \frac{24}{5} \mu g l \cos\theta$

Now $v^2 - u^2 = 2a\, l^1$

$0 - \frac{24}{5} \mu g\, l \cos\theta = 2[-\mu g \cos\theta]\, l^1$

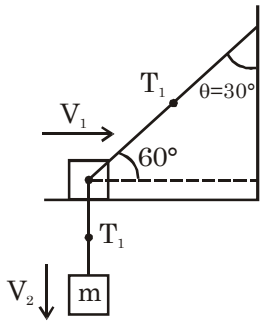



$l^1 = \frac{12}{5} l = \frac{a}{b} l$

$a - b = 12 - 5 = 7$

**4. Ans. 2**

**Sol.**




$T_1 \sin(\theta) V_1 = T_1 V_2$

$V_1 \sin(\theta) = V_2$

$a_1 \sin(\theta) + V_1 \cos\theta \; V_1 \cos\theta \frac{d\theta}{dt} = a_2$

$a_1 \sin(30) = a_2$

$a_1 = 2a_2$

$mg - T = ma_2$ ... (i)

$T \cos 60° = ma_1$ ... (ii)

$a_1 = 2a_2$ ... (iii)

On solving equation (i), (ii) and (iii) we get

$a_2 = 2 m/s^2$

**5. Ans. 8**

**Sol.** $\text{Energy} = \frac{QV}{2}$

$Q = \frac{360 \times 2}{4500} C$

$\therefore \quad Q = \frac{8}{50} C$

$i = \frac{Q}{t}$

# PART–2 : CHEMISTRY SOLUTION

## SECTION - I

**1. Ans. (C)**

**2. Ans. (B)**

**3. Ans. (C)**

**4. Ans. (C)**

**5. Ans. (C)**

**6. Ans. (A,C)**

**7. Ans. (D)**

**8. Ans. (A,B,D)**

**9. Ans. (A,B,C,D)**

**10. Ans. (B,C)**

**11. Ans. (C)**

**12. Ans. (D)**

**13. Ans. (A,B,C,D)**

## SECTION - IV

**1. Ans. (249)**

**OMR ANS (6)**

$(\Delta H_r)_{298K} = (H - H) + \frac{1}{2} (0 = 0) - 2 (O - H)$

$= 400 + 250 - 900$

$= - 250$ kJ

$(\Delta H_r)_{348K} = (\Delta H)_{298K} + (\Delta C_p)_r (T_2 - T_1)$

$= - 250 + \frac{20 \times 50}{1000}$

**2. Ans. (5)**

$W = 2 \times 2 + \frac{1}{2} \times 2 \times 1$

$= 5$

**3. Ans. (2)**

**Sol.** $PdCl_2.4NH_3$ , $NiCl_2.6H_2O$

**4. Ans. (2)**

**5. Ans. (4)**

# PART-3 : MATHEMATICS SOLUTION

## SECTION-I

**1. Ans. (C)**

$$(\theta_1+\theta_2)\left(\frac{\cos^4 x}{\theta_1}+\frac{\sin^4 x}{\theta_2}\right)=1$$

$$\cos^4x+\sin^4x+\frac{\theta_2}{\theta_1}\cos^4 x+\frac{\theta_1}{\theta_2}\sin^4 x=\theta$$

$$1-2\sin^2 x\cos^2 x+\frac{\theta_2}{\theta_2}\cos^4 x+\frac{\theta_1}{\theta_2}\sin^4 x=0$$

$$\left(\sqrt{\frac{\theta_2}{\theta_1}}\cos^2 x-\sqrt{\frac{\theta_1}{\theta_2}}\sin^2 x\right)^2=0$$

$$\tan^2 x=\frac{\theta_2}{\theta_1}$$

$$\theta_2=\theta_1\tan^2 x$$

$$\frac{d\theta_2}{d\theta_1}=\tan^2 x$$

**2. Ans. (A)**

$$1+\frac{1}{2}+\frac{1}{2^2}+....=\frac{1}{\left(1-\frac{1}{2}\right)}=2$$

**3. Ans. (D)**

$$\lim_{x\to0}\frac{\left(\frac{\sin x}{x}+\frac{2\sin 2x}{2x}\right)}{\left(\frac{3\sin 3x}{3x}+\frac{4\sin 4x}{4x}\right)}=\frac{3}{7}$$

