

ANSWER KEY**EXERCISE - I**

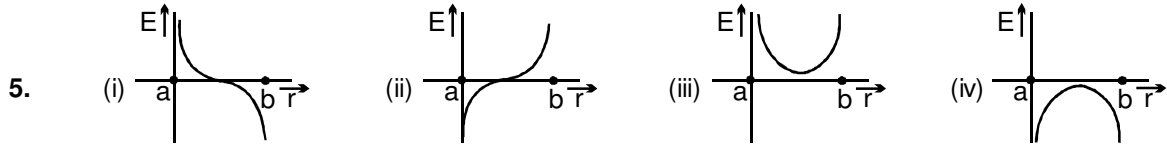
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|-------|-------|-------|-------|-------|-------|-------|
| 1. D | 2. C | 3. D | 4. B | 5. D | 6. A | 7. D |
| 8. B | 9. B | 10. D | 11. A | 12. A | 13. A | 14. D |
| 15. A | 16. B | 17. B | 18. B | 19. B | 20. B | 21. D |
| 22. C | 23. D | 24. B | 25. B | 26. B | 27. B | 28. B |
| 29. D | 30. C | 31. B | 32. B | 33. B | 34. A | 35. C |
| 36. B | 37. A | 38. D | 39. B | 40. B | 41. B | 42. C |
| 43. B | 44. D | 45. C | 46. A | 47. A | 48. D | 49. B |
| 50. C | 51. B | 52. A | 53. A | 54. D | 55. B | 56. B |
| 57. A | 58. A | 59. C | 60. D | 61. C | 62. C | |

ANSWER KEY**EXERCISE - II**

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|---------|-----------|---------|-----------|---------|---------|--------|
| 1. C,D | 2. B,D | 3. B | 4. C,D | 5. A,D | 6. B | 7. A,C |
| 8. A | 9. A,B,D | 10. A,C | 11. A,B,C | 12. A | 13. B,D | 14. B |
| 15. A,D | 16. B,C | 17. A,C | 18. A | 19. D | 20. C | 21. B |
| 22. D | 23. A,B,D | 24. A,D | 25. B,C,D | 26. B,C | | |

ANSWER KEY**EXERCISE - III**

1. $\frac{2\ell}{3}$ from charge $4e$ (If q is positive stable, If q is negative unstable)
2. $\frac{d}{2\sqrt{2}}, \frac{4}{3\sqrt{3}}, \frac{Qq}{\pi\epsilon_0 d^2}$ 3. $a = l(1 + \sqrt{2})$, the equilibrium will be stable
4. a) $\sqrt{\frac{m\pi^3\epsilon_0 d^3}{Qq}}$ (b) $\sqrt{\frac{m\pi^3\epsilon_0 d^3}{2Qq}}$



6. $-\left[\frac{3}{11}\right]^{3/2} 3 \times 10^{-9} \text{C}$

7. 0

8. 0

9. $\frac{qQ}{8\pi^2\epsilon_0 r^2}$

10. $\frac{3\sigma\lambda}{2m\epsilon_0}$

11. (i) $\frac{4Kqx}{\left(\frac{a^2}{2} + x^2\right)^{3/2}}$, along the axis, (ii) 0 (iii) $\frac{2Kqa}{\left(\frac{a^2}{2} + x^2\right)^{3/2}}$

12. (a) (i) 0 (ii) 0 (iii) $\frac{4\sqrt{2}Kq}{a^2}$, (b) (i) $\frac{4Kq}{x^2}$ (ii) 0 (iii) $\frac{2Kqa}{x^3}$

13. $W = Kqq_0 \left(\frac{1}{r_B} - \frac{1}{r_A} \right) = 1.2 \text{ J}$

14. (a) $\frac{Qq}{4\pi\epsilon_0 K}$ (b) $\sqrt{\frac{K}{m}}$

15. $-9.0 \times 10^{-3} \text{ J}$

16. (i) $\frac{4Kq^2}{a} \left[3 + \frac{3}{\sqrt{2}} + \frac{1}{\sqrt{3}} \right]$

(ii) $W_{\text{ext}} = -\frac{2Kq^2}{a} \left[3 + \frac{3}{\sqrt{2}} + \frac{1}{\sqrt{3}} \right]$, $W_{\text{el}} = \frac{2Kq^2}{a} \left[3 + \frac{3}{\sqrt{2}} + \frac{1}{\sqrt{3}} \right]$

