JEE EXPERT

ANSWER KEY

REGULAR TEST SERIES - (RTS-03)
Batch : 11^{TH} (Zenith - B01)
Date 25.08.2019

PHYSICS

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

CHEMISTRY

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

MATHEMATICS

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

JEE EXPERT

SOLUTIONS

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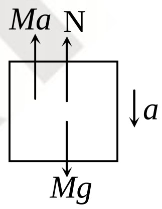
PHYSICS

1. **Sol.:** F.B.D. of block is as shown



$Mg = N + Ma$

$Mg = \frac{Mg}{4} + Ma$ $\qquad a = \frac{3g}{4}$

y **(C)**

2. **Sol.:** **(A)**

3. **Sol.:** $a = \frac{Mg\sin\theta}{2M}$ and $T = Ma$

y **(C)**

4. **Sol.:** $a = \frac{mg - \mu mg}{2m}$ = 0.4 g m/s^2

y **(B)**

5. **Sol.:** $19.6 = \mu \times 10 \times 9.8$

μ = 0.2

y **(B)**

6. **Sol.:** F – 7g = 7a, T – 2g = 2a

On solving F = 140 N

y **(A)**

7. **Sol.:** The inclined plane exerts a force of mg cos θ perpendicular to inclination and mg sin θ along inclination.

y **(A)**

8. **Sol.:** For equilibrium of $\sqrt{2}$ M block

$2T\cos\theta = \sqrt{2}Mg$, T = Mg, $\cos\theta = \frac{1}{\sqrt{2}}$, θ = 45°

∴ **(C)**

9. **Sol.:** Thrust on the block $F = v\dfrac{dm}{dt} = 5$ N

Acceleration of the block $= \dfrac{F}{M} = \dfrac{5}{2}\ ms^{-2}$

y **(B)**

10. **Sol.:** $a = \left(\dfrac{M-m}{M+m}\right)g$, $s = \dfrac{1}{2}at^2 \Rightarrow 1.4 = \dfrac{1}{2}\left(\dfrac{M-m}{M+m}\right)g\,(2)^2 \Rightarrow \dfrac{m}{M} = \dfrac{13}{15}$

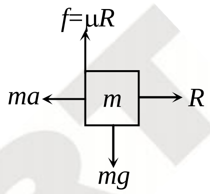
y **(A)**

11. **Sol.:** $\Sigma F_y = 0$, R = ma

Mg = μR = μma

$\mu = \dfrac{g}{a} = 0.5$

y **(C)**



12. **Sol.:** $\vec{a} = \dfrac{\vec{F}}{m} = \dfrac{3\hat{i}+\hat{j}}{0.1} = 30\hat{i} + 10\hat{j}$

$\vec{r}(t) = \vec{r}(0) + \vec{u}t + \dfrac{1}{2}\vec{a}t^2$

$\vec{r}(t) = \hat{i}(5t + 15t^2) + \hat{j}(-2 - 2t + 5t^2)$

x = 10 $\Rightarrow$ $5t + 15t^2 = 10$ $\Rightarrow$ t = $\dfrac{2}{3}$ s

$y = -2 - 2t + 5t^2 = -\dfrac{10}{9}$ m

$\therefore$ **(C)**

13. **Sol.:** $mg\sin\theta = 5\text{N}$,

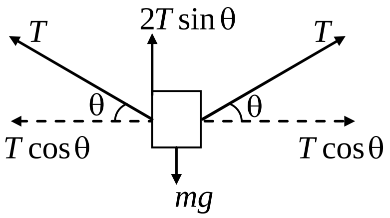
$f_l = \mu mg\cos\theta = 3.4\,\text{N}$,

$a = \dfrac{mg\sin\theta - f}{m} = 1.6\ \text{ms}^{-2}$

$\therefore$ **(B)**

14. **Sol.:** **(B)**

15. **Sol.:** $2T\sin\theta = mg$



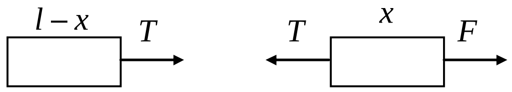
$\Rightarrow \quad T = \dfrac{mg}{2\sin\theta}$

But $\quad \theta = 0$

$\Rightarrow \quad T = \infty$

$\therefore$ **(D)**

16. **Sol.:** $F - T = \dfrac{M}{L}xa$



$T = \dfrac{M}{L}(L-x)a$

$\Rightarrow \quad T = \dfrac{F}{L}(L-x)$

$\therefore$ **(C)**

17. **Sol.:** $f^{s} = \mu\, mg\cos\theta = 0.7\times 2\times 9.8\times\dfrac{\sqrt{3}}{2} > 9.8$

