JEE-ADVANCED-2014-P2-Model

Time: 2.00 PM to 5.00 PM **IMPORTANT INSTRUCTIONS** **Max Marks: 180**

PHYSICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 1 – 10)	Questions with Single Correct Choice	3	-1	10	30
Sec – II(Q.N : 11 – 16)	Questions with Comprehension Type (3 Comprehensions – 2 +2+2 = 6Q)	3	-1	6	18
Sec – III(Q.N : 17 – 20)	Matrix Matching Type	3	-1	4	12
Total				**20**	**60**

CHEMISTRY:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 21 – 30)	Questions with Single Correct Choice	3	-1	10	30
Sec – II(Q.N : 31 – 36)	Questions with Comprehension Type (3 Comprehensions – 2 +2+2 = 6Q)	3	-1	6	18
Sec – III(Q.N : 37 – 40)	Matrix Matching Type	3	-1	4	12
Total				**20**	**60**

MATHEMATICS:

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 41 – 50)	Questions with Single Correct Choice	3	-1	10	30
Sec – II(Q.N : 51 – 56)	Questions with Comprehension Type (3 Comprehensions – 2 +2+2 = 6Q)	3	-1	6	18
Sec – III(Q.N : 57 – 60)	Matrix Matching Type	3	-1	4	12
Total				**20**	**60**

PART-I_PHYSICS **Max Marks : 60**

Section-1
(Only one Option correct Type)

This section contains 10 Multiple Choice questions. Each Question has Four choices (A), (B), (C) and (D). Out of Which **Only One is correct**

1. Suppose we use a physical balance to measure the mass of an object and found the mean value of our observations to be 120.1 g. The least count of the balance is 0.1 g.

   A) mass of object in scientific notation is $1.201\times10^{-4}\,kg$

   B) Limit of resolution of balance used is $\frac{10}{1gram}$

   C) mass of object must be somewhere between 120.05 gram and 120.15 gram

   D) mass of object may be 120.5 gram

2. A projectile thrown from ground at some angle is having velocities $\vec{u}$ and $\vec{v}$ at two points during its flight. If $\vec{u}$ and $\vec{v}$ are perpendicular to each other than the minimum kinetic energy of projectile during the journey is (mass of the projectiles is m)

   A) $\frac{1}{2}m\left(\frac{u^2v^2}{u^2+v^2}\right)$ B) $\frac{m}{2}\frac{uv}{(u^2+v^2)}$ C) $\frac{m}{2}\frac{(u^2+v^2)}{u^2v^2}$ D) $\frac{m}{2}\frac{(u^2+v^2)}{uv}$

3. A moving car possess average velocities of $5ms^{-1}, 10ms^{-1}$ and $15ms^{-1}$ in the first, second and third seconds, respectively. What is the total distance covered by the car in these 3s?

   A) 15m B) 30m C) 55m D) 45m

4. A particle moving in the positive x-direction has initial velocity v_0. The particle undergoes retardation kv^2, where v is its instantaneous velocity. The velocity of the particle as a function of time is given by

   A) $v=\frac{v_0}{(1+kv_0t)}$ B) $v=\frac{2v_0}{1+kt}$ C) $v=\frac{v_0}{kt}$ D) $v=\frac{v_o}{\left(1+k^2v_0^2t\right)}$

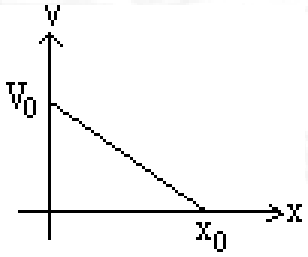
5. The maximum height attained by a projectile is increased by 5%, keeping the angle of projection constant, what is the percentage increase in horizontal range?

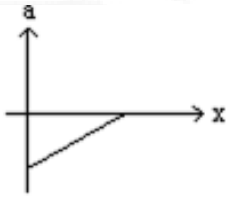
A) 5% B) 10% C) 20% D) 40%

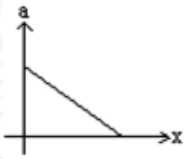
6. A body is projected with an initial velocity u at an angle 67^0 with the horizontal ground in the vertical plane (at t=0sec), then find the time at which the instantaneous velocity vector of the projectile makes an 127^0 with the initial projected velocity vector (take $\tan 37^0 = 3/4$, Acceleration due to gravity is g)

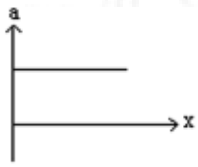
A) $\frac{8u}{5g}$ B) $\frac{4u}{5g}$ C) $\frac{7u}{5g}$ D) $\frac{6u}{5g}$

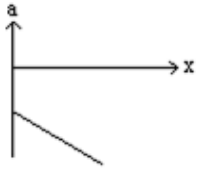
7. The given graph shows the variation of velocity with displacement for the particle moving along the straight line. Which one of the graph given below correctly represents the variation of acceleration with displacement?



