FIITJEE Phase Test (JEE-Advanced)

BATCHES – Reshuffling Test_Class - XI

PHYSICS, CHEMISTRY & MATHEMATICS

Pattern - CPT-2 | **QP CODE:** | **PAPER - 1**

Time Allotted: 3 Hours **Maximum Marks: 186**

- Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.
- You are not allowed to leave the Examination Hall before the end of the test.

INSTRUCTIONS

Caution: Question Paper CODE as given above MUST be correctly marked in the answer OMR sheet before attempting the paper. Wrong CODE or no CODE will give wrong results.

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains **Three Sections.**
3. **Section-I** is Physics, **Section-II** is Chemistry and **Section-III** is Mathematics.
4. All the section can be filled in **PART-A & B** of OMR.
5. Rough spaces are provided for rough work inside the question paper. No additional sheets will be provided for rough work.
6. Blank Papers, clip boards, log tables, slide rule, calculator, cellular phones, pagers and electronic devices, in any form, are not allowed.

B. Filling of OMR Sheet

1. Ensure matching of OMR sheet with the Question paper before you start marking your answers on OMR sheet.
2. On the OMR sheet, darken the appropriate bubble with ***Blue/Black Ball Point Pen*** for each character of your Enrolment No. and write in ink your Name, Test Centre and other details at the designated places.
3. OMR sheet contains alphabets, numerals & special characters for marking answers.

C. Marking Scheme For All Two Parts.

(i) **Part-A (01-04) –** Contains Six (04) multiple choice questions which have ONLY ONE CORRECT answer Each question carries **+3 marks** for correct answer and **-1 marks** for wrong answer.

(ii) **PART–A** (**05–12)** contains (8) Multiple Choice Questions which have **One or More Than One Correct** answer.
Full Marks: **+4** If only the bubble(s) corresponding to all the correct options(s) is (are) darkened.
Partial Marks: **+1** For darkening a bubble corresponding **to each correct option,** provided NO incorrect option is darkened.
Zero Marks: **0** If none of the bubbles is darkened.
***Negative Marks*: –1 In all other cases.**
For example, if **(A), (C) and (D)** are all the correct options for a question, darkening all these three will result in **+4 marks**; darkening only **(A) and (D)** will result in **+2 marks**; and darkening **(A) and (B)** will result in **–1** marks, as a wrong option is also darkened.

(iii) **Part-B (01-06)** contains six (06) Numerical based questions, the answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30) and each question carries **+3 marks** for correct answer. **There is no negative marking.**

Name of the Candidate :_____

Batch :_____ **Date of Examination :**_____

Enrolment Number :_____

SECTION-1 : PHYSICS

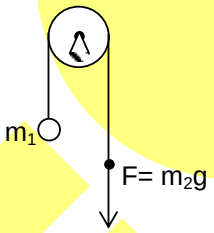
PART – A

(Single Correct Choice Type)

This section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. If a stone is released from a balloon rising with acceleration a at the instant when its velocity is v, then immediately after release, the acceleration and velocity of the stone are:
   (A) a(upward), v(upward)
   (B) g(upward), v(upward)
   (C) g(downward), v(upward)
   (D) (g-a) (downward), v(upward)

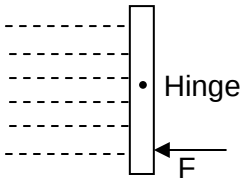
2. A hanging body of mass m_1 is pulled by a force $F = m_2g$ acting on the massless inextensible smooth string. The acceleration of m_1 is



   (A) $\frac{m_2 - m_1}{m_1 + m_2}g$
   (B) $\frac{m_1}{m_2}g$
   (C) $\frac{m_1 m_2}{(m_1 + m_2)^2 g}$
   (D) $\frac{(m_2 - m_1)}{m_1}g$

3. A string of length 1m and linear mass density 0.01 kg m^{-1} is stretched to a tension of 100 N. When both ends of the string are fixed, the three lowest frequencies for standing wave are f_1, f_2 and f_3. When only one end of the string is fixed, the three lowest frequencies for standing wave are n_1, n_2 and n_3. Then
   (A) $n_3 = 5n_1 = f_3 = 125$ Hz
   (B) $f_3 = 5f_1 = n_2 = 125$ Hz
   (C) $f_3 = n_2 = 3f_1 = 150$ Hz
   (D) $n_2 = \frac{f_1 + f_2}{2} = 75$ Hz