$\therefore \quad f = mg\sin\theta = 9.8$

$\therefore$ **(A)**

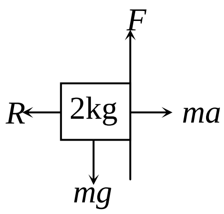
18. **Sol.:** $\mu mg = m\left(\dfrac{mg}{4m}\right) \Rightarrow \mu = \dfrac{1}{4}$

y **(C)**

19. **Sol.:** $a_{\max} = \mu g$

y **(A)**

20. **Sol.:** $F > mg$



Ĝ $\mu(R) > mg$

Ĝ $\mu(ma) > mg$

Ĝ $\mu > \dfrac{g}{a}$

y **(A)**

21. **Sol.:** For constant velocity $\mathrm{F = mg}$, so acceleration of man $\mathrm{a} = \dfrac{\mathrm{F}}{2\mathrm{m}} = \dfrac{\mathrm{g}}{2}$

y **(D)**

22. **Sol.:** $N = m_A(g-a) = 0.5(10-2) = 4\ \mathrm{N}$

y **(B)**

23. **Sol.:** Friction is static so $a = 0\ \text{m/s}^2$, $f = T\cos 60 = 40\cos 60 = 20\ \text{N}$

y **(C)**

24. **Sol.:** Maximum friction force is 50 N which is greater than 40 N. Block does not move.

y **(A)**

25. **Sol.:** From constraint relation, $a_B = 8a_A$

y **(C)**

26. **Sol.:** Coefficient of friction $\mu_s = \frac{F_1}{R} = \frac{75}{mg} = \frac{75}{20 \times 9.8} = 0.38$

y **(D)**

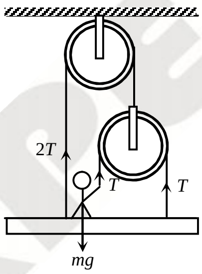
27. **Sol.:** $mv\frac{dv}{dx} = -Ax \quad \Rightarrow \quad \int_v^0 mv\,dv = -\int_0^x Ax\,dx \quad \Rightarrow \quad m\frac{v^2}{2} = A\frac{x^2}{2} \quad \Rightarrow \quad x = v\sqrt{\frac{m}{A}}$

y **(A)**

28. **Sol.:** $4T = mg$

$\therefore \quad T = \frac{60 \times 10}{4} = 150\ \text{N}$

y **(A)**



29. **Sol.:** **(C)** $mg - B = mf$

$B - (m - m')g = (m - m')f$

$\Rightarrow \quad m'g = (2m - m')f \quad \Rightarrow \quad m' = \frac{2mf}{g + f}$

$\Rightarrow \quad w' = \frac{2wf}{g + f}$

30. **Sol.:** $\mu ma = mg$ or $a = \frac{g}{\mu}$

y **(B)**

61 **Sol. (B)** **62** **Sol. (A)** **63** **Sol. (C)**

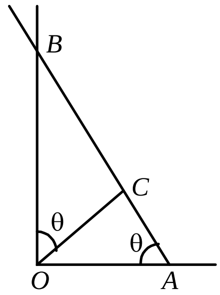
64. **Sol. (C)** Here a = 1, b = 1, h = 2

$$\tan\theta = \left|\frac{2\sqrt{h^2 - ab}}{a+b}\right| = \frac{2\sqrt{4-1}}{2} = \sqrt{3}$$

$\therefore$ $\theta = 60°$

65. **Sol. (C)** $(x + y - 1)(x - y - 4) = 0$

66. **Sol. (D)** $\tan(180° - \theta)$ = slope of AB = –3



$\therefore$ $\tan\theta = 3$

$\therefore$ $\frac{OC}{AC} = \tan\theta$, $\frac{OC}{BC} = \cot\theta$

$\Rightarrow$ $\frac{BC}{AC} = \frac{\tan\theta}{\cot\theta} = \tan^2\theta = 9.$

67. **Sol. (B)**

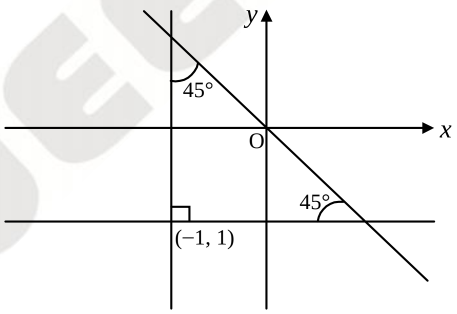
The sides are x + y – 4 = 0, x – 1 = 0, y – 2 = 0. So, the triangle is right angled at (1, 2).

The hypotenuse is x + y – 4 = 0 whose ends are (1, 3) and (2, 2).

The circumcentre = $\left(\frac{1+2}{2}, \frac{3+2}{2}\right)$ and circumradius $= \frac{1}{2}\sqrt{(1-2)^2 + (3-2)^2} = \frac{1}{\sqrt{2}}$.