A) 

B) 

C) 

D) 

8. A body is projected with a initial velocity 'u' at an angle 'θ' with the horizontal ground in the vertical plane, the magnitude of rate of change of speed of the projectile when the projectile is at half of the maximum height is

A) $\frac{g\tan\theta}{\sqrt{2+\tan^2\theta}}$ B) $\frac{g\tan\theta}{\sqrt{1+\tan^2\theta}}$ C) $\frac{g\tan\theta}{\sqrt{4+\tan^2\theta}}$ D) $g\sin\theta$

9. Three particles are initially kept at the vertices A, B and C of a triangle with $\angle A = 120^0$ and $\angle B = \angle C = 30^0$. They simultaneously start moving and will simultaneously meet at the incentre (point of intersection of angular bisectors) of ΔABC and then stop. The ratio of average velocities of the particles is

A) $\sin 15^0 : \cos 30^0 : \cos 30^0$ B) $\cos 15^0 : \sin 30^0 : \sin 30^0$

C) $\tan 15^0 : \tan 30^0 : \tan 30^0$ D) $\cot 15^0 : \cot 30^0 : \cot 30^0$

10. The lengths of two objects are measured as 20.17 m and 20.15 m. The difference of these two lengths to correct number of significant digits is

A) 2.0×10^{-2} m B) 2.00×10^{-2} m

C) 2.000×10^{-2} m D) 0.02 m

Section-2
(Paragraph Type)

This section contains 3 paragraphs each describing theory, experiment, data etc. Six questions relate to three paragraphs with two questions on each paragraph. Each question pertaining to a particular **paragraph** should have only one correct answer among the four choices A, B, C and D.

Passage I:

A dense collection of equal number of electrons and positive ions is called neutral plasma. Certain solids containing fixed positive ions surrounded by free electrons can be treated as

neutral plasma. Let N be the number density of free electrons, each of mass m. When the electrons are subjected to an electric field, they are displaced relatively away from the heavy positive ions. If the electric field becomes zero, the electrons begin to oscillate about the positive ions with a natural angular frequency ω_p, which is called the plasma frequency. To sustain the oscillations, a time varying electric field needs to be applied that has an angular frequency ω, where a part of the energy is absorbed and a part of it is reflected. As ω approaches ω_p, all the free electrons are set to resonance together and all the energy is reflected. This is the explanation of high reflectivity of metals.

11. Taking the electronic charge as e and the permittivity as $\in_0$, use dimensional analysis to determine the correct expression for ω_p

A) $\sqrt{\frac{Ne}{m\in_0}}$ B) $\sqrt{\frac{m\in_0}{Ne}}$ C) $\sqrt{\frac{Ne^2}{m\in_0}}$ D) $\sqrt{\frac{m\in_0}{Ne^2}}$

12. Estimate the wavelength at which plasma reflection will occur for a metal having the density of electrons, $N \approx 4\times10^{27} m^{-3}$. Take $\in_0 \approx 10^{-11}$ and $m \approx 10^{-30}$, where these quantities are in proper SI units.

A) 800 nm B) 600 nm C) 300nm D) 200nm

Passage-II:

Measurements always have uncertainties. If you measure the thickness of the cover of the book "PHYSICS for bright future" using an ordinary ruler, then your measurement may be reliable only to the nearest millimeter and your result may be 2 mm (say). It would be absolutely wrong to state this result as 2.00 mm till we are not aware of the limitations of the measuring device. Based on the above facts, answer the following questions.

13. The percentage error in measuring a distance of about 50cm with a meter stick having calibrations up to 1mm is

A) 0.1% B) 0.2% C) 0.3% D) 0.4%

14. The percentage error in measuring a time interval of 4 minute with a stop watch having least count of 0.2s is

A) 5% B) 0.06% C) 0.08% D) 0.10%

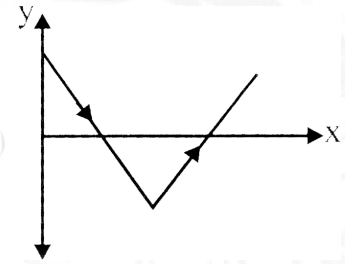
Passage-III:

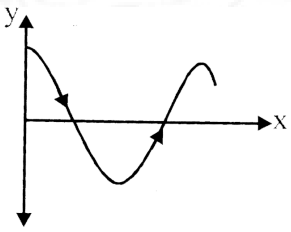
A particle starts moving at $t = 0$ in $x - y$ plane such that its coordinate (m) with time (in sec) as $x = 2t$ and $y = 5\sin(2t)$ respectively

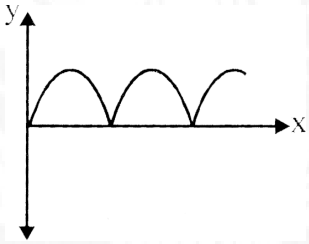
15. Maximum speed of the particle is:

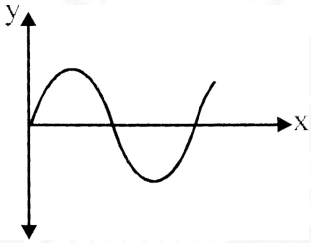
A) $12\ m/s$ B) $\sqrt{29}\ m/s$ C) $2\sqrt{26}\ m/s$ D) $10\ m/s$

16. The path of the particle will be:

A) 

B) 

C) 

D) 

Section-3
(Matching List Type)

This section contains four questions, each having two matching lists (List-1 & List-II). The options for the **correct match** are provided as (A), (B),(C) and (D) out of which **ONLY ONE** is correct.