**4. Ans. (A)**

$x^2+y^2-4(1)^2=0$

$$\frac{y-3x}{c}=1$$

$$x^2+y^2-\left(\frac{y-3x}{c}\right)^2=1$$

$$x^2\left(1-\frac{36}{c^2}\right)+y^2\left(1-\frac{4}{c^2}\right)+\frac{24xy}{c^2}=0$$

$$2-\frac{40}{c^2}=0 \quad\Rightarrow\quad c^2=20$$

**5. Ans. (A)**

$$\text{Let } y=\lim_{x\to0}(\sin x)^{\tan x}$$

$$\ell ny=\tan x\,\ell n(\sin x)$$

$$=\lim_{x\to0}\frac{\ell n(\sin x)}{\cot x}=\frac{\cos x}{\sin x(-\text{cosec}^2x)}$$

$$\ell ny=0\Rightarrow y=1$$

**6. Ans. (A,B,D)**

$$\int_0^1\frac{dx}{(1+x)(2+x)\sqrt{x-x^2}}$$

$$\int_0^1\frac{dx}{(1+x)(2+x)\sqrt{\left(\frac{1}{2}\right)^2-\left(x-\frac{1}{2}\right)^2}}$$

$$\text{Let } x-\frac{1}{2}=\frac{\sin\theta}{2}$$

$$dx=\frac{\cos\theta}{2}d\theta$$

$$\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}}\frac{\frac{\cos\theta}{2}d\theta}{\left(\frac{3}{2}+\frac{1}{2}\sin\theta\right)\left(\frac{5}{2}+\frac{1}{2}\sin\theta\right)}$$

$$I=4\int_0^{\pi}\frac{d\theta}{(\cos^2\theta-8\cos\theta+15)}$$

$$I=4\int_0^{\pi}\frac{d\theta}{(\cos\theta-5)(\cos\theta-3)}$$

$$I=2\int_0^{\pi}\frac{((\cos\theta-3)-(\cos\theta-5))}{(\cos\theta-5)(\cos\theta-3)}d\theta$$

$$I=2\left(\int_0^{\pi}\frac{d\theta}{(\cos\theta-5)}-\int_0^{\pi}\frac{d\theta}{(\cos\theta-3)}\right)$$

**7. Ans. (A,B)**

$$\begin{vmatrix}a\alpha & 1 & 7\\ b & a\alpha & 3\\ -1 & 1 & 4\end{vmatrix}=0$$

$4a^2\alpha^2-3a\alpha-4b-3+7b+7a\alpha=0$

$4a^2\alpha+a\alpha+3b-3=0$

$\alpha\in R$, then $D\geq0$

$16a^2-16a^2(3b-3)\geq0$

$1-3b+3\geq0$

$$b\leq\frac{4}{3}$$

**8. Ans. (A,B)**

(A) $\begin{vmatrix}a & b & 1\\ a+\alpha & b+\alpha & 1\\ a+2\alpha & b+2\alpha & 1\end{vmatrix}$ $R_1\to R_1-R_2$ & $R_3\to R_3-R_1$

(B) $\begin{vmatrix}a_1 & b_1 & 1\\ a_1r & b_1r & 1\\ a_1r^2 & b_1r^2 & 1\end{vmatrix}=0$

(C) $R_1 \to R_1 + R_2 + R_3$

$$\begin{vmatrix} a-b & p-q & 1 \\ b-c & q-r & 1 \\ c-a & r-p & 1 \end{vmatrix}$$

$$\begin{vmatrix} 0 & 0 & 1 \\ b-c & q-r & 1 \\ c-a & r-p & 1 \end{vmatrix}$$

Not necessarily.

(D) $\frac{1}{2}\begin{vmatrix} 1 & 3 & 1 \\ 2 & 5 & 1 \\ -3 & 7 & 1 \end{vmatrix} = \frac{1}{2}((-2)-(5)+29)) \neq 0$

**9. Ans. (A,B)**

$$\int x^{\ell nx}\frac{\ell nx}{x}dx$$

Let $t = x^{\ell nx}$

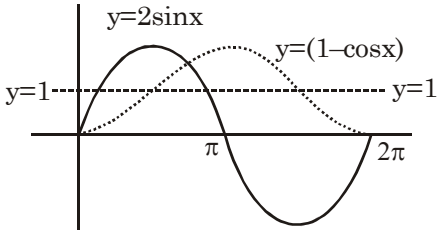
$\ell nt = (\ell nx)^2$

$$dt = \frac{2\ell nx}{x}.x^{\ell nx}dx$$

$$\int dt = x^{\ell nx} + C$$

$f(x) = x^{\ell nx}$

**10. Ans. (A,D)**




$f(x)$ is continuous and non-differentiable in the given interval.

