JEE EXPERT

ANSWER KEY

JEE Mains

MODULE TEST (MT - 01)

Batch : 11^{TH} (Zenith - A01 & A02)

Date 25.08.2019

PHYSICS

1	(A)	2	(D)	3	(A)	4	(D)	5	(B)
6	(C)	7	(D)	8	(C)	9	(C)	10	(A)
11	(A)	12	(B)	13	(A)	14	(A)	15	(B)
16	(A)	17	(B)	18	(C)	19	(D)	20	(B)
21	(C)	22	(D)	23	(A)	24	(B)	25	(D)
26	(C)	27	(A)	28	(D)	29	(A)	30	(C)

CHEMISTRY

31	(A)	32	(C)	33	(A)	34	(B)	35	(B)
36	(B)	37	(A)	38	(B)	39	(D)	40	(B)
41	(D)	42	(A)	43	(D)	44	(C)	45	(C)
46	(D)	47	(D)	48	(B)	49	(C)	50	(D)
51	(B)	52	(B)	53	(D)	54	(D)	55	(A)
56	(A)	57	(C)	58	(C)	59	(C)	60	(B)

MATHEMATICS

61	(C)	62	(C)	63	(D)	64	(C)	65	(C)
66	(B)	67	(A)	68	(C)	69	(A)	70	(C)
71	(A)	72	(D)	73	(B)	74	(B)	75	(B)
76	(C)	77	(C)	78	(C)	79	(A)	80	(D)
81	(B)	82	(B)	83	(C)	84	(D)	85	(B)
86	(C)	87	(A)	88	(A)	89	(A)	90	(C)

JEE EXPERT

SOLUTIONS

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PART - I : PHYSICS

1. **Sol. (A)**

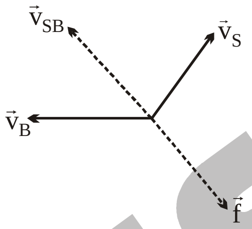
WD by friction force on a system is ref. frame inpendent.

[$\therefore$ $WD_f = -\mu mgL$]

2. **Sol. (D)**

3. **Sol. (A)**

$$\vec{v}_{SB} = \vec{v}_S - \vec{v}_B = \vec{v}_S + (-\vec{v}_B)$$

i.e. 

4. **Sol. (D)**

$v_{Ax} = v_{Bx}$

$v_{Ay}^2 + v_{Bx}^2 > v_{By}^2 + v_{Bx}^2$

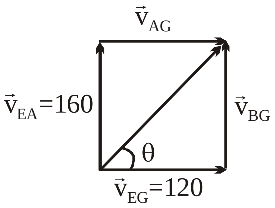
$\therefore$ $v_{Ay} > v_{By}$

$R = \dfrac{2v_x v_y}{g}$ $\quad\therefore R_A > R_B$

$H = \dfrac{2v_y^2}{g}$ $\quad\therefore H_A > H_B$

$T = \dfrac{2v_y}{g}$ $\quad\therefore T_A > T_B$]

5. **Sol. (B)**



$$\therefore \tan\theta = \frac{160}{120} = \frac{4}{3}$$

$$\theta = 53^\circ \quad]$$

6. **Sol. (C)**

$$W = \int_0^{\infty} P\,dt = \int_0^{\infty} \frac{P_0 t_0^2}{(t+t_0)^2}\,dt = P_0 t_0 \ ]$$

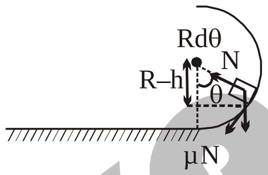
7. **Sol. (D)**

$$WD = \int_0^{\theta_0} \mu mg \cos\theta . R d\theta$$

$$= \mu mg R \sin\theta_0$$

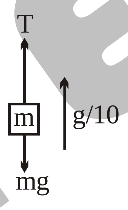
$$= \mu mg [R^2 - (R-h)^2]^{1/2}$$

$$= \mu mg [2Rh - h^2]^{1/2} \quad]$$



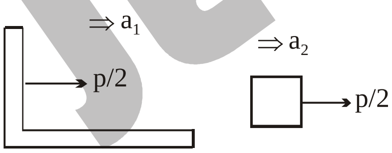
8. **Sol. (C)**

FBD in both cases is same.



