PAPER (पेपर)- 2

PAPER-2 : INSTRUCTIONS TO CANDIDATES

- **This question paper has three (03) parts: PART-I: Physics, PART-II: Chemistry and PART-III: Mathematics.**
- **Each part has total of eighteen (18) questions divided into three (03) Sections (Section-1, Section-2 and Section-3).**
- **Total number of questions in Paper-2 : Fifty four (54).**
- **Paper-2 Maximum Marks : One Hundred Eighty (180).**

Instructions for Section-1 : Questions and Marking Scheme

SECTION-1 (Maximum Marks : 24)

- This section contains **SIX (06)** questions.
- Each question has **FOUR options** for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme :

Full Marks :	**+4** If only (all) the correct option(s) is (are) chosen.
Partial Marks :	**+3** If all the four options are correct but ONLY three options are chosen.
Partial Marks :	**+2** If three or more options are correct but ONLY two options are chosen, both of which are correct options.
Partial Marks :	**+1** If two or more options are correct but ONLY one option is chosen and it is a correct option.
Zero Marks :	**0** If none of the options is chosen (i.e. the question is unanswered).
Negative Marks :	**–2** In all other cases.

- **For Example :** If first, third and fourth are the ONLY three correct options for a question with second option being an incorrect option; selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in –2 marks.

Answering Section-1 Questions :

- To select the option(s), **using the mouse click** on the corresponding button(s) of the option(s).
- To deselect chosen option(s), click on the button(s) of the chosen option(s) again or click on the **Clear Response** button to clear all the chosen options.
- To change the option(s) of a previously answered question, if required, first click on the **Clear Response** button to clear all the chosen options and then select the new option(s).
- To mark a question ONLY for review (i.e. without answering it), click on the **Mark for Review & Next button**.
- To mark a question for review (after answering it), click on **Mark for Review & Next button** – answered question which is also marked for review will be evaluated.
- To save the answer, click on the **Save & Next** button – the answered question will be evaluated.

Instructions for Section-2 : Questions and Marking Scheme

This solution was download from Resonance JEE ADVANCED 2018 Solution portal

SECTION-2 (Maximum Marks : 24)

- This section contains **EIGHT (08)** questions. The answer to each question is **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 6.25, 7.00, –0.33, –0.30,,30.27, –127.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme :

Full Marks : **+3** If ONLY the correct numerical value is entered as answer.

Zero Marks : **0** In all other cases.

Answering Section-2 Questions :

- Using the attached computer mouse, click on numbers (and/or symbols) on the **on-screen virtual numeric keypad** to enter the numerical value as answer in the space provided for answer.
- To change the answer, if required, first click on the **Clear Response** button to clear the entered answer and then enter the new numerical value.
- To mark a question ONLY for review (i.e. answering it), click on **Mark for Review & Next button** – the answered question which is also marked for review will be evaluated.
- To mark a question for review (after answering it), click **Mark for Review & Next button** – the answered question which is also marked for review will be evaluated.
- To save the answer, click on the **Save & Next button** – the answered question will be evaluated.

Instructions for Section-3 : Questions and Marking Scheme

SECTION-3 (Maximum Marks : 12)

- This section contains **FOUR (04)** questions.
- Each question has **TWO (02)** matching lists ; **LIST-I** and **LIST-II**.
- **FOUR options** are given representing matching of elements from LIST-I and LIST-II. ONLY ONE of these four each question, choose the option, choose the option corresponding to the correct matching.
- For each question, mark will be awarded according to the following marking scheme :

Full Marks : **+3** If ONLY the option corresponding to the correct matching is chosen.

Zero Marks : **0** If none of the options is chosen (i.e. the question is unanswered).

Negative Marks : **–1** In all other cases.

Answering Section-3 Questions :

- To select an option, using the mouse click on the corresponding button of the option.
- To deselect the chosen answer, click on the button of the chosen option again or click on the **Clear Response button**.
- To change the chosen answer, click on the button of another option.
- To mark a question ONLY for review (i.e. without answering it), click on **Mark for Review & Next button**.
- To mark a question for review (after answering it), click on **Mark for Review & Next button** – the answered which is also marked for review will be evaluated.

To save the answer, click on the **Save & Next button** – the answered question will be evaluated.