4. A square gate of size 1m x 1m is hinged at its mid point. A fluid of density ρ fills the space to the left of the gate. The force F, required to hold the gate stationary is



   (A) $\rho g/3$
   (B) $\rho g/2$
   (C) $\rho g/6$
   (D) None of these

(Multi Correct Choice Type)

This section contains 8 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

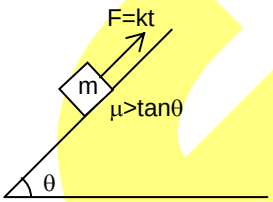
5. In case of circular motion of a body, if tangential force also acts on the body in addition to centripetal force, then work done
   (A) by both the forces is zero.
   (B) by both the forces is positive.
   (C) by centripetal force is zero but work done by tangential force is not zero.
   (D) by tangential force is zero but work done by centripetal force is not zero.

Space for rough work

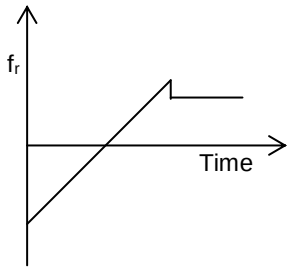
6. A simple pendulum has time period T = 2s in air. If the whole arrangement is placed in a nonviscous liquid whose density is $\frac{1}{2}$ times the density of bob. The time period of the simple pendulum in the liquid will be

(A) $\frac{2}{\sqrt{2}}$ s (B) 4 s (C) $2\sqrt{2}$ s (D) $4\sqrt{2}$ s

7. A block of mass m is placed on an inclined surface. Coefficient of friction between plane and block is $\mu > \tan\theta$. A force F = kt is applied on block at t = 0. Then which of the following represents variation of magnitude of frictional force with time.



(A)



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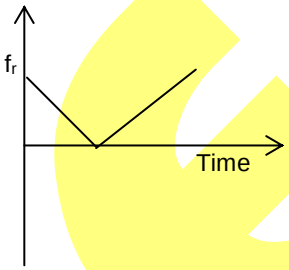

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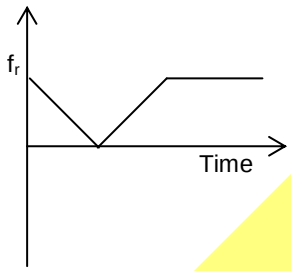
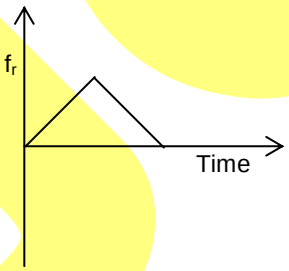


(D)



8. A rigid body is in pure Rotation about a fixed axis of rotation. Then which of the following statements are true.

(A) You can find two points in the body in a plane perpendicular to the axis of rotation having same velocity

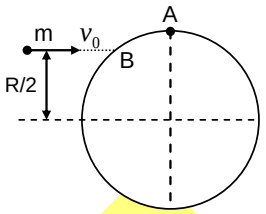
(B) You can find two points in the body in a plane perpendicular to the axis of rotation having same acceleration.

(C) Speed of all the particles lying on the curved surface of a cylinder whose axis coincides with the axis of rotation is same.

(D) Angular speed of the body is same as seen from any point in the body.

Space for rough work

9. A disc of mass m and radius R is lying on a smooth horizontal surface. A particle of mass m moving horizontally with a velocity v_0, collides with the disc at B and sticks to it. Speed of the point A on the disc just after impact will be



(A) $\frac{\sqrt{31}}{8}v_0$ (B) $\frac{\sqrt{5}}{16}v_0$

(C) $\frac{5v_0}{16}$ (D) $\frac{v_0}{2}$

10. A man of mass 60 kg can throw a stone of mass 1 kg upto a height 5 m. Now the same stone is being thrown in the horizontal direction when he is standing on frictionless ground. Choose the correct option(s): ($g = 10\ m/s^2$)

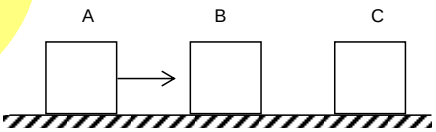
(A) He throws the stone with the same total work done as before then speed of stone is $v = 10\sqrt{\frac{60}{61}}\ m/s$

(B) He throws the stone with the same impulse with respect to ground as before then speed of stone is v = 10 m/s.