$$\int_0^{\pi/2}(1-\cos x)dx = \frac{\pi}{2}-1$$

**11. Ans. (C,D)**

Do yourself

**12. Ans. (A,B)**

$14 = 2^x + 4^x + 8^x$

$\Rightarrow \quad x = 1$

$f'(x) = 2^x\ell n^2 + 4^x\ell n4 + 8^x\ell n8$

$f'(1) = 2\ell n2 + 8\ell n2 + 24\ell n2$

$f'(1) = 34\ell n2$

$$g'(14) = \frac{1}{34(\ell n2)}$$

**13. Ans. (B,C,D)**

$$f'(x) = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$$

$$f'(x) = \lim_{h\to 0}\frac{f(x)+f(h)-f(x)}{h}$$

$f'(x) = f'(0)$

$f(x) = 2x + C$

$f(0) = 0 \Rightarrow f(x) = 2x$

$$\int f(x)dx = x^2 + C$$

$g(x) = x^2$

$g(2) = 4$

## SECTION – IV

**1. Ans. 1**

$$\int_{10}^{19}\frac{\sin x\,dx}{(1+x^a)} < \int_{10}^{19}\frac{dx}{(1+x^a)} < \int_{10}^{19}\frac{dx}{(1+10^a)}$$

$$\frac{9}{(1+10^a)} < \frac{1}{9}$$

$1 + 10^a > 81$

$a = 2, 3, 4, 5, .....$

**2. Ans. 4**

$$f(t) = \int_{-\infty}^{\infty} e^{-(\sqrt{t}x)^2}dx$$

Let $\sqrt{t}x = z$

$$f(t) = \frac{\int_{-\infty}^{\infty} e^{-z^2}dz}{\sqrt{t}} = \frac{\sqrt{\pi}}{\sqrt{t}}$$

$$f'(t) = \frac{\sqrt{\pi}}{2t^{3/2}}$$

**3. Ans. 5**

$$2\int\frac{(1+\cos\theta)\sin\theta d\theta}{(\cos\theta-1)\sqrt{\cos\theta+\cos^2\theta+\cos^3\theta}}$$

Let $\cos\theta = t^2$

$\sin\theta d\theta = -2tdt$

$$-4\int\frac{(1+t^2)(t)dt}{(t^2-1)\sqrt{t^6+t^4+t^2}}$$

$$-4\int\frac{\left(1+\frac{1}{t^2}\right)dt}{\left(t-\frac{1}{t}\right)\sqrt{\left(t^2+\frac{1}{t^2}\right)+1}}$$

$$-4\int\frac{\left(1+\frac{1}{t^2}\right)dt}{\left(t-\frac{1}{t}\right)\sqrt{\left(t-\frac{1}{t}\right)^2+3}}$$

Let $t-\frac{1}{t}=z$

$\left(t+\frac{1}{t^2}\right)dt=dz$

$-4\int\frac{dt}{t\sqrt{(t^2+3)}}$

$-4\int\frac{dt}{t^3\sqrt{1+3t^{-2}}}$

By solving

$-\frac{2}{\sqrt{3}}\ell n\left|\frac{\sqrt{\cos\theta+\sec\theta+1}-\sqrt{3}}{\sqrt{\cos\theta+\sec\theta+1}+\sqrt{3}}\right|+C$

$k_1 + k_2 + k_3 = 5$

**4. Ans. 1**

$LHS=\int_0^1(1+x+x^2+.....+x^{24})dx$

$\int_0^1\frac{(1-x^{25})}{(1-x)}dx$

Let $x = \cos\theta$

$\int_{\pi/2}^{0}\frac{(1-\cos^{25}\theta)}{2\sin\frac{\theta}{2}}$

$\int_0^{\pi/2}(1-\cos^{25}\theta)\cot\frac{\theta}{2}d\theta$

$\Rightarrow \quad \lambda = 1$

**5. Ans. 0**

It is a homogeneous equation for which

$\frac{d^2y}{dx}=0$

ALLEN CAREER INSTITUTE KOTA (RAJASTHAN)