This solution was download from Resonance JEE ADVANCED 2018 Solution portal

PART-I : PHYSICS

SECTION 1 (Maximum Marks: 24)

- This section contains **SIX (06)** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks	**: +4**	If only (all) the correct option(s) is (are) chosen.
Partial Marks	: **+3**	If all the four options are correct but ONLY three options are chosen.
Partial Marks	: **+2**	If three or more options are correct but ONLY two options are chosen, both of which are correct options.
Partial Marks	: **+1**	If two or more options are correct but ONLY one option is chosen and it is a correct option.
Zero Marks	: **0**	If none of the options is chosen (i.e. the question is unanswered).
Negative Marks	**: –2**	In all other cases.

- **For Example:** If first, third and fourth are the ONLY three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in –2 marks.

1. A particle of mass m is initially at rest at the origin. It is subjected to a force and starts moving along the x-axis. Its kinetic energy K changes with time as $dK/dt = \gamma t$ where λ is a positive constant of appropriate dimensions. Which of the following statements is (are) true?

(A) The force applied on the particle is constant

(B) The speed of the particle is proportional to time

(C) The distance of the particle from the origin increases linearly with time

(D) The force is conservative

Ans. **(ABD)**

Sol. $mv\frac{dv}{dt} = \frac{dk}{dt} = \gamma t$

$v\,dv = \frac{\gamma}{m} t\,dt$

$\frac{v^2}{2} = \frac{\gamma}{m}\frac{t^2}{2}$ $\Rightarrow v \propto t$

$\frac{dv}{dt} = \text{constant}$ $\Rightarrow F = \text{constant}$

$\frac{dx}{dt} \propto t$ $\Rightarrow x \propto t^2$

2. Consider a thin square plate floating on a viscous liquid in a large tank. The height h of the liquid in the tank is much less than the width of the tank. The floating plate is pulled horizontally with a constant velocity u_0. Which of the following statements is (are) true?

(A) The resistive force of liquid on the plate is inversely proportional to h

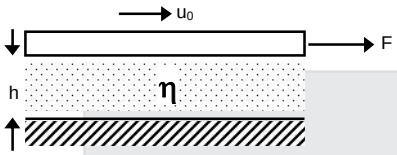
(B) The resistive force of liquid on the plate is independent of the area of the plate

(C) The tangential (shear) stress on the floor of the tank increases with u_0

(D) The tangential (shear) stress on the plate varies linearly with the viscosity η of the liquid

Ans. **(ACD)**

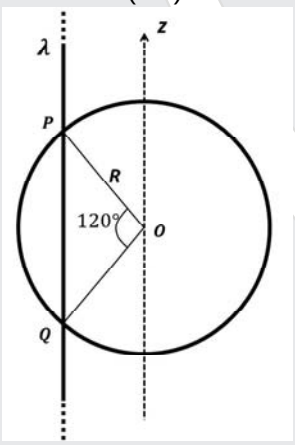
Sol.



$$f = \eta A \frac{dv}{dy}$$

$$= \eta A \frac{u_0}{h}$$

3. An infinitely long thin non-conducting wire is parallel to the z-axis and carries a uniform line charge density λ. It pierces a thin non-conducting spherical shell of radius R in such a way that the arc PQ subtends an angle 120° at the centre O of the spherical shell, as shown in the figure. The permittivity of free space is ε_0. Which of the following statements is (are) true?



(A) The electric flux through the shell is $\sqrt{3}R\lambda / \varepsilon_0$

(B) The z-component of the electric field is zero at all the points on the surface of the shell

(C) The electric flux through the shell is $\sqrt{2}R\lambda / \varepsilon_0$

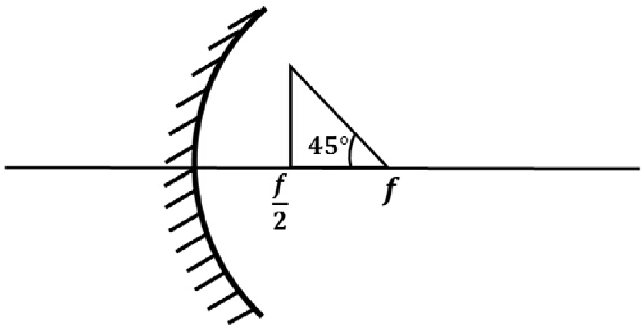
(D) The electric field is normal to the surface of the shell at all points