(C) If he throws the stone with the same relative velocity as before, then speed of stone is $v = \frac{600}{61} m/s$

(D) If he throws the stone with the same momentum as before, then speed of stone is $v = \frac{600}{61} m/s$

11. Three identical blocks A, B and C are placed on horizontal frictionless surface. The blocks B and C are at rest. But A is approaching towards B with a speed 10 m/s. The coefficient of restitution for all collisions is 0.5. Then,



(A) speed of the block C just after collision is approximately 5.62 m/s

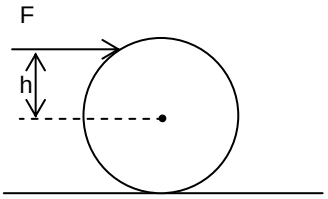
(B) speed of the block B just after collision is 8 m/s

(C) speed of the block C just after collision is 6 m/s

(D) speed of the block B just after collision is 7.5 m/s

Space for rough work

12. When a body is rolling without slipping on a rough horizontal surface as shown in the figure. The frictional force will act on the body is / are



(A) In forward direction, if $h < \frac{I_{cm}}{mR}$

(B) In backward direction, if $h < \frac{I_{cm}}{mR}$

(C) In forward direction, if $h > \frac{I_{cm}}{mR}$

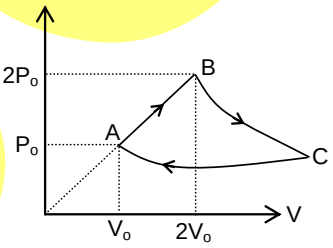
(D) be zero, if $h = \frac{I_{cm}}{mR}$

PART – B
(Numerical based)

This section contains 6 Numerical based questions, the answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30)

1. The power radiated by a black body is P, and it radiates maximum energy around the wavelength λ_0. If the temperature of black body is now changed so that it radiates maximum energy around a wavelength $\frac{3\lambda_0}{4}$, the new power radiated by it is $\frac{64P}{81} \times n$, then find the value of 'n'.

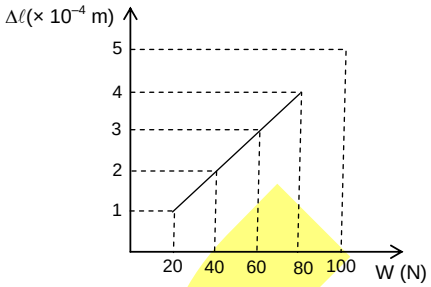
2. One mole of a diatomic gas is taken around a cyclic process shown in the figure. The process BC is adiabatic expansion and the process CA is isothermal compression. If the volume of the gas at C is given by $V_c = (2)^n V_0$, then the value of 'n' is



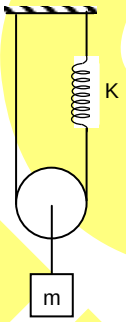
3. A rod of negligible heat capacity has a length of 50 cm, area of cross-section 5 cm^2 and thermal conductivity 500 W/m^oC. The temperature of one end is maintained at 0°C and that of the other end is slowly and linearly varied from 0°C to 60°C in 20 min. Assuming no heat loss through the lateral side, the total heat transmitted through the rod in 20 minutes is 2n kJ, then find the value of 'n'.

Space for rough work

4. A 1 m long metal wire of cross sectional area 10^{-6} m^2 is fixed at one end from a rigid support and a weight W is hanging at its other end. The graph shows the observed extension of length $\Delta\ell$ of the wire as a function of W. Young's modulus of material of the wire in SI units is $k \times 10^{11}$, then find the value of 'k'.



5. Figure below shows a massless pulley, a spring of constant K = 250 N/m and a mass 1 kg. On displacing the mass slightly, find its frequency (approximate) of its vertical oscillation.(Take $\sqrt{10}=\pi$)



6. A train has just completed a U-curve in a track which is a semicircle. The engine is at forward end of the semicircular part of the track while the last carriage is at the rear end of the semi-circular track. The driver blows a whistle of frequency 200 Hz. Velocity of sound is 340 m/s. Then the apparent frequency as observed by a passenger in the middle of the train, when the speed of the train is 30 m/s is $n \times 10^2$ Hz. What is value of 'n'?