# CLASSROOM CONTACT PROGRAMME
(Academic Session : 2016 - 2017)

# JEE (Main + Advanced) : ENTHUSIAST COURSE
## PHASE : I

Test Type : MINOR  Test Pattern : JEE-Advanced

## TEST DATE : 26 - 06 - 2016

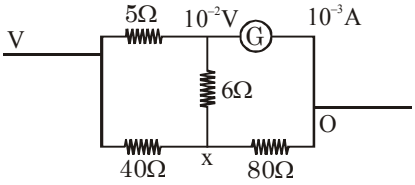
## PAPER-2

## PART-1 : PHYSICS  SOLUTION

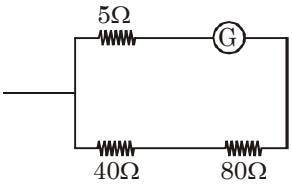
### SECTION-I

**1. Ans. (A)**

**Sol.**




whest stone bridge




$15 \times 10^{-3} = 120 \times i$

$i = \frac{1}{8} \times 10^{-3} A$

$\Rightarrow i_T = \frac{9}{8} mA$

$V = \frac{120 \times 15}{120 \times 15} \times \frac{9}{8} mA$

$= \frac{40}{3} \times \frac{9}{8} = 15 \text{ mV}$

**2. Ans. (C)**

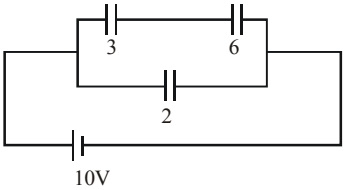
**Sol.** $C_{eq} = 4\ \mu F$

$U_{source} = E^2 C_{eq} = 10^2 \times 4 \times 10^{-6} = 4 \times 10^{-4}$ J

$\Rightarrow$ Heat generated

$= U = \frac{1}{2} C_{eq} E^2 = \frac{1}{2} \times (4\mu F) \times (10)^2 = 2 \times 10^{-4}$ J

$Q_1 = Q_2 = Q_3 = 2 \times 10^{-6} \times 10 = 20\ \mu C$




$C_{Eq} = 2 + 2 + 4\ \mu F$

$Q = 40\ \mu F$

$WD = \Delta QV = 40 \times 10 \times 10^{-6}$ J

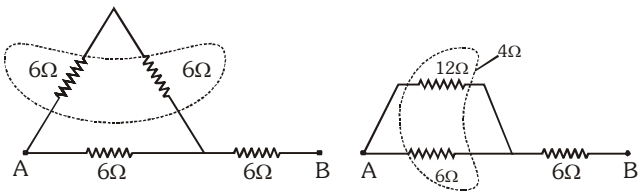
$= 4 \times 10^{-4}$ J

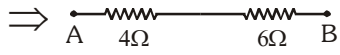
$\Delta H\ WD - \Delta U = \frac{1}{2} C_{Eq} V^2$

$= 2 \times 10^{-4}$ J

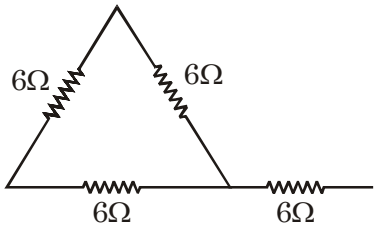
**3. Ans. (B)**

**Sol.**




$\Rightarrow$  $\Rightarrow R_{eq} = 10\Omega$






$R_{Eq} \frac{12 \times 6}{12 + 6} + 6 = 10\Omega$

**4. Ans. (C)**

**Sol.** $f\lambda = \sqrt{\frac{\gamma RT}{M}}$

$1100 \times 0.4 = \sqrt{\frac{\gamma \times \frac{25}{3} \times 300}{16 \times 10^{-3}}}$

$\frac{4 \times 440 \times 440 \times 16 \times 10^{-3}}{4 \times 25} = \gamma$

$= 121 \times 1024 \times 10^{-5} = \gamma$

$1.29 = \gamma$

**5. Ans. (B)**

**6. Ans. (A)**

**Sol.B** $T^2 = Cr^3$

$$\frac{8^2}{19200^3} = C$$

$$\frac{T_1^2}{8^2} = \left(\frac{18000}{19200}\right)^3 \Rightarrow T_1 = 8 \times (2.5)^{3/2}$$

$$T_2^2 = 8^2 \times \left(\frac{64000}{19200}\right)^3 \Rightarrow T_2 = 8 \times \left(\frac{10}{3}\right)^{3/2}$$