68. **Sol. (D)**

Clearly joint equation of lines is (y + 1) (x + 1) = 0



$\Rightarrow$ x + y + xy + 1 = 0

69. **Sol. (B)** The pair of straight lines $6xy - 2x - 3y + 1 = 0$ are perpendicular to each other i.e., (2x – 1) (3y – 1) = 0. So orthocentre is the point of intersection of these lines.

70. **Sol. (D)** Given pair of lines is $y^2 - 9xy + 18x^2 = 0$ …(i)

or $(y-3x)(y-6x) = 0$

Hence given lines are $y - 3x = 0$ …(ii)

$y - 6x = 0$ …(iii)

and y = a …(iv)

Vertices of triangle formed are $(0,\ 0), \left(\frac{a}{3},\ a\right), \left(\frac{a}{6},\ a\right)$

Area of the triangle = $\frac{1}{2}\left|\left(\frac{a}{3}.a - a.\frac{a}{6}\right)\right| = \frac{a^2}{12}$

71. **Sol. (A)** $(x+y-1)p + (2x-3y+1)q = 0$

Hence, x + y – 1 = 0 …(i)

2x – 3y + 1 = 0 …(ii)

$\therefore$ (i) and (ii), passes through $\left(\frac{2}{5},\ \frac{3}{5}\right)$

72. **Sol. (C)** Any line through (1, 2) can be written as $\frac{x-1}{\cos\theta} = \frac{y-2}{\sin\theta} = r$

where θ is the angle which this line makes with positive direction of x-axis. Any point on this line is (r cosθ + 1, r cosθ + 2) when $|r| = \frac{1}{3}\sqrt{6}$, this point lies on the line x + y = 4.

i.e. r cosθ + 1 + r sinθ + 2 = 4,

$|r| = \frac{1}{3}\sqrt{6} \quad \Rightarrow \quad r(\cos\theta + \sin\theta) = 1,\ |r| = \frac{1}{3}\sqrt{6}$

$\Rightarrow \quad r^2\ (1 + 2\sin\theta\cos\theta) = 1,\ r^2 = \frac{6}{9} \quad \Rightarrow \quad 1 + \sin 2\theta = \frac{1}{r^2} = \frac{9}{6} \quad \Rightarrow \quad \sin 2\theta = \frac{1}{2}$

$\Rightarrow \quad 2\theta = \frac{\pi}{6}$ or $\frac{5\pi}{6} \quad \Rightarrow \quad \theta = \frac{\pi}{12}$ or $\frac{5\pi}{12}$

73. **Sol. (C)** If the image of a point P in a line l is P′, then mid point of [PP′] lies on the line l and the line PP′ is perpendicular to the line l.

74. **Sol. (B)** $\sqrt{3}x + y = 0$ makes an angle of 120° with OX and $\sqrt{3}x - y = 0$ makes an angle 60° with OX. So, the required line is y – 2 = 0.

75. **Sol. (C)** Let $\alpha = t^2,\ \beta = t + 1 \quad \Rightarrow \quad t = \beta - 1$

$\therefore \quad \alpha = (\beta - 1)^2 \quad \Rightarrow \quad x = (y-1)^2$

76. **Sol. (C)** A(0, 0), B(2, 0) and C(0, 2) form a right angled triangle, right angle at A (0, 0) and BC hypotenuse.

So A(0, 0) is orthocentre and mid-point D of BC i.e. (1, 1) is circumcentre.

$\therefore$ distance between circumcentre and orthocentre = AD = $\sqrt{2}$.

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

$$h = \frac{\alpha + 2 + 4}{3},\ k = \frac{\beta + 5 - 11}{3}$$

$\Rightarrow$ $\alpha = 3h - 6$, $\beta = 3k + 6$

Since C(α, β) lies on L_1 : $9x + 7y + 4 = 0$

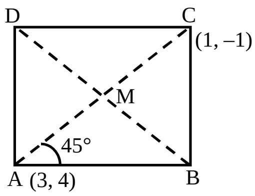
$9(3h - 6) + 7(3k + 6) + 4 = 0$

$\Rightarrow$ $3(9h + 7k) - 8 = 0$

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

78. **Sol. (A)** $\dfrac{\Delta DBC}{\Delta ABC} = \dfrac{1}{2} \Rightarrow 2\begin{vmatrix} x & 3x & 1 \\ -3 & 5 & 1 \\ 4 & -2 & 1 \end{vmatrix} = \begin{vmatrix} 6 & 3 & 1 \\ -3 & 5 & 1 \\ 4 & -2 & 1 \end{vmatrix} \Rightarrow x = \dfrac{11}{8}$

79. **Sol. (C)** Middle point M of diagonal AC is



$$M\left(\frac{3+1}{2}, \frac{4-1}{2}\right) = M\left(2, \frac{3}{2}\right)$$

If D is D(h, k) …(i)

and $B(x_1, y_1)$, then $2 = \dfrac{x_1 + h}{2}, \dfrac{3}{2} = \dfrac{y_1 + k}{2}$