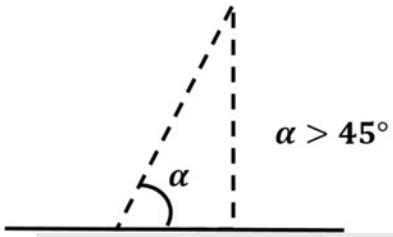
Ans. **(AB)**

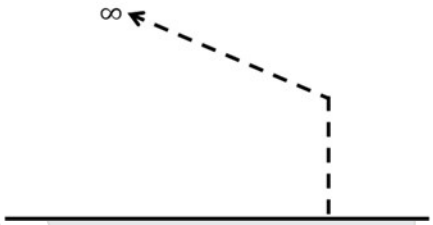
Sol. $Q_{enc} = \lambda \sqrt{3}\ R$

$$\phi = \frac{Q_{enc}}{\epsilon_0} = \frac{\sqrt{3}\lambda R}{\epsilon_0}$$

4. A wire is bent in the shape of a right angled triangle and is placed in front of a concave mirror of focal length f, as shown in the figure. Which of the figures shown in the four options qualitatively represent(s) the shape of the image of the bent wire? (These figures are not to scale.)



(A)


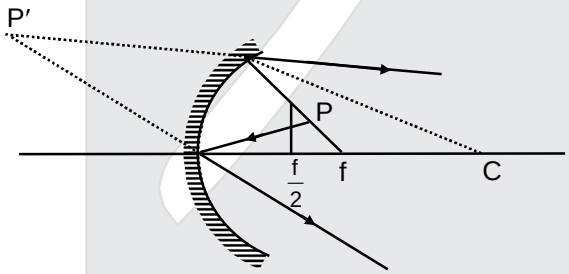
(B)


(C)

(D)

Ans. **(B)**

Sol.



The angle of the object is 45º the focus will not be defined for all points. For small angle the answer would be 'C' but for 45º best option is B

5. In a radioactive decay chain, $^{232}_{90}Th$ nucleus decays to $^{212}_{90}Pb$ nucleus. Let N_α and N_β be the number of α and β^- particles, respectively, emitted in this decay process. Which of the following statements is (are) true?

(A) $N_\alpha = 5$ (B) $N_\alpha = 6$ (C) $N_\beta = 2$ (D) $N_\beta = 4$

Ans. **(AC)**

Sol. $_{90}Th^{232} \rightarrow {}_{82}Pb^{212} + x\ {}_2He^4 + y\ {}_{-1}e^0$

$2x - y = 8$

$4x = 20$

6. In an experiment to measure the speed of sound by a resonating air column, a tuning fork of frequency 500 Hz is used. The length of the air column is varied by changing the level of water in the resonance tube. Two successive resonances are heard at air columns of length 50.7 cm and 83.9 cm. Which of the following statements is (are) true ?
(A) The speed of sound determined from this experiment is 332 ms^{-1}
(B) The end correction in this experiment is 0.9 cm
(C) The wavelength of the sound wave is 66.4 cm
(D) The resonance at 50.7 cm corresponds to the fundamental harmonic

Ans. **(AC)**

Sol. $(2n + 1)\ \frac{\lambda}{4} = 50.7\ cm + e$

$(2n + 3)\ \frac{\lambda}{4} = 83.9\ cm + e$

using $n = 1$ $e = -0.9$ cm

$\lambda = 66.4$ cm

$v = f\lambda = 332$ m/s

SECTION 2 (Maximum Marks: 24)

- This section contains **EIGHT (08)** questions. The answer to each question is a **NUMERICAL VALUE.**
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded off to the **second decimal place**; e.g. 6.25, 7.00, –0.33, –.30, 30.27, –127.30) using the mouse and the onscreen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme:
  Full Marks : 3 If ONLY the correct numerical value is entered as answer.
  Zero Marks : 0 In all other cases.

7. A solid horizontal surface is covered with a thin layer of oil. A rectangular block of mass m = 0.4kg is at rest on this surface. An impulse of 1.0 N s is applied to the block at time t = 0 so that it starts moving along the x-axis with a velocity $v(t) = v_0 e^{-t/\tau}$, where v_0 is a constant and $\tau = 4$s. The displacement of the block, in metres, at $t = \tau$ is _____. Take $e^{-1} = 0.37$.