**7. Ans. (A, B)**

**Sol.** (A) $Q = Q_0\left(1 - \frac{1}{k}\right) = C_0V_0(k - 1)$

(C) $F = \frac{Q^2}{2A\varepsilon_0} = \frac{k^2C_0^2V_0^2}{2A\varepsilon_0}$

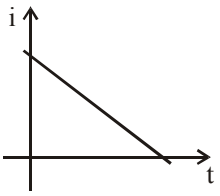
(D) $E_P = \frac{\sigma_P}{\varepsilon_0} = \frac{Q_P}{\varepsilon_0} = \frac{C_0V_0}{\varepsilon_0}\left(1 - \frac{1}{k}\right)$

**8. Ans. (B,C,D)**

**9. Ans. (B)**

**Sol.** $Q = at - bt^2$

$$\frac{dQ}{dt} = a - 2bt = 0$$

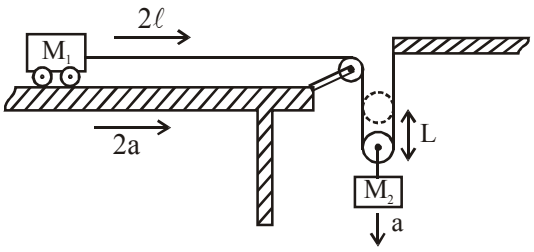



$$t = \frac{a}{2b}$$

$P_{max}$ at $t = 0$

**10. Ans. (A,D)**

**Sol.**



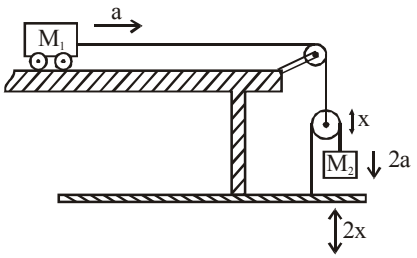

$M_2g - 2T = M_2a$

$2(T = M_1 \times 2a)$

$M_2g = (M_2 + 4M_1)a$

$$M_2 = \frac{M_2 + 4M_1}{2}$$

$M_2 = 4M_1$

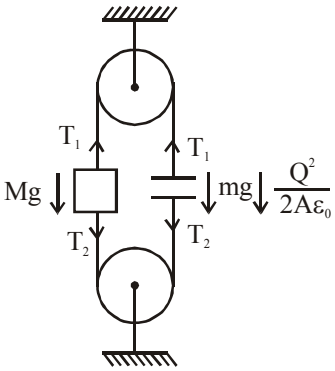



$a_{M_2}$ can't be 2g, So not possible.

**11. Ans. (B,C)**

**Sol.** $T_1 = Mg + T_2$

$$T_1 = mg + \frac{Q^2}{2A\varepsilon_0} = mg + \frac{CV^2}{2d}$$




$$T_2 + mg = \frac{Q^2}{2A\varepsilon_0} = \frac{CV^2}{2d}$$

$T_1 - T_2 = 2mg = Mg \quad \Rightarrow M = 2m$

$V_{min} \Rightarrow T_2 = 0$

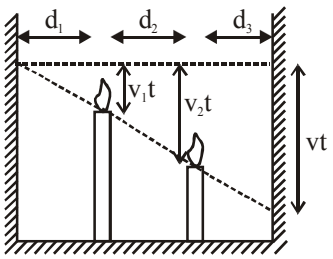
$$mg = \frac{1 \times 64}{2 \times 1} = 32$$

$m = 3.2$ kg

$M = 6.4$ kg

**12. Ans. (A,B,D)**

**Sol.** $\frac{v_1t}{v_2t} = \frac{d_1}{d_1 + d_2}$



$$\frac{v_2 t}{vt} = \frac{d_1 + d_2}{d_1 + d_2 + d_3}$$

$$v_2 = v\left(\frac{d_1 + d_2}{d_1 + d_2 + d_3}\right) = 1 \times \frac{30}{10} = \frac{1}{2} nm/s$$

$$v_1 = \frac{v_2 d_1}{d_1 + d_2} = v\left(\frac{d_1 + d_2}{d_1 + d_2 + d_3}\right)\left(\frac{d_1}{d_1 + d_2}\right)$$