]

9. **Sol. (C)**



$\therefore$ $a_1 = a_2 = p/2m$

$\therefore$ acceleration of pulley = $p/2m$]

10. **Sol. (A)**

Since $WD_C = -\Delta U$

11. **Sol. (A)**

12. Sol. (B)

$$\frac{1}{2}(M+m)v_0^2 = \frac{1}{2}kx_m^2$$

$$kx_m = \mu_s(M+m)g$$

$$x_m = \mu_s / k$$

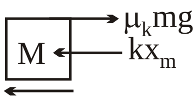
$$\frac{1}{2}(M+m)u_0^2 = \frac{1}{2}k\left(\frac{(M+m)\mu_s g}{k}\right)^2$$

$$k = \left(\frac{\mu_s g}{v_0}\right)^2 (M+m) \quad]$$

13. Sol. (A)

$$a_{Box} = \mu_k g$$

$$a_{Block} = (\mu_s - \mu_k)\frac{mg}{M}$$



$$a_{Block} = \frac{kx_m - \mu_k mg}{M}$$

$$= (\mu_s - \mu_k)\frac{mg}{M}$$

14. Sol. (A)

15. Sol. (B)

In order for the box to accelerate up the incline, there must be an upward-directed force ... this is coming from the force of static friction acting on the box by the contact with the plank.]

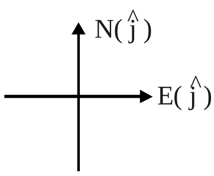
16. Sol. (A)

17. Sol. (B)

$$\vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \vec{F}_4 + \vec{F}_5 = 2(4\hat{i})$$

and $$\vec{F}_2 + \vec{F}_3 + \vec{F}_4 + \vec{F}_5 = 2(7\hat{j})$$

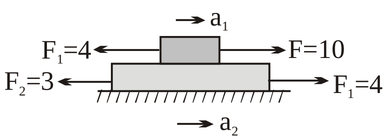
$$\vec{F}_1 = 8\hat{i} - 14\hat{j}$$



$$\vec{a}_1 = 4\hat{i} - 7\hat{j}$$

$$\sqrt{16+49} = \sqrt{65}\ \text{m/s}^2$$

18. Sol. (C)



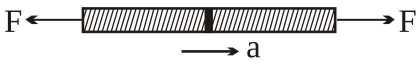
$$a_1 = \frac{F - F_1}{m_1} = \frac{10-4}{1} = 6 m/s^2$$

$$a_2 = \frac{F_1 - F_2}{m_2} = \frac{4-3}{2} = 0.5 \text{ m/s}^2 \quad]$$

19. Sol. (D)

$F - F = Ma$

$$T - \frac{F}{2} = \frac{M}{2}a$$



$$\Rightarrow T = \frac{F}{2} = \frac{Mg}{2} \quad]$$

20. Sol. (B)

(A) Spring force applies pulling force the ball radially inward.

(B) Observer on plat form sees the ball at rest, not moving at any speed.

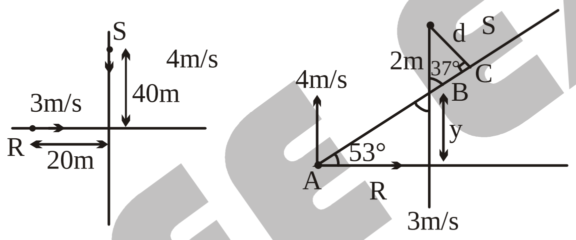
(C) Newton's law is applicable in inertial

(D) Frame only.]