Ans. **6.30**

Sol. $v_0 = \frac{J}{m} = \frac{1}{0.4} = \frac{5}{2}$ m/s

$s = v_0 \int_0^{\tau} e^{-t/\tau}\, dt$

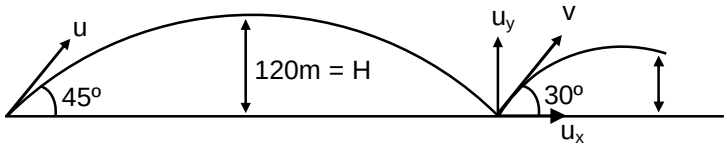
$= v_0\, \tau\, (1 - e^{-1})$

$= \left(\frac{5}{2}\right)(4)(0.63) = 6.30$ m

8. A ball is projected from the ground at an angle of 45° with the horizontal surface. It reaches a maximum height of 120m and returns to the ground. Upon hitting the ground for the first time, it loses half of its kinetic energy. Immediately after the bounce, the velocity of the ball makes an angle of 30° with the horizontal surface. The maximum height it reaches after the bounce, in metres, is _____.

Ans. **30 m**

Sol.



$K_2 = \frac{1}{2}mu^2$ $\qquad \frac{U_y}{U_x} = \tan 30^\circ = \frac{1}{\sqrt{3}}$

$H = \frac{u^2 \sin^2 45^\circ}{2g}$ $\qquad \sqrt{3}\, u_y = u_x.$

$= \frac{u^2}{4g} = 120m$ $\qquad K_f = \frac{1}{2}mu^2 = \frac{1}{2}m(u_x^2 + u_y^2)$

$K_f = \frac{1}{2}K_i$

$\Rightarrow \quad \frac{1}{2}m(u_x^2 + u_y^2) = \frac{1}{2} \times \frac{1}{2}mu^2$

$\Rightarrow \quad u_x^2 + u_y^2 = \frac{u^2}{2}$

$\Rightarrow \quad$ using $u_x = \sqrt{3}\, u_y$

$\Rightarrow \quad 3\, u_y^2 + u_y^2 = \frac{u^2}{2}$

$\Rightarrow \quad u_y^2 = \frac{u^2}{8}$

$h = \frac{u_y^2}{2g} = \frac{u^2}{16g} = \frac{1}{4}\left(\frac{u^2}{4g}\right) = \frac{H}{4} = \frac{120}{4} = 30\ m$

9. A particle, of mass 10^{-3}kg and charge 1.0 C, is initially at rest. At time t = 0, the particle comes under the influence of an electric field $\vec{E}(t) = E_0 \sin\omega t\,\hat{i}$ where E_0 = 1.0 NC^{-1} and $\omega = 10^3$ rad s^{-1}. Consider the effect of only the electrical force on the particle. Then the maximum speed, in ms^{-1}, attained by the particle at subsequent times is _____.

Ans. **2.00**

Sol. $E = qE_0 \sin\omega t = m\frac{dv}{dt}$

$\int_0^v dv = \frac{qE_0}{m}\int_0^{\pi/\omega} \sin\omega t\, dt$

$v = \frac{qE_0}{\omega m}(-\cos\omega t)_0^{\pi/\omega}$

$= -\frac{qE_0}{m\omega}((-\cos\pi) - (-\cos 0))$

$= \frac{2qE_0}{m\omega} = 2m/s$

10. A moving coil galvanometer has 50 turns and each turn has an area 2×10^{-4} m^2 . The magnetic field produced by the magnet inside the galvanometer is 0.02T. The torsional constant of the suspension wire is 10^{-4} Nm rad^{-1}. When a current flows through the galvanometer, a full scale deflection occurs if the coil rotates by 0.2 rad. The resistance of the coil of the galvanometer is 50Ω. This galvanometer is to be converted into an ammeter capable of measuring current in the range 0 – 1.0A. For this purpose, a shunt resistance is to be added in parallel to the galvanometer. The value of this shunt resistance, in ohms, is _____.