$$= 1 \times \frac{1}{2} \times \frac{1}{3} = \frac{1}{6} mm/s$$

$$t_1 = \frac{200}{1/6} = 1200 \sec$$

$$t_2 = \frac{200}{1/2} = 400 \sec$$

**13. Ans. (B,C)**

**Sol.** $u = \frac{306 \times 5}{18} = \frac{1530}{18}$

$$f_1 = \frac{340 + 85}{340} \times 40 = 50 \text{ Hz}$$

$f_b = 50\text{-}40 = 10$ Hz

$$f_2 = \frac{340 \times 40}{340 - 85} = \frac{160}{3} Hz$$

$$f_{b'} = \frac{160}{3} - 40 = \frac{40}{3} Hz$$

**14. Ans. (A,B)**

**Sol.** $g - \omega^2 R = \frac{g}{3}$

$$\omega^2 R = \frac{2g}{3}$$

$$\left(\frac{2\pi}{60 \times 60}\right)^2 \times R = \frac{2}{3} \times \frac{GM}{R^2}$$

$$\frac{4\pi}{3600} \times \frac{3 \times 2}{2G} \frac{GM}{4/3R^3} = P$$

$$P = \frac{2\pi}{3600 \times 3600 \times 2 \times (20/3) \times 10^{-6}}$$

$$= \frac{10^6 \pi}{192} \approx 5000 \text{ p kg/m}^3$$

$$\omega^2 R = \frac{2g}{3} = \frac{2}{3}\frac{GM}{R^2}$$

$$\omega^2 (R + h) = \frac{GM}{(R + h)^2}$$

$$\left(1 + \frac{h}{R}\right) = \frac{3}{2}\frac{R^2}{(R + h)^2} \Rightarrow 1 + h = \sqrt{\frac{3}{2}}$$

$$\Rightarrow h = \left(\sqrt{\frac{3}{2}} - 1\right) R$$

$gh = g - \omega^2 R \cos^2\theta$

$$= g - \frac{2g}{3} \times \frac{1}{4} = \frac{5g}{6}$$

**15. Ans. (A)**

**Sol.** $\frac{E_0}{\ell_0} = \frac{IR}{\ell_1}$

$$I = \frac{5 \times 3}{15 \times 2.5} = 0.4A$$

**16. Ans. (A)**

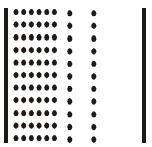
**Sol.** $\frac{10}{3} = \frac{0.5 \times R}{1.5}$

$\frac{15}{1.5} = R \Rightarrow R = 10\Omega$

**17. Ans. (A)**

**Sol.** $\oint \vec{E}.d\vec{A} = \frac{\int \rho A dx}{\varepsilon_0}$

$$E = \frac{\int \rho dx}{\varepsilon_0}$$



$$\frac{dE}{dx} = -\frac{d^2V}{dx^2} = \frac{\rho}{\varepsilon_0}$$

$$\frac{i}{A} = J = \rho v$$

$$-eV + \frac{1}{2}mv^2 = 0$$

$$v = \sqrt{\frac{2eV}{m}}$$

$$\Rightarrow \frac{i}{A}\sqrt{\frac{m}{2eV}} = \rho$$

$$\frac{d^2V}{dx^2} = \frac{-1}{\varepsilon_0} \times \frac{i}{A} \times \sqrt{\frac{m}{2eV}}$$

$$\Rightarrow \frac{d^2V}{dx^2} \propto \frac{1}{\sqrt{V}}$$

**18. Ans. (A)**

**Sol.** $$\frac{d}{dx}\left(\frac{dV}{dx}\right) = \frac{-i}{\varepsilon_0 A}\sqrt{\frac{m}{2e}} \times V^{-1/2}$$

$$\frac{d}{dV}\left(\frac{dV}{dx}\right) \times \frac{dV}{dx} = \frac{-i}{\varepsilon_0 A}\sqrt{\frac{m}{2e}} V^{-1/2}$$

Take $\frac{dV}{dx} = z$

$$\int z dz = \frac{-i}{\varepsilon_0 A}\sqrt{\frac{m}{2e}} \int V^{-1/2} dV$$

$$\frac{z^2}{2} = +\frac{i}{\varepsilon_0 A}\sqrt{\frac{m}{2e}} \times 2V^{1/2}$$

$$\frac{dV}{dx} = \sqrt{\frac{4i}{\varepsilon_0 A}\sqrt{\frac{m}{2e}}} V^{1/4}$$

$$\int V^{-1/4} dV = \sqrt{\frac{4i}{\varepsilon_0 A}\sqrt{\frac{m}{2\ell}}} \int dx$$

$$\frac{4}{3} V_0^{3/4} = \sqrt{\frac{4i}{\varepsilon_0 A}\sqrt{\frac{m}{2e}} \times d}$$