(iii) $\sqrt{\frac{Kq^2}{2ma} \left[3 + \frac{3}{\sqrt{2}} + \frac{1}{\sqrt{3}} \right]}$

(iv) $\sqrt{\frac{2Kq^2}{ma} \left[3 + \frac{3}{\sqrt{2}} + \frac{1}{\sqrt{3}} \right]}$

(v) $\sqrt{\frac{Kq^2}{ma} \left[3 + \frac{3}{\sqrt{2}} + \frac{1}{\sqrt{3}} \right]}$

17. $2 \tan^{-1} \left(\frac{\sigma q_0}{2\epsilon_0 mg} \right)$

18. $\sqrt{\frac{2kQ^2}{mR}}$

19. $20\sqrt{\ln 2}$

20. $-\frac{kq^2}{a} (3 - \sqrt{2})$

21. $\frac{Q^2}{m\pi\epsilon_0 V^2}$

22. $\frac{2\epsilon_0 u^2 m}{q\sigma}$

23. $1.8 \times 10^5 \text{ sec}$

24. $\text{K.E.} = \frac{1}{2} \frac{Q^2}{4\pi\epsilon_0 d}$

25. $-\frac{2x^3}{3} + y^3 + C$

26. $\frac{\sqrt{2}qp}{4\pi\epsilon_0 r^2}$

27. (i) $\frac{2KP_0Q}{r^3}(-\hat{i})$ (ii) $\frac{KP_0Q}{r^3}\hat{j}$

(iii) $\frac{6KP_0P}{r^4}\hat{i}$ (iv) $\frac{3KP_0P}{r^4}(+\hat{j})$

28. $|E| = \frac{\sqrt{7}K}{8}$, $V = \frac{K}{4}$ [where $K = 1/4 \pi\epsilon_0$]

29. $\frac{kP}{\sqrt{2}y^3}(-\hat{i} - 2\hat{j})$

ANSWER KEY

EXERCISE - IV

- Q.1** (a) 60° (b) $mg + \frac{kq_1q_2}{\ell^2}$
 (c) $\sqrt{3} \text{ mg}$, mg . q_1 & q_2 should have unlike charges for the beads to remain stationary & $q_1q_2 = -mg\ell^2/k$

Q.2 9.30 **Q.3** $\sqrt{\frac{\lambda q}{2\epsilon_0 m}}$ **Q.4** $H_2 = h_1 + h_2 - g\left(\frac{\ell}{V}\right)^2$

Q.5 $W_{\text{first step}} = \left(\frac{8}{3} - \frac{4}{\sqrt{5}}\right) \frac{Kq^2}{r}$, $W_{\text{second step}} = 0$, $W_{\text{total}} = 0$

Q.6 $\frac{v}{\sqrt{3}}$ **Q.7** $\sqrt{4\pi\epsilon_0 Ka}$

Q.8 $\frac{Q_1}{Q_2} = \frac{R_1}{R_2}$ **Q.9** $\lambda R E_0 \hat{i}$ **Q.10** $\sigma = \frac{\epsilon_r \rho_0}{\epsilon_r - 1}$

Q.11 $-\frac{4kq}{\pi R^2} \hat{i}$ **Q.12** A, D

ANSWER KEY

EXERCISE - V

1. D 2. A 3. (i) A, C, (ii) D, (iii) A, C

4. (a) E, (b) B, (c) $v_0 = 3 \text{ m/s}$; K.E. at the origin = $(27 - 10\sqrt{6}) \times 10^{-4} \text{ J}$ approx. $2.5 \times 10^{-4} \text{ J}$

5. C 6. 5.86 m/s 7. B

8. $-\frac{1}{4\pi\epsilon_0} \frac{q^2}{a} \cdot \frac{4}{\sqrt{6}} [3\sqrt{3} - 3\sqrt{6} - \sqrt{2}]$ 9. (a) K.E. = $\frac{P}{4\pi\epsilon_0} \frac{Q}{d^2}$, (b) $\frac{QP}{2\pi\epsilon_0 d^3}$ along positive x-axis

10. D 11. $\frac{(\sigma_1 - \sigma_2)Qa}{2\sqrt{2}\epsilon_0}$ 12. D 13. C 14. C 15. A, D

16. A 17. D 18. 0003 19. A