Space for rough work

SECTION-2 : CHEMISTRY

PART – A

(Single Correct Choice Type)

This section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

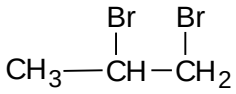
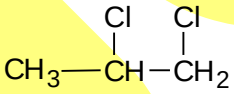
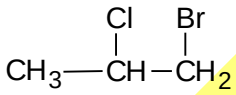
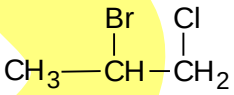
1. Which is the correct order of dipole moments of the given compounds?
   (A) $BCl_3 > CO_2 > H_2O$ (B) $H_2O > BeF_2 > H_2S$
   (C) $NH_3 > NF_3 > BF_3$ (D) $CH_4 > H_2O > NH_3$

2. The electron affinity of oxygen is
   (A) less than that of nitrogen (B) greater than that of chlorine
   (C) less than that of sulphur (D) greater than that of fluorine

3. One litre aqueous solution contains 0.01 mole of $NaNO_3$ and 0.001 mole of NaOH. What is the pH of the solution?
   (A) 3 (B) 9
   (C) 11 (D) 5

4. $CH_3 - CH = CH_2 \xrightarrow[H_2O]{Br_2 + NaCl} Product(s)$

   Which of the following is not a product of above reaction?

   (A) 
   (B) 
   (C) 
   (D) 

(Multi Correct Choice Type)

This section contains 8 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

5. The radius of second orbit of which of the following species can be determined by applying Bohr's theory?
   (A) H (B) Li^+
   (C) He^+ (D) Be^{2+}

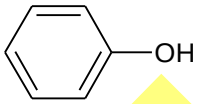
6. Choose correct statement(s) regarding the following equilibrium system?

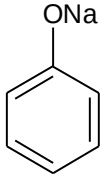
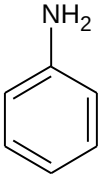
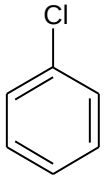
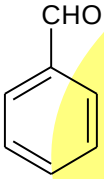
   $2NH_3(g) \rightleftharpoons N_2(g) + 3H_2(g);\ \Delta H = 68\ kJ\ mol^{-1}$

   The factor(s) that favour(s) percentage of decomposition of NH_3 is/are
   (A) increasing temperature (B) increasing pressure
   (C) removing N_2 (D) decreasing temperature

Space for rough work

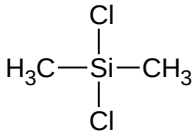
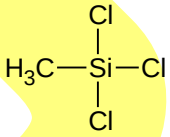
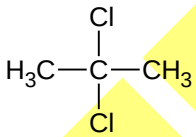
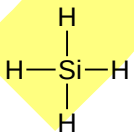
7. Which of the following compound(s) can react with oxygen?
(A) Na_2O (B) Na_2O_2
(C) Mg (D) $Mg(NO_3)_2$

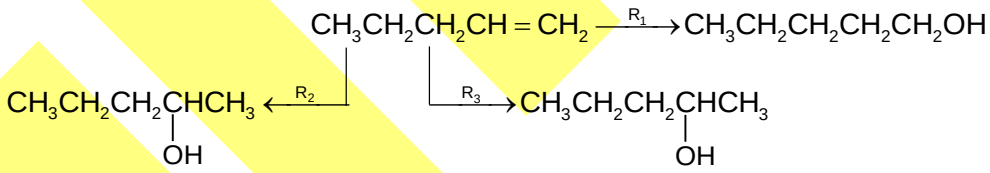
8. Which of the following compound(s) is/are more reactive than  towards electrophilic substitution reaction with Cl^+?

(A) 
(B) 
(C) 
(D) 

9. The correct hydrolysis order(s) given below is /are
(A) $BI_3 > BBr_3 > BCl_3 > BF_3$ (B) $CCl_4 > SiCl_4 > GeCl_4 > SnCl_4$
(C) $BF_3 > BCl_3$ (D) $SiCl_4 > CCl_4$

10. Which of the following compound(s) form silicones upon hydrolysis?

(A) 
(B) 
(C) 
(D) 

11. 