Squaring

$i \propto V_0^{3/2}$

## PART–2 : CHEMISTRY SOLUTION

### SECTION-I

**1. Ans. (B)**

atom A = $8 \times \frac{1}{8} + 5 \times \frac{1}{2} = \frac{7}{2}$

Atom B $\Rightarrow$ 4

**2. Ans. (C)**

**3. Ans. (D)**

**4. Ans. (D)**

**5. Ans. (A)**

**6. Ans. (B)**

**7. Ans.(A, B, C)**

We know that ;

$\Delta H_C^0$ [C(s)] = $\Delta H_F^0[CO_2(g)]$ & $\Delta H_C^0[H_2(g)]$ = $\Delta H_F^0(H_2O(l))$

$4C(s) + 5H_2(g) \rightarrow C_4H_{10}(g)$

$\Delta H_F^0 = [C_4H_{10}(g)] = 4\Delta H_C^0$ [C($l$)] + $5\Delta H_C^0$ [$H_2$(g)] – $\Delta H_C^0[C_4H_{10}(g)]$

$= 4(-400) + 5(-300) + 3000$
$= -1600 - 1500 + 3000$
$= -100$ kJ/mol

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

$\Delta H^0_{Combustion}[CH_4(g)] = [\Delta H_F^0[CO_2(g)] + 2\Delta H_F^0(H_2O(l))$

$- (\Delta H_F^0(CH_4(g) + 2\Delta H_F^0[O_2(g)])$

$\Delta H_C^0[CH_4(g)] = -400 - 600 + 100 = -900$ kJ/mol.

**8. Ans.(A,C)**

**9. Ans.(A,C,D)**

**10. Ans. (A,B,C)**

**11. Ans. (A,D)**

**12. Ans. (A,B,C)**

**13. Ans. (A,B,D)**

**14. Ans. (B,C,D)**

**15. Ans.(A)**

**16. Ans.(D)**

**17. Ans. (A)**

**18. Ans. (B)**

# PART-3 : MATHEMATICS SOLUTION

## SECTION-I

**1. Ans. (C)**

$$\lim_{k\to 0}\frac{\int_0^k\left(\frac{1-\cos 4x}{x^2+2}\right)dx}{2k^3}$$

Apply L'H Rule

$$\lim_{k\to 0}\frac{\left(\frac{1-\cos 4k}{k^2+2}\right)}{6k^2}=\lim_{k\to 0}\left(\frac{1-\cos 4k}{16k^2}\right)\cdot\frac{16k^2}{(k^2+2)}\cdot\frac{1}{6k^2}$$

$$=\lim_{k\to 0}\left(\frac{1}{2}\right)\frac{16}{(2)(6)}=\frac{2}{3}$$

**2. Ans. (D)**

$a = -2; b = -2; c = 2$

(use expansion of sinx, cosx, $e^x$)

**3. Ans. (D)**

$m - 2 = 9 \Rightarrow m = 11$

**4. Ans. (B)**

$f(\theta) = \sin(\sin\theta)$

$f'(\theta) = \cos(\sin\theta).\cos\theta$

$f''(\theta) = -\cos(\sin\theta)\sin\theta - \cos\theta^2(\sin(\sin\theta))$

$f''(\theta) + \tan\theta f'(\theta) + g(\theta) = 0.$

$-\cos\theta(\sin\theta)\sin\theta - \cos^2\theta(\sin(\sin\theta))$

$+ \sin\theta.\cos(\sin\theta) + g(\theta) = 0$

$\therefore\ g(\theta) = \cos^2\theta.\sin(\sin\theta)$

**5. Ans. (B)**

$$I=\int_{1/4}^{3/4}\frac{\ell nx}{\ell nx+\ell n(1-x)}dx \qquad ...(1)$$

$$I=\int_{1/4}^{3/4}\frac{\ell n(1-x)}{\ell nx+\ell n(1-x)}dx \qquad ...(2)$$

(using property)

add (1) and (2)