21. Sol. (C)

$$V_{S/R} = \sqrt{3^2 + 4^2} = 5 \quad]$$

22. Sol. (D)



$$\tan 53° = \frac{y}{20}$$

$$y = 20 \times \frac{4}{3} = \frac{80}{3}$$

$$\sin 37° = \frac{d}{40 - \frac{80}{3}} \qquad d = \frac{3}{5}\left[\frac{40}{3}\right] = 8 \text{ m} \quad]$$

23. Sol. (A)

$$\tan 37° = \frac{8}{BC}$$

$$\frac{3}{4} = \frac{8}{BC}$$

$$BC = \frac{32}{3}$$

$$\sin 53° = \frac{80}{3AB}$$

$$\frac{4}{5} = \frac{80}{3\times AB}$$

$$AB = \frac{100}{3}$$

$$t = \frac{\frac{32}{3}+\frac{100}{3}}{5} = \frac{132}{15} = 8.8 \text{ sec.}$$

24 Sol. (B)

$S_{ABX} = 0$

$v_0 \sin\theta_2 - kv_0\cos\theta_1 = 0$

$\therefore\ k = \dfrac{\sin\theta_2}{\cos\theta_1}$]

25. Sol. (D)

Isolated means no real forces act on the day.

(A) In a non-inertial reference frame, a pseudoforce will act on the isolated body. Thus, in that frme the body will have accelaration so $\hat{v} \neq \text{const.}$ ·

(C) In an inertial frame, no force acts on an isolated particle. $\therefore\ \vec{a} = \vec{0}\ \vec{v} = \overrightarrow{\text{const}}.$]

26. Sol. (C)

27. Sol. (A)

28. Sol. (D)

29. Sol. (A)

30. Sol. (C)

PART - III : MATHEMATICS

61. **(C)** The line passes through the interior point (1, 1). So m can have any real value.

62. **(C)**The combined equation of the tangents drawn from (0, 0) to $x^2 + y^2 - 2rx - 2hy + h^2 = 0$ is

$$(x^2 + y^2 - 2rx - 2hy + h^2)h^2 = (-rx - hy + h^2)^2$$

This equation represents a pair of perpendicular straight lines

If coefficient of x^2 + coefficient of $y^2 = 0 \Rightarrow 2h^2 - r^2 - h^2 = 0$

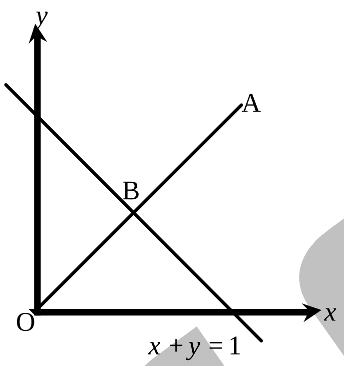
$\Rightarrow \quad r^2 = h^2$ or $r = \pm h$.

63. **(D)** Centre of the circle is (0, 0)

A is the image of the origin in the line $x + y = 1$

$$OB = \frac{1}{\sqrt{2}} \Rightarrow OA = \sqrt{2}$$

$\therefore \quad A \equiv (1, 1)$



64. **(C)** $r = \sqrt{(4-1)^2 + (6-2)^2} = \sqrt{9+16} = 5$

$\therefore \quad$ Area $= \pi r^2$

65. **(C)** Equation of radical axis (i.e. common chord) of the two circles is

$$10x + 4y - a - b = 0 \quad \ldots(i)$$

Centre of first circle is H(–4, –4).

Since second circle bisects the circumference of the first circle, therefore, centre H(–4, –4) of the first circle must lie on the common chord (i)

$\therefore \; -40 - 16 - a - b = 0 \Rightarrow a + b = -56$

66. **(B)** Let $P(a\cos\theta, b\sin\theta)$ be a point on $x^2 + y^2 = a^2$

Chord of contact of tangents from P to circle $x^2 + y^2 = b^2$ is

$$xa\cos\theta + ya\sin\theta = b^2$$

or $\quad y = -\cot\theta\, x + \dfrac{b^2}{a}\operatorname{cosec}\theta \qquad \ldots(i)$

Since line (i) is tangent to circle $x^2 + y^2 = c^2$

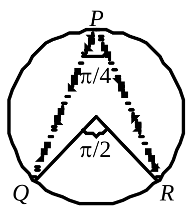
$\therefore \quad \left(\dfrac{b^2}{a}\operatorname{cosec}\theta\right)^2 = c^2 (1 + \cot^2\theta)$

or $\quad b^2 = ac$

$\therefore$ Roots of equation $ax^2 + 2bx + c = 0$ are real and equal.0

67. **(A)** The pair of straight lines $2x^2 + 3xy - 2y^2 - 9x + 7y - 5 = 0$ are perpendicular to each other so orthocentre is point of intersection of these lines.