In the above reaction, R_1, R_2 and R_3 are

(A) R_1 is $\frac{B_2H_6, THF}{H_2O_2, NaOH}$ (B) R_2 is $\frac{Hg(OCOCH_3)_2, H_2O}{NaBH_4}$

(C) R_3 is HCl/CCl_4 (D) R_2 is $\frac{Hg(OCOCH_3)_2, CH_3OH}{NaBH_4}$

Space for rough work

12. Under which of the following condition(s), the rate constant of a molecular reaction becomes maximum?
(A) $E_a = 0$ (B) T = Infinity
(C) $t_{½}$ = Infinity (D) Temperature coefficient is minimum

PART – B
(Numerical based)

This section contains 6 Numerical based questions, the answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30)

1. One litre aqueous solution contains 4 g NaOH and 7.644 g of $NaHCO_3$. The solution requires a certain volume of 5 M HCl solution for complete neutralization. What is the volume of HCl in mL unit?

2. The energy of first orbit of hydrogen atom is $-13.6\ eV$. If the ionization energy of the ground state hydrogen atom is expressed as $y \times 10^{-22}$ kJ/atom, what is the value of y?
(Charge of electron = 1.6×10^{-19} Coulomb)

3. How much heat in Kcal mol^{-1} is absorbed by heating one mole of an ideal gas at constant pressure form 0 K to 8096 K? $\left[C_P = \frac{5R}{2}\right]$

4. A hydrocarbon(X) containing four carbon atoms displays geometrical isomerism. (Y) is the ring-chain isomer of (X). Reaction of (Y) with chlorine in presence of sunlight gives a monochloro product(Z). How much is the mass of one mole of (Z) in g unit?

5. $Na + O_2\,(\text{excess}) \longrightarrow \text{Products}$
What is the molar mass of the heaviest unknown product of above reaction in g mol^{-1} unit?

6. 400 mL of 0.2 M solution of CH_3COOH is mixed with 400 mL of 0.1 M solution of NaOH. What is the pH of the resulting solution? [pK_a of CH_3COOH = 4.78]

Space for rough work

SECTION-3 : MATHEMATICS

PART – A

(Single Correct Choice Type)

This section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

1. If the line $3x-y+1=0$ and $x-2y+3=0$ are equally inclined to the line $y=mx$, then the value of m is given by

(A) $2m^2-7m-7=0$ (B) $7m^2-7m-2=0$

(C) $7m^2-2m-7=0$ (D) $2m^2-7m-2=0$

2. The value of $a\in R$ for which the sum of the squares of the roots of the equation $2x^2-2(a-6)x+(2a-5)=0$ is least, is

(A) 2 (B) 3

(C) 8 (D) 7

3. In a ΔABC, if $\dfrac{\sin 2A+\sin 2B+\sin 2C}{\cos A+\cos B+\cos C-1}=\lambda\cos\dfrac{A}{2}\cos\dfrac{B}{2}\cos\dfrac{C}{2}$, then λ equals

(A) 8 (B) 3

(C) 1 (D) 7

4. The maximum value of n for which $\sum_{-14}^{n}1>\sum_{1}^{n}\left(n+\dfrac{1}{2}\right)$ is

(A) 3 (B) 5

(C) 1 (D) None of these

(Multi Correct Choice Type)

This section contains 8 **multiple choice questions.** Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** may be correct.

5. If the equation $x^4+ax^3+bx^2+cx+d=0$, where $a,b,c,d\in R$ has four imaginary roots, two with sum $3+4i$ and the other two with product $13+i$, then

(A) $a=-6$ (B) $b=50$ (C) $c=-70$ (D) $\dfrac{ad}{bc}=\dfrac{2}{7}$

Space for rough work

6. Let $a_1, a_2, a_3, \ldots\ldots, a_n$ be in A.P. and $g_1, g_2, g_3, \ldots\ldots, g_n$ be in G.P. If $a_1 = 3, g_1 = 2$ and $a_9 = g_9 = 5$, then which of the following hold(s) good?

(A) $a_5 g_{17} = 50$ (B) $a_{21} g_{25} = 250$

(C) $a_{37} g_{17} = 150$ (D) $a_{29} g_9 \neq a_5 g_{17}$

7. The circles $x^2 + y^2 = 1$ and $x^2 + y^2 = 2x$

(A) intersect in two distinct points

(B) intersect on the line $x = \frac{1}{2}$

(C) intersect in the points $\left(\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$ and $\left(\frac{1}{2}, -\frac{\sqrt{3}}{2}\right)$

(D) have a common chord of length $\sqrt{3}$

8. An ellipse, with centre origin, intersects the hyperbola $2x^2 - 2y^2 = 1$ orthogonally. The eccentricity of the ellipse is reciprocal of that of the hyperbola. If the axes of the ellipse are along the coordinates axes, then:

(A) equation of ellipse is $x^2 + 2y^2 = 2$ (B) the foci of ellipse are $(\pm 1, 0)$

(C) equation of ellipse is $x^2 + 2y^2 = 4$ (D) the foci of ellipse are $\left(\pm\sqrt{2}, 0\right)$

9. Consider the word ENTRANCE. Which of the following is correct?

(A) Total ways of selecting 4 alphabets from this word is 36

(B) Total ways of selecting 4 alphabets from this word is 35

(C) Total ways of making a 4 letter word using the letters of this word is 606

(D) Total ways of making a 4 letter word using the letters of this word is 600

10. Roots of the Quadratic equation $(x-a)(x-b)+1=0,\ a,b \in R$

(A) always lie between a and b (B) may lie between a and b.

(C) may not be real (D) may be equal

11. If $\left(9+\sqrt{80}\right)^n = I + f$ where I, n are integers and $0 < f < 1$, then

(A) I is an odd integer (B) I is an even integer

(C) $(I+f)(1-f) = 1$ (D) $1 - f = \left(9-\sqrt{80}\right)^n$

12. Let $P(x_1, y_1)$ and $Q(x_2, y_2), y_1 < 0, y_2 < 0$ be the ends of the latus rectum of the ellipse $x^2 + 4y^2 = 4$. The equations of parabolas with latus rectum PQ are

(A) $x^2 + 2\sqrt{3}y = 3 + \sqrt{3}$ (B) $x^2 - 2\sqrt{3}y = 3 + \sqrt{3}$

(C) $x^2 + 2\sqrt{3}y = 3 - \sqrt{3}$ (D) $x^2 - 2\sqrt{3}y = 3 - \sqrt{3}$

Space for rough work

PART – B
(Numerical based)

This section contains 6 Numerical based questions, the answer of which maybe positive or negative numbers or decimals (e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30)

1. Tangents are drawn to circle $x^2+y^2=12$ at the points where it is met by the circle $x^2+y^2-5x+3y-2=0$, then x – coordinate of points of intersection of these tangents is _

2. Tangents are drawn from the point (–1, 2) to the parabola $y^2=4x$. If the square of the area of the triangle formed by the tangents and the chord of contacts be 2^k, then k is equal to

3. The tangent at P on the hyperbola $\left(\frac{x^2}{a^2}\right)-\left(\frac{y^2}{b^2}\right)=1$ meets the asymptote $\frac{x}{a}-\frac{y}{b}=0$ at Q. If the locus of the mid point of PQ has the equation $\left(\frac{x^2}{a^2}\right)-\left(\frac{y^2}{b^2}\right)=k$, then $\frac{8k}{3}$ has the value equal to

4. The number of ways of choosing 3 distinct numbers from first '15' natural numbers such that no two are consecutive is 143k then k is equal to

5. The number of solutions of $\cos x=|1+\sin x|$, $0\le x\le 3\pi$, is:

6. The value of the expression $(0.16)^{\log_{2.5}\left(\frac{1}{3}+\frac{1}{3^2}+\frac{1}{3^3}+.....+\infty\right)}$ is equal to

Space for rough work

Answers – A

Answers

PAPER-1

Physics

1.	C	2.	D	3.	D	4.	C
5.	C	6.	C	7.	C	8.	CD
9.	A	10.	ABC	11.	AD	12.	BCD

1.	4	2.	6	3.	9	4.	2
5.	5	6.	2				

Chemistry

1.	C	2.	C	3.	C	4.	B
5.	AC	6.	AC	7.	ABC	8.	AB
9.	AD	10.	AB	11.	AB	12.	AB

1.	38.2	2.	21.76	3.	40.48	4.	90.5
5.	78	6.	4.78				

Mathematics

1.	C	2.	D	3.	A	4.	B
5.	ACD	6.	ABC	7.	ABCD	8.	AB
9.	AC	10.	BCD	11.	ACD	12.	BC

1.	1	2.	7	3.	2	4.	2
5.	3	6.	4				

Hints & Solutions

PAPER-1

PHYSICS

Part-A

1. **C**

Sol. Acceleration = $\frac{mg}{m}$ and velocity = V.