$$2I=\int_{1/4}^{3/4}dx\Rightarrow 2I=\left(\frac{3}{4}-\frac{1}{4}\right)$$

$$2I=\frac{1}{2}\Rightarrow I=\frac{1}{4}$$

**6. Ans. (Bonus)**

$$A_n=\lim_{n\to\infty}\sum_{r=1}^{3n}\frac{2rn}{r^2+n^2}=\lim_{n\to\infty}\sum_{r=1}^{3n}\left(\frac{2\left(\frac{r}{n}\right)}{\left(\frac{r^2}{n^2}\right)+1}\right)$$

$$A_n=\int_0^3\frac{2x}{1+x^2}dx\Rightarrow A_n=\ell n10$$

**7. Ans. (D)**

$y = \tan^{-1}(\sec x)$

$\tan y = \sec x \Rightarrow \sec^2 y\frac{dy}{dx}=\sec x\tan x$

$$\left.\frac{dy}{dx}\right|_{x=\frac{\pi}{4}}=\left.\frac{\sec x\tan x}{\sec^2 y}\right|_{x=\frac{\pi}{4}}=\frac{\sqrt{2}}{3}=\frac{\sqrt{a}}{b}$$

$\therefore\ a = 2$ and $b = 3$.

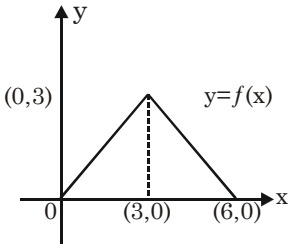
**8. Ans. (A,B,C)**

$f(\theta) = |\sin\theta| = \sin\theta$

$$\int_{\frac{\pi}{2}}^{\pi}\sin\theta d\theta=(-\cos\theta)\Big|_{\pi/2}^{\pi}=-(-1-0)=1$$

**9. Ans. (A,C)**

$f(x)$ is periodic with period '6'




$$\therefore\ \int_0^6 f(x)dx=\frac{1}{2}\times 6\times 3=9$$

**10. Ans. (B,C,D)**

$$f(x)=x^2+\int_0^x e^{-t}f(x-t)dt$$

$$f(x)=x^2+\int_0^x e^{-x+t}f(t)dt \quad \text{(using property)}$$

$$f(x)=x^2+e^{-x}\int_0^x e^t f(t)dt \qquad ...(1)$$

differentiate wrt 'x' both sides

$f'(x) = 2x + x^2$

$$\therefore\ f(x)=\frac{x^3}{3}+x^2+c$$

but $f(0) = 0$ (from (1))

Hence, $f(x)=\left(\frac{x^3}{3}+x^2\right)$

**11. Ans. (A,B,C)**

$$y = \frac{\left(x^2 + \sqrt{3}x + 2\right)\left(x^2 - \sqrt{3}x + 2\right)}{\left(x^2 + \sqrt{3}x + 2\right)}$$

$$\frac{dy}{dx} = 2x - \sqrt{3} \Rightarrow \alpha = 2; \beta = -\sqrt{3}$$

$$(\alpha - \beta) = 2 + \sqrt{3}$$

**12. Ans. (C)**

$p = 2$; $q = -5$ and $r = 6$

**13. Ans. (B,D)**

$$\frac{x}{a} + \frac{y}{b} = 1 \Rightarrow a + b = -1 \quad ...(1)$$

$$\frac{4}{a} + \frac{3}{b} = 1 \quad ....(2)$$

from (1) and (2)

$a = 2$; $b = -3$ or $a = -2$ and $b = 1$.

**14. Ans. (C,D)**

Do yourself

**Paragraph for Question 15 and 16**

$f(x) = (x - 1)^3 + 3$

$$g(x) = \tan^{-1}\left(\frac{x-1}{2}\right)$$

**15. Ans. (A)**

**16. Ans. (D)**

**Paragraph for Question 17 and 18**

$$\frac{f(x+y) - f(x)}{2} = \frac{f(y) - 2}{2} + xy \quad ...(1)$$

differentiate wrt 'x'

$$\frac{f'(x+y) - f'(x)}{2} = y$$

Put $x = 0$

$f'(y) - f'(0) = 2y$

$f'(y) = 2y + 3$

$f(y) = y^2 + 3y + c \quad ...(2)$

put $x = y = 0$ in (1) to get $f(0) = 2$

use $f(0) = 2$ in (2) to get $c = 2$

$\therefore f(x) = x^2 + 3x + 2$

**17. Ans. (B)**

**18. Ans. (C)**