68. **(C)**



69. **(A)** $2 . (1) (0) + 2(k) = k + 6$

or $\quad 2k^2 - k - 6 = 0$

or $\quad 2k^2 - 4k + 3k - 6 = 0$

or $\quad k = -3/2 , + 2$

70. **(C)** Equation of the circle through the origin can be written as

$$x^2 + y^2 + 2gx + 2fy = 0 \ldots(i)$$

It cuts the two given circles orthogonally

so $\quad 2.0. g - 2.4.f = 12 + 0$

and $\quad -4g - 6f = -3 + 0$

Solving $g = 3, f = -3/2$

$\therefore$ The equation of circle is $x^2 + y^2 + 6x - 3y = 0$

71. **(A)** | x | = | y | x – y = 0 and x + y = 0

Bisectors of the angles between these are $\frac{x-y}{\sqrt{2}} = \pm\frac{x+y}{\sqrt{2}}$ $\Rightarrow$ y = 0 and x = 0

By solving y = 0, x + y = 3 we get one of the required points while by solving x = 0, x + y = 3 we get the other point.

72. **(D)** Let (h, k) be the point on the locus. Then by the given conditions

$$(h-a_1)^2+(k-b_1)^2=(h-a_2)^2+(k-b_2)^2$$

$$\Rightarrow \quad 2h(a_{12}-a_2)+2k(b_1-b_2)+a_2^2+b_2^2-a_1^2-b_1^2=0$$

$$\Rightarrow \quad h(a_1-a_2)+k(b_1+b_2)+\frac{1}{2}(a_2^2+b_2^2-a_1^2-b_1^2)=0 \quad \ldots(i)$$

Also, since (h, k) lies on the given locus, therefore

$$(a_1-a_2)h+(b_1-b_2)k+c=0 \quad \ldots(ii)$$

Comparing (i) and (ii), we get

$$c=\frac{1}{2}(a_2^2+b_2^2--a_1^2-b_1^2)$$

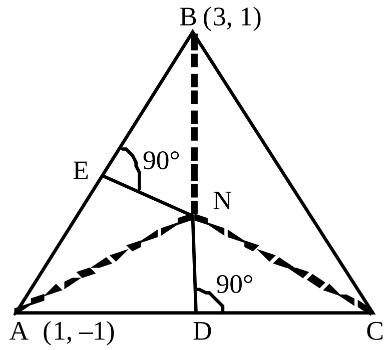
73. **(B)**

74. **(B)** Since a, b, c are in A.P.

$\Rightarrow$ 2b = a + c $\Rightarrow$ a – 2b + c = 0

$\Rightarrow$ Family of lines is concurrent at the point (1, –2)

75. **(B)** E is mid of AB $\Rightarrow$ E (2, 0)



Slope of $AB=\frac{1+1}{3-1}=1$, $EN \perp AB$

$\therefore$ Equation of EN is $y-0=-1(x-2)$

$\Rightarrow$ $x+y-2=0$ …(i)

Equation of DN is $3x-2y+8=0$ …(ii)

Solving (i) and (ii), we get $N\left(-\frac{4}{5},\frac{14}{5}\right)$, which is the circumcentre.

76. **(C)** Let $lx+my+n=0$ and $lx+my+n_1=0$ represent parallel lines given by

$$ax^2+2hxy+by^2+2gx+2fy+c=0$$

$$\therefore \quad ax^2+2hxy+by^2+2gx+2fy+c=(lx+my+n)(lx+my+n_1)$$

$$\therefore \quad l^2=a \quad \ldots(i)$$

$$m^2=b \quad \ldots(ii)$$

$$nn_1 = c \qquad \ldots(iii)$$

$$m(n+n_1) = 2f \qquad \ldots(iv)$$

$$l(n+n_1) = 2g \qquad \ldots(v)$$

$$2lm = 2h \qquad \ldots(vi)$$

From (vi) $\Rightarrow \; h = lm \quad \therefore \; h^2 = l^2m^2 = ab$

$$\therefore \quad \frac{a}{h} = \frac{h}{b} \qquad \ldots(vii)$$

Also $\dfrac{2g}{2f} = \dfrac{l(n+n_1)}{m(n+n_1)} \quad \Rightarrow \quad \dfrac{g}{f} = \dfrac{l}{m} = \dfrac{lm}{m^2} = \dfrac{h}{b}$

$$\therefore \quad \frac{h}{b} = \frac{g}{f} \qquad \ldots(viii)$$

From (vii) and (viii) $\Rightarrow \; \dfrac{a}{h} = \dfrac{h}{b} = \dfrac{g}{f}$