2. **D**

Sol. $a = \frac{F - m_1 g}{m_1}$

3. **D**

Sol. $f = \frac{m}{2\ell}\sqrt{\frac{T}{\mu}}$; $n = \frac{2m+1}{4\ell}\sqrt{\frac{T}{\mu}}$

4. **C**

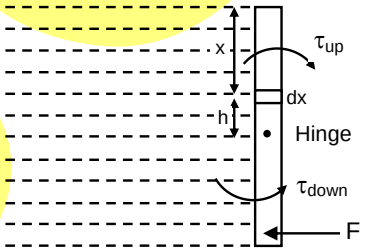
Sol. Hydrostatic torque above and below hinge will be clockwise and anticlockwise respectively. It can be found by:

$\tau = \int d\tau$

$= \int (\rho g x)(1\,dx)(h)$

($h \rightarrow$ Distance of differential strip from hinge)

Finally, $\tau_{up} + \tau_F = \tau_{down}$



5. **C**

Sol. $\vec{F}.d\vec{s}$

6. **C**

Sol. $T = 2\pi\sqrt{\frac{\ell}{g_{eff}}}$

7. **C**

Sol. Consider t = 0,

F = Kt = 0

f = mg sin θ up the plane.

Consider $t = t_o$ such that

$\Rightarrow$ $F = Kt_0 = mg \sin\theta$

f = 0 at this instant

For $t > t_0$ block will start moving up with friction acting down the plane. Hence, friction changes sign for values t > 0 and finally becomes constant. (Kinetic friction).

Note: magnitude of friction will always remain ≥ 0.

8. **CD**

Sol. Conceptual

9. **A**

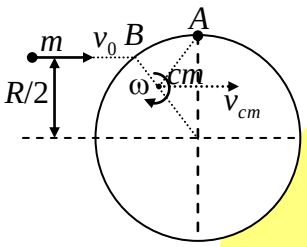
Sol. COM, $mv_0\hat{i} = 2m\vec{v}_{cm} \Rightarrow \vec{v}_{cm} = \frac{v_0}{2}\hat{i}$

COAM about CM $\left(mv_0\frac{R}{2}\sin 30^o\right)(-\hat{k})=\left(m\frac{R^2}{4}+\frac{1}{2}mR^2+\frac{mR^2}{4}\right)\vec{\omega}$

$\vec{\omega}=\frac{v_0}{4R}(-\hat{k})$

$\vec{v}_A=\vec{v}_{cm}+\vec{\omega}\times\vec{r}$

$=\frac{v_0}{2}\hat{i}+\frac{v_0}{4R}(-\hat{k})\times\left(\frac{R}{2}.\frac{\sqrt{3}}{2}\hat{i}+\frac{3R}{4}\hat{j}\right)$



$=\frac{11v_0}{16}\hat{i}-\frac{\sqrt{3}v_0}{16}\hat{j}$; $|\vec{v}_A|=\frac{\sqrt{31}}{8}v_0$

10. **ABC**

Sol. Same work

$W = 1 \times 10 \times 5 = 50$ J

$W=\frac{1}{2}\times 1\times V^2+\frac{1}{2}60\times\left(\frac{V}{60}\right)^2=50$

$\Rightarrow\ V^2\left(1+\frac{1}{60}\right)=50\times 2$

$\Rightarrow\ V=\sqrt{\frac{100\times 60}{61}}=10\sqrt{\frac{60}{61}}$ m/s

Same impulse $J=1\times\sqrt{2\times 10\times 5}=10$

$\therefore\ V=\frac{J}{m}=\frac{10}{1}$ = 10 m/s

Same relative velocity

$V_m=\frac{10}{61}$, $V_s=60\times\frac{10}{61}\times\frac{1}{1}=\frac{600}{61}$ m/s

Same momentum, $V_s=\frac{1\times 10}{1}$ = 10 m/s

11. **AD**

Sol. $V_A=\left(1+\frac{1}{2}\right)5=\frac{1}{2}\times 10=\frac{5}{2}$ = 2.5 m/s

$V_B=\left(1+\frac{1}{2}\right)5$ = 7.5 m/s

$V_B'=\left(1+\frac{1}{2}\right)\frac{7.5}{2}-\frac{7.5}{2}=\frac{7.5}{4}$ m/s = 1.875 m/s

$V_C=\left(1+\frac{1}{2}\right)\frac{7.5}{2}=\frac{45}{8}$ = 5.625 m/s

12. **BCD**

Sol. $a=\alpha R=\frac{F(h+R)R}{I_{cm}+mR^2}$

$F-F_s=\frac{mR(h+R)R}{I_{cm}+mR^2}$

$\Rightarrow\ F_s=\frac{F\left[\frac{I_{cm}}{mR}-R\right]}{I_{cm}+mR^2}$

Part-B

1. **4.00**

Sol. $T \propto \frac{1}{\lambda}$ and $P \propto T^4$

2. **6.00**

Sol. In process BC, $(2P_o)(2V_o)^{7/5} = P_C V_C^{7/5}$
In process CA, $P_o V_o = P_C V_C$
Take ratio and solve.