Ans. **5.56 or 5.55**

Sol. N = 50

$A = 2 \times 10^{-4}$ m^2 $C = 10^{-4}$, R = 50 Ω , B = 0.02 T, θ = 0.2 rad

Ni AB = Cθ

$$i_g = \frac{C\theta}{N\ AB} = \frac{10^{-4} \times 0.2}{50 \times 2 \times 10^{-4} \times 0.02}$$

= 0. 1 A

$i_g \times G = (i - i_g)\ S$

$0.1 \times 50 = (1 - 0.1) \times S$

$5 = 0.9 \times S$

$$S = \frac{50}{9}\ \Omega$$

11. A steel wire of diameter 0.5 mm and Young's modulus 2×10^{11} Nm^{-2} carries a load of mass M. The length of the wire with the load is 1.0 m. A vernier scale with 10 divisions is attached to the end of this wire. Next to the steel wire is a reference wire to which a main scale, of least count 1.0 mm, is attached. The 10 divisions of the vernier scale correspond to 9 divisions of the main scale. Initially, the zero of vernier scale coincides with the zero of main scale. If the load on the steel wire is increased by 1.2 kg, the vernier scale division which coincides with a main scale division is _____. Take g = 10 ms^{-2} and π = 3.2.

Ans. **3**

Sol. $$\Delta\ell = \frac{F\ell}{Ay} = \frac{1.2x10x1}{\pi\left(\frac{5x10^{-4}}{2}\right)^2 x2x10^{11}}$$

Solving this we get

$\Delta\ell$ = 0.3 mm

Since least count of vernier calipers is 0.1mm. So, third marking of vernier scale will coincide with main scale.

12. One mole of a monatomic ideal gas undergoes an adiabatic expansion in which its volume becomes eight times its initial value. If the initial temperature of the gas is 100 K and the universal gas constant 8.0J $mol^{-1}K^{-1}$, the decrease in its internal energy, in Joule, is_____.

Ans. 900 J

Sol. $T V^{\gamma-1} = T_f (8V)^{\gamma-1}$

$$\Rightarrow T_f = \frac{T}{(8)^{\frac{5}{3}-1}} = \frac{T}{4}$$

$$\Delta U = nC_v \Delta T = \frac{f}{2} nR\Delta T = \frac{f}{2} 1.R. \left(\frac{-3T}{4}\right)$$

$$= -\frac{3}{2} x\, 8\, x\, \frac{3}{4}\, x\, 100$$

= –900 J

decrease in internal energy is 900 J.

13. In a photoelectric experiment a parallel beam of monochromatic light with power of 200W is incident on a perfectly absorbing cathode of work function 6.25 eV. The frequency of light is just above the threshold frequency so that the photoelectrons are emitted with negligible kinetic energy. Assume that the photoelectron emission efficiency is 100%. A potential difference of 500V is applied between the cathode and the anode. All the emitted electrons are incident normally on the anode and are absorbed. The anode experiences a force $F = n \times 10^{-4}$ N due to the impact of the electrons. The value of is _____. Mass of the electron $m_e = 9 \times 10^{-31}$kg and 1.0 eV = 1.6×10^{-19}J.

Ans. **24.00**

Sol. Number of electrons emitted $N = \frac{200W}{6.25eV}$

rate of change of linear momentum of electrons = $F = N\sqrt{2mk}$

$$F = \frac{200}{1.6 \times 6.25 \times 10^{-19}} \times \sqrt{29 \times 10^{-31} \times 1.6 \times 10^{-19}} \times 500$$

= 24.00

14. Consider a hydrogen-like ionized atom with atomic number with a single electron. In the emission spectrum of this atom, the photon emitted in the n = 2 to n = 1 transition has energy 74.8 eV higher than the photon emitted in the n = 3 to n = 2 transition. The ionization energy of the hydrogen atom is 13.6 eV. The value of Z is _____.

Ans. **3**

Sol. $13.6\, Z^2 \left(1 - \frac{1}{4}\right) = 74.8 \text{ eV} + 13.6\, z^2 \left(\frac{1}{4} - \frac{1}{9}\right)$

$$\Rightarrow 13.6 \times Z^2 \left(\frac{11}{18}\right) = 74.8$$

$$\Rightarrow Z^2 = 9 \Rightarrow Z = 3$$

SECTION 3 (Maximum Marks: 12)

- This section contains **FOUR (04)** questions.
- Each question has **TWO (02)** matching lists: **LIST-I** and **LIST-II**.
- **FOUR** options are given representing matching of elements from **LIST-I** and **LIST-II**. **ONLY ONE** of these four options corresponds to a correct matching.
- For each question, choose the option corresponding to the correct matching.
- For each question, marks will be awarded according to the following marking scheme:

  Full Marks : 3 If ONLY the option corresponding to the correct matching is chosen.
  Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered).
  Negative Marks : 1 In all other cases.

15. The electric field E is measured at a point P(0, 0, d) generated due to various charge distributions and the dependence of E on d is found to be different for different charge distributions. List-I contains different relations between E and d. List-II describes different electric charge distributions, along with their locations. Match the functions in List-I with the related charge distributions in List-II.

List-I		**List-II**	
P.	E is independent of d	1.	A point charge Q at the origin
Q.	$E \propto 1/d$	2.	A small dipole with point charges Q at (0, 0, ℓ) and –Q at (0, 0, –ℓ) Take $2\ell << d$
R.	$E \propto 1/d^2$	3.	An infinite line charge coincident with the x-axis, with uniform linear charge density λ.
S.	$E \propto 1/d^3$	4.	Two infinite wires carrying uniform linear charge density parallel to the x-axis. The one along (y = 0, z = ℓ) has a charge density $+\lambda$ and the one along (y = 0, z = –ℓ) has a charge density $-\lambda$. Take $2\ell << d$
		5.	Infinite plane charge coincident with the xy-plane with uniform surface charge density.

(A) P → 5; Q → 3, 4; R → 1; S → 2

(B) P → 5; Q → 3; R → 1, 4; S → 2

(C) P → 5; Q → 3; R → 1, 2; S → 4

(D) P → 4; Q → 2, 3; R → 1; S → 5

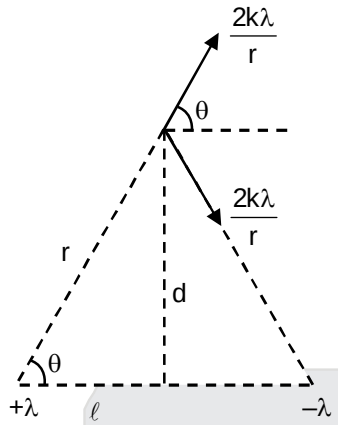
Ans. **(B)**

Sol. (1) in case of point charge $E = \frac{KQ}{d^2}$

(2) In case of dipole $E = \frac{Kp}{d^3}$

(3) For an infinite long line charge $E = \frac{2K\lambda}{d}$

(4)



$$E = \frac{K\lambda}{r}\cos\theta = \frac{k\lambda}{\sqrt{d^2+\ell^2}} = \frac{\ell}{\sqrt{d^2+\ell^2}} = \frac{4k\lambda\ell}{(d^2+\ell^2)} \simeq \frac{2k\lambda\ell}{d^2}$$

(5) $E = \frac{\sigma}{2\varepsilon_0}$

16. A planet of mass M, has two natural satellites with masses m_1 and m_2. The radii of their circular orbits are R_1 and R_2 respectively. Ignore the gravitational force between the satellites. Define v_1, L_1, K_1 and T_1 to be, respectively, the orbital speed, angular momentum, kinetic energy and time period of revolution of satellite 1; and v_2, L_2, K_2 and T_2 to be the corresponding quantities of satellite 2. Given $m_1/m_2 = 2$ and $R_1/R_2 = 1/4$, match the ratios in List-I to the numbers in List-II.

List-I		**List-II**	
P.	$\frac{v_1}{v_2}$	1.	$\frac{1}{8}$
Q.	$\frac{L_1}{L_2}$	2.	1
R.	$\frac{K_1}{K_2}$	3.	2
S.	$\frac{T_1}{T_2}$	4.	8