$\Rightarrow$ $x_1 = 4 - h,\ y_1 = 3 - k$

Now, $B(x_1, y_1)$ is $B(4 - h, 3 - k)$ …(ii)

Suppose slope of AB is m and slope of AC is $\dfrac{4+1}{3-1} = \dfrac{5}{2}$

Then $\tan(45°) = \left|\dfrac{m - \frac{5}{2}}{1 + \frac{5m}{2}}\right| \Rightarrow (2m - 5) = \pm(2 + 5m)$

$\Rightarrow$ $m = -\dfrac{7}{3}, \dfrac{3}{7} \Rightarrow$ Equation of AB is $y - 4 = -\dfrac{7}{3}(x - 3)$

or $7x + 3y - 33 = 0$ and equation of BC is $y + 1 = \dfrac{3}{7}(x - 1)$ or $3x - 7y - 10 = 0$

solving these two equations we get B $\left(\dfrac{9}{2}, \dfrac{1}{2}\right)$

$\Rightarrow$ $\dfrac{9}{2} = 4 - h, \dfrac{1}{2} = 3 - k$ by (ii)

$$\Rightarrow \quad h = -\frac{1}{2},\ k = \frac{5}{2} \quad \Rightarrow\ D(h,\ k) = \left(-\frac{1}{2},\ \frac{5}{2}\right)$$

80. **Sol. (C)** $\tan\theta = \left|\frac{2+1}{1-2}\right| = 3$

$\Rightarrow \quad \theta = \tan^{-1} 3$

81. **Sol. (C)** $(3x - y + 1)(x + 2y - 5)\big|_{(0,\ 0)} < 0$

So, $(3x - y + 1)\,(x + 2y - 5)\big|_{a^2,\ a+1} < 0 \quad \Rightarrow \quad (3a^2 - a)\,(a^2 + 2a + 2 - 5) < 0$

$\Rightarrow \quad a(3a-1)(a-1)(a+3) < 0 \quad \Rightarrow \quad a \in (-3,\ 0) \cup \left(\frac{1}{3},\ 1\right)$

82. **Sol. (B)**

83. **Sol. (B)**

84. **Sol. (B)**

85. **Sol. (B)** $(\cos 20° + \sin 20°)^2 + (\cos 20° - \sin 20°)^2 = 2$

$\therefore \cos 20° + \sin 20° = \sqrt{2 - p^2} > 0$

$\therefore \cos 40° = (\cos 20° - \sin 20°)\,(\cos 20° + \sin 20°) = p\sqrt{2 - p^2}$.

86. **Sol. (B)** $\sec\alpha + \operatorname{cosec}\alpha = p$, $\sec\alpha \,.\, \operatorname{cosec}\alpha = q$

$\therefore\ \sin\alpha + \cos\alpha = p\sin\alpha \,.\, \cos\alpha$, $\sin\alpha.\ \cos\alpha = \frac{1}{q}$

$\therefore\ \sin\alpha + \cos\alpha = \frac{p}{q}$

$\therefore\ \frac{p^2}{q^2} = 1 + 2\sin\alpha.\cos\alpha = 1 + \frac{2}{q}$

87. **Sol. (B)** Given, $1 = \sin x + \sin^2 x + \sin^3 x \ \Rightarrow\ \cos^2 x = \sin x(1 + \sin^2 x) = \sin x(2 - \cos^2 x)$

$\Rightarrow\ \cos^4 x = (1 - \cos^2 x)\,(4 + \cos^4 x - 4\cos^2 x)$

$= 4 - 4\cos^2 x + \cos^4 x - \cos^6 x - 4\cos^2 x + 4\cos^4 x$

$\Rightarrow\ \cos^6 x - 4\cos^4 x + 8\cos^2 x = 4$

88. **Sol. (C)** $\sin\theta + \text{cosec}\,\theta = 2$

This is possible iff $\sin\theta = 1$ and $\text{cosec}\,\theta = 1$

$\therefore \sin^4\theta + \text{cosec}^4\theta = 1 + 1 = 2$

89. **Sol.** (D) $\tan(A+B) = \dfrac{\tan A + \tan B}{1 - \tan A \tan B} = \dfrac{\dfrac{\alpha}{\alpha+1} + \dfrac{1}{2\alpha+1}}{1 - \dfrac{\alpha}{\alpha+1}\cdot\dfrac{1}{2\alpha+1}} = \dfrac{2\alpha^2 + 2\alpha + 1}{2\alpha^2 + 2\alpha + 1} = 1 = \tan\dfrac{\pi}{4}$

$\therefore \quad A + B = \dfrac{\pi}{4}$

90. **Sol. (C)**