3. **9.00**

Sol. $T = \frac{t}{20}$ °C where t is time in seconds.

$$\frac{d\theta}{dt} \rightarrow \frac{dQ}{dt} = \frac{kA(T-0)}{\ell}$$

$$\Delta Q = \int dQ = \frac{kA}{\ell}\int \frac{t}{20} dt = 18000 \text{ J.}$$

4. **2.00**

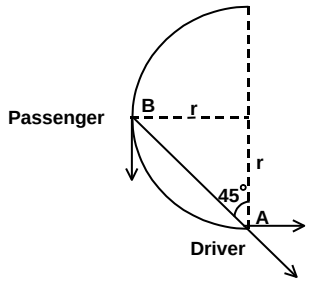
Sol. $\gamma = \frac{F\ell}{A\Delta\ell} = 2 \times 10^{11}$ N/m^2

5. **5.00**

Sol. $Keq = 4k,\ f = \frac{1}{2\pi}\sqrt{\frac{4k}{m}} = 5$

6. **2.00**

Sol: Velocity component of the source in the direction of motion of sound = 30 cos 45° along BA.
Velocity component of observer in the direction BA = 30 cos 45°.
∴ There is no relative motion between the source and the observer, hence no change in real frequency is observed.



CHEMISTRY

PART – A

1. C

Sol. NH_3, NF_3, H_2O and H_2S have non-zero dipole moment and BF_3, BCl_3, CO_2 and BeF_2 have zero dipole moment.

2. C

3. C

Sol. $p^{OH} = -\log[OH] = -\log 10^{-3} = 3$

4. B

Sol. In the reaction mixture only Cl^- is present not Cl^+.

5. AC

Sol. H and He^+ are one electron systems.

6. AC

7. ABC

Sol. $Na_2O \xrightarrow{O_2} Na_2O_2 \xrightarrow{O_2} NaO_2$

$2Mg + O_2 \longrightarrow 2MgO$

8. AB

Sol. PhO^- is more reactive than phOH due to more +R effect of O^- species. $PhNH_2$ is more reactive because NH_2 is a better activating group than OH.

9. AD

10. AB

11. AB

12. AB

Sol. $k = Ae^{-E_a/RT}$

For k to be maximum, $E_a = 0$, $T = \infty$

PART – B

1. 38.2

Sol. Moles of NaOH and $NaHCO_3$

$= \frac{4}{40} + \frac{7.644}{84} = 0.191$

$N_1V_1 = N_2V_2$

or, $0.191 \times 1000 = 5 \times V$

$\therefore V = 38.2$ mL

2. 21.76

Sol. $E_H = -13.6$ eV

I.E (of H) = 13.6 eV

$= 13.6 \times 1.6 \times 10^{-19} \times 10^{-3}$

$= 21.76 \times 10^{-22}$

$= y \times 10^{-22}$

$\therefore y = 21.76$

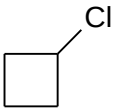
3. 40.48

Sol. $\Delta H = nC_P\Delta T$

$$= 1\times\frac{5}{2}\times R\times(8096-0)$$

$$= 1\times\frac{5}{2}\times 2\times 8096 = 40480 \text{ cal} = 40.48 \text{ Kcal}$$

4. 90.5

Sol. $X = CH_3CH = CHCH_3$ $Y =$  $Z =$ 

Molar mass of Z = 90.5

5. 78

6. 4.78

Sol. $\underset{400\times 0.2=80}{CH_3COOH} + \underset{400\times 0.1=40}{NaOH} \longrightarrow \underset{0}{CH_3COONa} + \underset{0}{H_2O}$

$80-40=40$ $\quad 40-40=0$ $\quad 40$ $\quad 40$

$$\therefore pH = pK_a + \log\frac{[CH_3COONa]}{[CH_3COOH]} = 4.78 + \log\frac{40}{40} = 4.78$$