17. Match the physical quantities given in column I with the dimensions expressed in terms of mass (M), length (L), Time (T), and charge 'Q' given in column II and the select the correct answer using the code given below the columns.

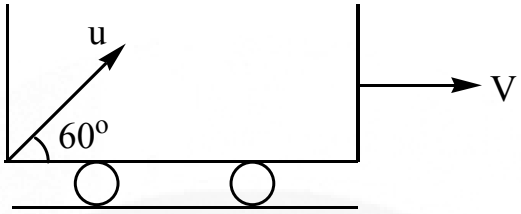
Column – I	Column – II
P) Capacitance	1. $\left[M^{-1}L^{-2}T^{2}Q^{2}\right]$
Q) Inductance	2. $\left[ML^{2}T^{-2}\right]$
R) Torque	3. $\left[ML^{2}T^{-1}\right]$
S) Angular momentum	4. $\left[ML^{2}Q^{-2}\right]$

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

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

18. A gun is fitted to a trolley car at an angle 60^{0} as shown in figure. If a shell is projected from gun with a velocity 40 m/s with respect to trolley car and velocity of trolley is 10 m/s (constant). Then match the following.

$\left(g = 10\ m/s^{2}\right)$(Assume that the shell hits the floor of the trolley)



Match **List – I** with **List – II** and select the correct answer using the code given below lists

	List – I		**List – II**
(P)	Time of flight of shell in seconds for an observer on the ground	(1)	$6\sqrt{3}$
(Q)	Time of flight of shell in seconds for an observer on the trolley car	(2)	$4\sqrt{3}$
(R)	Horizontal range of shell in meters with respect to trolley	(3)	$120\sqrt{3}$
(S)	Horizontal range of shell in meters with respect to ground	(4)	$80\sqrt{3}$

A) P – 2; Q – 2; R – 4; S – 3

B) P – 1; Q – 2; R – 4; S – 3

C) P – 1; Q – 2; R – 3; S – 4

D) P – 2; Q – 2; R – 3; S – 4

19. Some physical quantities are given in **List – I** and some possible SI units in which these quantities may be expressed are given in **List – II.** Match the physical quantities in **List – I** with the units in **List – II** and select the correct answer using the code given below lists

	List – I		**List – II**
(P)	$\frac{GM_eM_s}{R^2}$ $G \rightarrow$ universal gravitational constant, $M_e \rightarrow$ mass of the earth, $M_s \rightarrow$ mass of the Sun	(1)	(volt) (coulomb) (metre)
(Q)	$\frac{3RT}{M}$ $R \rightarrow$ universal gas constant, $T \rightarrow$ absolute temperature, $M \rightarrow$ molar mass	(2)	$(\text{kilogram})(\text{meter})^3(\text{second})^{-2}$
(R)	$\frac{F^2}{q^2B^2}$ $F \rightarrow$ force, $q \rightarrow$ charge, $B \rightarrow$ magnetic field	(3)	$(\text{meter})^2(\text{second})^{-2}$
(S)	$\frac{GM_e}{R_e}$ $G \rightarrow$ universal gravitational constant, $M_e \rightarrow$ mass of the earth, $R_e \rightarrow$ radius of the earth	(4)	$(\text{farad})(\text{volt})^2(\text{kg})^{-1}$

A) P-1,2;Q-1,2;R-3,4;S-3,4 B) P-1,2;Q-1,2;R-1,2;S-3,4

C) P-3,4;Q-3,4;R-1,2;S-3,4 D) P-1,2;Q-3,4;R-3,4;S-3,4

20. Where C = capacitance, R = resistance, k = Boltzman constant, E = electric field, B = magnetic field, T = Absolute temperature, h = Planks constant,

c = Speed of light, e = Charge of electron. Match the physical quantities in **List – I** with their S.I units given in **List – II** and select the correct answer using the code given below lists

List – I	**List – II**
(P) $\frac{e^2}{2\varepsilon_0 hc}$	(1) Unit less
(Q) $\sqrt{\frac{R^2C^2}{\mu_0\varepsilon_0}}$	(2) Meter
(R) $\frac{3}{2}kT$	(3) Joule
(S) $\frac{E}{B}$	(4) meter per sec

A) $P-1; Q-2; R-3; S-4$ B) $P-2; Q-1; R-3; S-4$

C) $P-2; Q-1; R-4; S-3$ D) $P-1; Q-2; R-4; S-3$