77. **(C)** We have, $L_1(0,\,0)\,L_1(a,\,3) > 0$ and $L_2(0,\,0)\,L_2(a,\,3) > 0$

$\Rightarrow \quad -5(a+3-5) > 0$ and $6(2a-3+6) > 0$

$\Rightarrow \quad a < 2$ and $a > -\dfrac{3}{2} \;\Rightarrow$ a must lie between $-\dfrac{3}{2}$ and 2.

78. **(C)**

79. **(A)** Let the co-ordinates of A be (a, 0)

Then the slope of the reflected ray is $\dfrac{3-0}{5-a} = \tan\theta$ (say) $\qquad \ldots$(i)

Then the slope of the incident ray $= \dfrac{2-0}{1-a} = \tan(\pi-\theta) \; \ldots$(ii)

From (i) and (ii), $\because \quad \tan\theta + \tan(\pi-\theta) = 0$

$\Rightarrow \quad \dfrac{3}{5-a} + \dfrac{2}{1-a} = 0 \;\Rightarrow\; 3-3a+10-2a = 0 \;\Rightarrow\; a = \dfrac{13}{5}$

Thus, the co-ordinates of A are

80. **(D)** Let (h, k) be the centroid of the given triangle ABC with coordinates of C as (α, β), then

$h = \dfrac{\alpha+2+4}{3},\; k = \dfrac{\beta+5-11}{3} \;\Rightarrow\; \alpha = 3h-6,\; \beta = 3k+6$

Since $C(\alpha,\,\beta)$ lies on $L_1 : 9x+7y+4=0$

$\Rightarrow \quad 9(3h-6)+7(3k+6)+4=0 \;\Rightarrow\; 3(9h+7k)-8=0$

so that locus of (h, k) is $9x + 7y - \frac{8}{3} = 0$, which is parallel to L_1.

81. (B)

82. (B)

83. (C)

84. (D)

85. **(B)** Given, $x = \frac{2\sin\alpha}{1+\cos\alpha+\sin\alpha} \Rightarrow x(1+\cos\alpha) = (2-x)\sin\alpha$

Let $y = \frac{1-\cos\alpha+\sin\alpha}{1+\sin\alpha}$

Now $\frac{x}{y} = \frac{2\sin\alpha(1+\sin\alpha)}{(1+\sin\alpha)^2 - \cos^2\alpha} = \frac{2\sin\alpha(1+\sin\alpha)}{1+\sin^2\alpha+2\sin\alpha-1+\sin^2\alpha} = 1 \Rightarrow x = y$

86. (C)

87. (A)

88. **(A)** $\sqrt{3}\cot 20° - 4\cos 20° = \frac{\sqrt{3}\cos 20°}{\sin 20°} - 4\cos 20°$

$$= \frac{\sqrt{3}\cos 20° - 4\sin 20°\cos 20°}{\sin 20°} = \frac{2\left[\frac{\sqrt{3}}{2}\cos 20° - 2\sin 20°\cos 20°\right]}{\sin 20°}$$

$$= \frac{2\ (\sin 60°\cos 20° - \sin 40°)}{\sin 20°} = \frac{[2\sin 60°\cos 20° - 2\sin 40°]}{\sin 20°}$$

$$= \frac{\sin 80° + \sin 40° - 2\sin 40°}{\sin 20°} = \frac{\sin 80° - \sin 40°}{\sin 20°}$$

$$= \frac{2\cos 60°\ .\ \sin 20°}{\sin 20°} = 2\cos 60° = 1.$$

89. **(A)**

90. **(C)**

For positive integral value of n

$$\sin\left(\frac{\pi}{n}\right)\cdot\sin\left(\frac{2\pi}{n}\right)\cdot......\cdot\sin\frac{(n-1)\pi}{n} = \frac{n}{2^{n-1}}$$