Vidyamandir Classes
Gurukul for IITJEE Preparation

Advanced Practice Test-6

TIME : 3 hrs	M.M. : 300

Read the following Instructions very carefully before you proceed.

- **The Test consists of 75 questions.**
- The question paper consists of 3 parts: Part I : Chemistry, Part II : Physics, Part III : Mathematics. Each part contains 25 questions.

  Each question has 4 choices (A), (B), (C) and (D), out of which **Only One choice is Correct.**
- For each question you will be given **4 Marks** if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, **minus one (–2) Mark (NEGATIVE MARKING)** will be given.
- For answering a question, an **ANSWER SHEET (OMR SHEET)** is provided separately. Please fill your **Name, Roll Number, Group, Batch** and the **PAPER CODE** properly in the space provided in the **ANSWER SHEET.**

  IT IS YOUR OWN RESPONSIBILITY TO FILL THE OMR SHEET CORRECTLY.
- A blank space has been provided on each page for rough work. You will not be provided with any supplement or rough sheet. However some blank pages for rough work are given at the end of this paper.
- The use of log tables, calculator, mobile or any other electronic device is strictly prohibited.
- Please do not disturb the invigilator or any other student for any confusion(s) in the paper. **Violating the examination room discipline will immediately result in the cancellation of your paper and no excuses will be entertained.**

PART - I (CHEMISTRY) | 100 MARKS

This section contains 25 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct:

1. Molecules with a permanent dipole moment include which of the following ?

I. HCN **II.** O_3 **III.** XeF_2

The correct choice is :

(A) I only **(B)** I and II only **(C)** II and III only **(D)** I, II and III only

2. The change in entropy for the following transformations is respectively:
(+ indicates increases; –indicates decrease and 0 indicates no change)

I. $SO_2Cl_{2(g)} \xrightarrow{\Delta} SO_{2(g)} + Cl_{2(g)}$

II. $nCH_2 = CH_{2(g)} \xrightarrow{\text{catalyst}} \left[CH_2—CH_2\right]_{n(s)}$

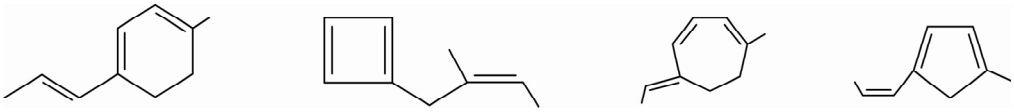
III. $I_{2(s)} \xrightarrow[1\text{atmosphere}]{\Delta} I_{2(V)}$

IV. Adiabatic reversible expansion of an ideal gas

The correct choice is :

(A) +, – , 0, + **(B)** +, – , 0, 0 **(C)** –, + , +, 0 **(D)** +, – , +, 0

3. A hydrocarbon (A) gives 1 mole of 2, 5-diketohexanal, 1 mole of glyoxal and 1 mole of acetaldehyde on reductive ozonolysis. The improbable structure of (A) would be :



(I) **(II)** **(III)** **(IV)**

The correct choice is :

(A) I, II **(B)** II, III **(C)** I, III **(D)** II, IV

4. The photochemical reaction of 2-methylpropane with F_2 gives 2-fluoro-2-methyl propane and 1-fluoro-2-methyl propane in 14:86 ratio. The corresponding ratio of the bromo products in the above reaction using Br_2 is most likely to be :

(A) 14:86 **(B)** 50:50 **(C)** 1:9 **(D)** 99:1

5. 1.0 m^3 of neon gas initially at 273.2 K and 10 atm undergoes expansion isothermally and reversibly to final pressure of 1 atm. The work done by the gas is :

(A) –232.85 kJ **(B)** –2332 kJ **(C)** –914.1 kJ **(D)** –2.32 kJ

6. The equilibrium : $SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$ is attained at 25°C in a closed container and inert gas helium is introduced. Which of the following statement(s) is(are) correct?

I. Concentrations of SO_2, Cl_2 and SO_2Cl_2 change. **II.** More chlorine is formed.

III. Concentration of SO_2 is reduced. **IV.** More SO_2Cl_2 is formed.

The correct choice is :

(A) I, II, III **(B)** II, III, IV **(C)** III, IV **(D)** None

7. The solubility of $CsBr_3$ in water is 746 ppm. Assuming the density of solution is 1g/cc the solubility product of $CsBr_3$ is : [Atomic masses are : Cs = 133, Br = 80]

(A) $1.6 \times 10^{-11}\ M^4$ **(B)** $4 \times 10^{-6}\ M^2$ **(C)** $8 \times 10^{-9}\ M^3$ **(D)** $3.2 \times 10^{-14}\ M^2$

8. The values of van der Waal's constant '*a*' and '*b*' for three different gases are given below. What is the correct order of liquefaction of gases?

Gases	*a*	*b*
X_2	1.3	0.090
Y_2	4.1	0.023
Z_2	2.2	0.075

(A) $X_2 > Y_2 > