SOLUTIONS

PHASE TEST-1

RBA, RB-1808-1809, RBK-1804

JEE ADVANCED PATTERN

Test Date: 16-09-2017

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PHYSICS

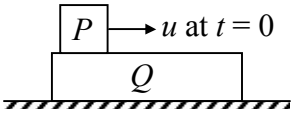
1. **(C)**

2. **(C)**

Friction between *P* and *Q* will retard *P* (and accelerate *Q*) till slipping is stopped

Masses of the blocks are same so

$\therefore$ Retardation of *P* = acceleration of $Q = \mu g$



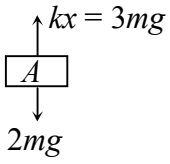
Thus $v_p = u - \mu gt$ and $v_q = \mu gt$

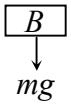
Once slipping is stopped both blocks will move with same velocity $\left(\text{i.e.}\frac{u}{2}\right)$. Graph (C) depicts this treatment.

3. **(C)**

$$a_A = \frac{3mg - 2mg}{2m} = \frac{g}{2}$$

And $a_B = \frac{mg}{m} = g$

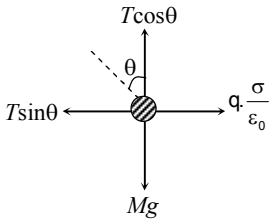




4. **(A)**

5. **(D)**

6. **(D)**



$T\sin\theta = \frac{q\sigma}{\varepsilon_0}$, $T\cos\theta = Mg$, $\tan\theta = \frac{q\sigma}{\varepsilon_0 Mg}$

7. **(A)**

Focal length of the convex lens

$$\frac{1}{f} = \left(\frac{\mu_2 - \mu_1}{\mu_1}\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{f} = \left(\frac{1.5 - 1}{1}\right)\left(\frac{1}{R} - \frac{1}{\infty}\right) = \frac{1}{2R} \Rightarrow f = 2R$$

So the ray would become parallel to the principal axis after the refraction and fall $\perp^r$ to the mirror and hence would get reflected back along the same path.

8. (C)

In the case of minimum deviation, ray inside the prism is parallel to base.

Therefore, ray is deviated equally from both refracting faces

If, $\delta = 34°$, $\delta' = \frac{\delta}{2} = 17°$

9. (B) **10. (D)** **11. (B, C)**

12. (A, B, C, D)

$h_1 = \frac{u^2}{2g}\sin^2\alpha$ and $h_2 = \frac{u^2}{2g}\cos^2\alpha$

$R = \frac{u^2}{g}2\sin\alpha\cos\alpha$

$R = \frac{u^2}{g} \times 2\frac{\sqrt{2gh_1}}{u}\frac{\sqrt{2gh_2}}{u}$, $R = 4\sqrt{h_1 h_2}$

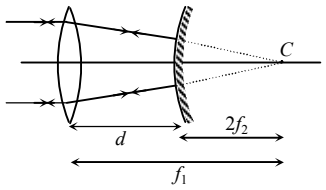
$\frac{t_1}{t_2} = \frac{2u\sin\alpha/g}{2u\sin(90-\alpha)/g} = \tan\alpha$

13. (B,D)

14. (A, B)

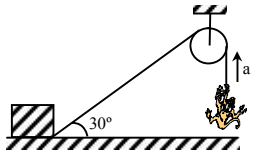
q_1 and q_2 both are negative and $\frac{kq_1}{\left(\frac{2a}{3}\right)^2} = \frac{kq_2}{\left(\frac{a}{3}\right)^2} \Rightarrow \frac{q_1}{q_2} = 4$

15. (A, B)



16. (0)

17. (6)



Let T be the tension in the string. The upward force exerted on the clamp = T sin 30° = T/2

$T/2 = 40N \Rightarrow T = 80N, a = \frac{T-mg}{m} = \frac{80-50}{5} = 6m/s^2$

18. (6)

$\vec{V}_{B\ell}$ = 4 m/s ↑

$\vec{V}_{B\ell} = \vec{V}_B - \vec{V}_\ell$

4 m/s = $\vec{V}_B$ – 2m/s

$\vec{V}_B$ = 4 + 2 = 6 m/s.

19. (1)

for B, u = 30 + 10 = 40 cm

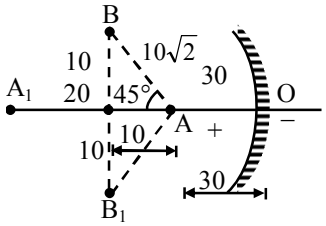
f = - 20 cm

v = - 40 cm

$m = -\frac{v}{u} = -1$

for A u = - 30 f = - 20, v = - 60

$A_1B_1 = \sqrt{20^2+10^2} = \sqrt{500} = 10\sqrt{5}$ cm



20. (3)

For image formed by lens

$\frac{1}{v_1} - \frac{1}{-15} = \frac{1}{+10}$

$\Rightarrow v_1$ = + 30 cm

i.e. 20 cm behind mirror

For mirror

$\frac{1}{v_2} + \frac{1}{20} = \frac{1}{-20}$

$\Rightarrow v_2$ = – 10 cm

Overall magnification = $\left(\frac{30}{-15}\right)\times\left(\frac{10}{20}\right)$ = –1

Length of image = 1 × 3 = 3 mm

CHEMISTRY

21. (D)

$$n_{H_2O} = \frac{pV}{RT} = 1.54$$

$$\frac{n_{MgSO_4 \times H_2O}}{n_{H_2O}} = \frac{1}{x} = \frac{54.2}{(120 + 18x) \times 1.54}$$

$x = 7$

22. (C)

* Presence of two EWG and resonance stablisation makes (i) strongest acid

* In (ii), two NH_2 group acts as ERG through resonance after the loss of H^+ therefore loss of H^+ is most difficult

23. (D)

Due to –I effect of –OH group and also $3^oC^{\oplus} > 2^oC^{\oplus} > 1^oC^{\oplus}$.

24. (B)

25. (A)

$[H^+] = 10^{-3}$ M

So $[Ca^{2+}] = \frac{1}{2} \times 10^{-3}$ M

Mass of

$$Ca^{2+} = \frac{10^{-3}}{2} \times 40$$

So, mass of Ca^{2+} ions in 10^6 mL, hard water

$$= \frac{\frac{1}{2} \times 10^{-3} \times 40 \times 10^6}{10^3} = 20$$

26. (A)

Molar mass of x = 0.444 × molar mass of y

Molar mass of x = 2.96 × 12

Molar mass of $y = \frac{2.96 \times 12}{0.444} = 80$

27. (B)

The redox reaction is :

$$Cr_2O_7^{2-} + 3SO_2 + 2H^+ \longrightarrow 2Cr^{3+} + 3SO_4^{2-} + H_2O$$

28. (C)

29. (B)

The hybridisation of atomic orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ are : sp, sp^2 and sp^3 respectively.

30. (C)

Because carbocation has two double bond in conjugation.

31. (A), (B), (D)

Based on lattice energy

32. (A),(B),(C)

33. (A, D)

Vapour pressure of liquid is only and only temperature dependent.

34. (C),(D)

35. (A,B,D)

$P_T = (1+3x) = 1+3\times 0.1 = 1.3$ atm (x = 0.1 as P_{Af} = 0.9 atm)

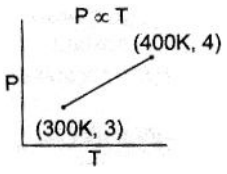
$\Delta P = 0.3$ atm or 76×0.3 cm of Hg

or 760 × 0.3 mm of Hg = 228 mm

36. (3)

$$T - 300 = \frac{4-3}{100}(p-3)$$

$$T - 300 = \frac{P}{100} - \frac{3}{100}$$



Multiply by 100

$T\times 100 - 3\times 10^4 = P - 3$

$P = 3 - 3\times 10^4 + 100T$

$\frac{dP}{dT} = 0 + 100 = 1\times 10^2$

x + y = 3

37. (2)

38. (1)

Let 'a' moles of Sn in ore sample

Eq. of Sn^{2+} = Eq. of $K_2Cr_2O_7$

$$(a \times 2) = \left(\frac{2.5}{294}\right) \times \frac{1}{0.5} \times \frac{10}{1000} \times 6$$

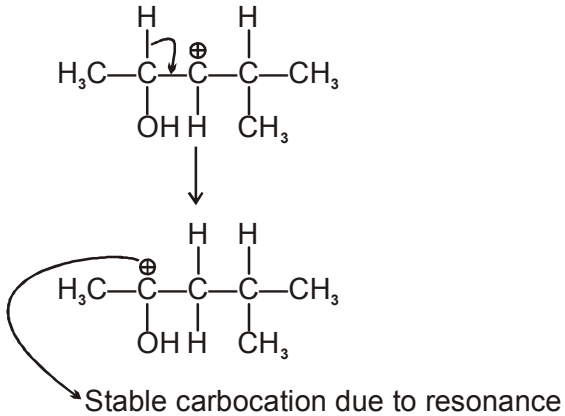
$a = 0.0051$

$wt_{Sn} = 0.06\,g$

$$\%\ \text{by wt}_{Sn} = \frac{0.06}{0.4} \times 100 = 15\% = x$$

$$\frac{x}{15} = 1$$

39. (2)



Stable carbocation due to resonance stabilise by –OH group.

40. (5)

$$\overset{+5}{BrO_3^-} + \overset{-1}{Br^-} + H^+ \longrightarrow \overset{0}{Br_2}(\ell)$$

n–factor = 5

$$E_{KBrO_3} = \frac{M_{KBrO_3}}{5}$$

$$\frac{M_{KBrO_3}}{E_{KBrO_3}} = 5$$

MATHEMATICS

41. (C)

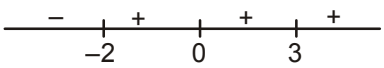
We have $r^2 = \dfrac{c^4}{a^2 \operatorname{cosec}^2\theta + b^2 \sec^2\theta} = \dfrac{c^4}{(a\cot\theta + b\tan\theta)^2 + (a-b)^2}$

$\Rightarrow$ Maximum value of $r^2 = \dfrac{c^4}{(a+b)^2}$ {when denominator is minimized}

$\Rightarrow$ Maximum value of $r = \dfrac{c^2}{(a+b)}$.

42. (C)

43. (C)



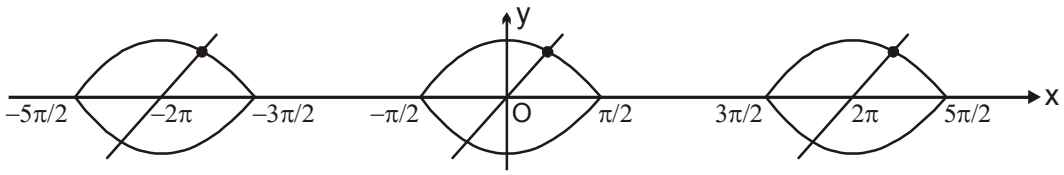
44. (B)

45. (A)

Image of (–8, 12) w.r.t 4x+ 7y + 13 is (–16, –2)

46. (B)

47. (C)



48. (B)

$1 \le \sin^{-1}(\cos^{-1}(\sin^{-1}(\tan^{-1}x))) \le \dfrac{\pi}{2}$

$\sin 1 \le \cos^{-1}(\sin^{-1}(\tan^{-1}x)) \le 1$

$\cos(\sin 1) \ge \sin^{-1}(\tan^{-1}x) \ge \cos 1$

$\sin(\cos(\sin 1)) \ge \tan^{-1}x \ge \sin(\cos 1)$

$\tan(\sin(\cos(\sin 1))) \ge x \ge \tan(\sin(\cos 1))$

49. (B)

$f(x_1) = f(x_2)$

$$\frac{x_1 - m}{x_1 - n} = \frac{x_2 - m}{x_2 - n}$$

$\Rightarrow x_1 = x_2 \Rightarrow$ f(x) is one-one

Let $f(x) = y = \frac{x-m}{x-n} \Rightarrow x = \frac{m-ny}{1-y} \Rightarrow y \neq 1$

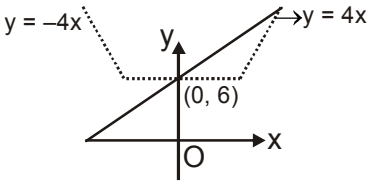
$\Rightarrow$ not onto

50. (B)

$g(x) = 1 + x - [x] \geq 1 \ \forall \ x \in R$

$\therefore \quad f(g(x)) = 1 \quad \forall x \in R$

51. (B)



When

(i) P = 0 then it has infinte solution

(ii) if –4 < P < 0 or 0 < P < 4 then it intersect at 2 points

(iii) P $\geq$ 4 or P $\leq$ –4 then it has only one solution

52. (A,C)

$\cos^{-1} x = \tan^{-1} x \Rightarrow x \in [0,1]$

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

$$\Rightarrow \quad x^2 = \sqrt{1-x^2} \Rightarrow x^4 + x^2 - 1 = 0$$

$$x^2 = \frac{\sqrt{5}-1}{2}$$

53. (A,B,C,D)

$\sin^2 x - \cos^2 x = -\cos 2x \leq 1$

$$\sqrt{\frac{6}{5}}\left(\frac{1}{\sqrt{2}}\sin x + \frac{1}{\sqrt{3}}\cos x\right) = \frac{\sqrt{3}}{\sqrt{5}}\sin x + \frac{\sqrt{2}}{\sqrt{5}}\cos x$$

$= \sin x \cdot \sin\phi + \cos x \cos\phi$ where $\sin\phi = \frac{\sqrt{3}}{\sqrt{5}}$, $\cos\phi = \frac{\sqrt{2}}{\sqrt{5}}$

$= \cos(x - \phi) \leq 1$

$= \cos^6 x + \sin^6 x = (\cos^2 x)^3 + (\sin^2 x)^3$

$= 1 - 3\sin^2 x \cos^2 x = 1 - \frac{3}{4}(\sin 2x)^2$

$= \le 1$

$= \cos^2 x + \sin^2 x = 1 - \frac{(\sin 2x)^2}{4} \le 1$

54. (A,B)

$AC = \sqrt{3^2 + 4^2} = 5$

The midpoint P of $AC = \left(\frac{1}{2}, -1\right)$

'm' of $AC = \frac{4}{-3}$ $\quad\therefore$ 'm' of $BD = \frac{3}{4}\tan\theta$

$\therefore$ B or $D = \left(\frac{1}{2} \pm \frac{5}{2}\cos\theta, -1 \pm \frac{5}{2}\sin\theta\right)$

55. (A, B)

We have, $x^2 + (a-1)x + \frac{1}{4} = \frac{a}{2}$. $(a \in R)$

Now, sum of roots $= \sin\theta + \cos\theta = 1 - a$ ... (1)

Product of roots $= \sin\theta \cdot \cos\theta = \frac{1-2a}{4}$ ... (2)

Also, $(1)^2 \Rightarrow 1 + \frac{1-2a}{2} = (1-a)^2 \Rightarrow 2a^2 - 2a - 1 = 0 \Rightarrow a = \frac{2 \pm \sqrt{4+8}}{4} = \frac{1 \pm \sqrt{3}}{2}$

But, $a = \frac{1+\sqrt{3}}{2}$ (Rejected as from (1), $(\sin\theta + \cos\theta)$ cannot be –ve, because $0 < \theta < \frac{\pi}{2}$)

$\Rightarrow \qquad a = \frac{1-\sqrt{3}}{2}$

So, from (1), $(\sin\theta + \cos\theta) = \frac{1}{2} + \frac{\sqrt{3}}{2} \Rightarrow \theta = 30°$ or $60°$. **Ans.**]

56. (4)

$S = \frac{1}{\cos\alpha} + \frac{2\cos\alpha}{\cos 2\alpha} = \frac{2\sin\alpha}{2\sin\alpha\cos\alpha} + \frac{2\cos\alpha}{\cos 2\alpha} = \frac{2\sin\alpha}{\sin 2\alpha} + \frac{2\cos\alpha}{\cos 2\alpha}$

$= \frac{2 \cdot 2(\sin\alpha\cos 2\alpha + \cos\alpha\sin 2\alpha)}{2\sin 2\alpha\cos 2\alpha} = 4\frac{\sin 3\alpha}{\sin 4\alpha} = 4$ **Ans.** if $\alpha = \frac{\pi}{7}$

57. (1)

$x^2 - 4x \geq 0 \quad \Rightarrow \quad x \in (-\infty, 0] \cup [4, \infty)$

$x - 3 > 0 \quad \Rightarrow \quad x \in (3, \infty)$

$x^2 - 4x < x^2 + 9 - 6x$

$\Rightarrow \quad x < \frac{9}{2}$ **Ans.** $x \in [4, 9/2)$

58. (2)

Use the condition $a_1a_2 = b_1b_2$

59. (9)

$5 - 2\pi > x^2 - 4x$

$x^2 - 4x + (2\pi - 5) < 0$

$2 - \sqrt{9 - 2\pi} < x < 2 + \sqrt{9 - 2\pi} \Rightarrow \lambda = 9$

60. (1)

$\because \; h(-1) = \frac{1}{3}, \; g\left(-\frac{1}{3}\right) = -1, \; f\left(-\frac{1}{2}\right) = -\frac{1}{3}$

$\Rightarrow 2f^{-1}\left(g^{-1}\left(h^{-1}\left(\frac{1}{3}\right)\right)\right)$

$= 2f^{-1}\left(-\frac{1}{3}\right) = 2\left(-\frac{1}{2}\right) = -1$