(A) P → 4; Q → 2; R → 1; S → 3

(B) P → 3; Q → 2; R → 4; S → 1

(C) P → 2; Q → 3; R → 1; S → 4

(D) P → 2; Q → 3; R → 4; S → 1

Ans. **(B)**

Sol. (P) $v_0 = \sqrt{\frac{GM}{R}}$

$$\frac{v_1}{v_2} = \sqrt{\frac{R_2}{R_1}} = \frac{2}{1}$$

(Q) $L = mvR$

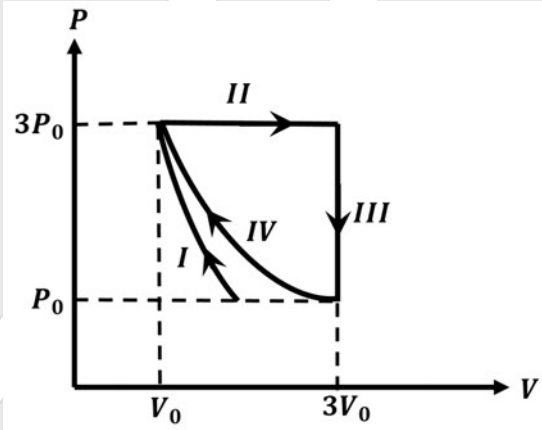
$$\frac{L_1}{L_2} = \frac{m_1}{m_2} = \frac{v_1}{v_2} = \frac{R_1}{R_2} = \frac{2}{1} \times \frac{2}{1} \times \frac{1}{4} = 1$$

(R) $KE = \frac{GMm}{R}$

$$\frac{K_1}{K_2} = \frac{m_1}{m_2} \times \frac{R_1}{R_2} = \frac{2}{1} \times \frac{4}{1} = 8$$

(S) $\frac{T_1}{T_2} = \left(\frac{R_1}{R_2}\right)^{3/2} = \frac{1}{8}$

17. One mole of a monatomic ideal gas undergoes four thermodynamic processes as shown schematically in the PV-diagram below. Among these four processes, one is isobaric, one is isochoric, one is isothermal and one is adiabatic. Match the processes mentioned in List-1 with the corresponding statements in List-II.



List-I		List-II	
P.	In process I	1.	Work done by the gas is zero
Q.	In process II	2.	Temperature of the gas remains unchanged
R.	In process III	3.	**No** heat is exchanged between the gas and its surroundings
S.	In process IV	4.	Work done by the gas is $6P_0V_0$

(A) P → 4; Q → 3; R → 1; S → 2 (B) P → 1; Q → 3; R → 2; S → 4

(C) P → 3; Q → 4; R → 1; S → 2 (D) P → 3; Q → 4; R → 2; S → 1

Ans. **(C)**

Sol. (P) Process -1 is adiabatic (Q = 0)

(Q) Process -2 is isobaric

$\Delta w = 6P_0V_0$,

(R) Process -3 is isochoric

$\Delta W = 0$

(S) Process -4 is isothermal (T = constant)

18. In the List-I below, four different paths of a particle are given as functions of time. In these functions, α and β are positive constants of appropriate dimensions and $\alpha \neq \beta$. In each case, the force acting on the particle is either zero or conservative. In List-II, five physical quantities of the particle are mentioned: $\vec{p}$ is the linear momentum, $\vec{L}$ is the angular momentum about the origin, K is the kinetic energy, U is the potential energy and E is the total energy. Match each path in List-I with those quantities in List-II, which are **conserved for that path**.

List-I		**List-II**	
P.	$\vec{r}(t) = \alpha t\hat{i} + \beta t\hat{j}$	1.	$\vec{p}$
Q.	$\vec{r}(t) = \alpha\cos\omega t\hat{i} + \beta\sin\omega t\hat{j}$	2.	$\vec{L}$
R.	$\vec{r}(t) = \alpha(\cos\omega t\hat{i} + \sin\omega t\hat{j})$	3.	K
S.	$\vec{r}(t) = \alpha t\hat{i} + \frac{\beta}{2}t^2\hat{j}$	4.	U
		5.	E

(A) P → 1, 2, 3, 4, 5; Q → 2, 5; R → 2, 3, 4, 5; S → 5

(B) P → 1, 2, 3, 4, 5; Q → 3, 5; R → 2, 3, 4, 5; S → 2, 5

(C) P → 2, 3, 4; Q → 5; R → 1, 2, 4; S → 2, 5

(D) P → 1, 2, 3, 5; Q → 2, 5; R →2, 3, 4, 5; S → 2, 5

Ans. **(A)**

Sol. (P) $\vec{V}$ = constant $\vec{a} = 0$ P → 1, 2, 3, 4, 5

(Q) $\vec{a} = -\omega^2\vec{r}$ path of the particle is elliptical Q → 2, 5

(R) $\vec{a} = -\omega^2\vec{r}$ path of the particle is circular R → 2, 3, 4, 5

$|\vec{V}|$ = constant

(S) $\vec{a}$ = constant S → 5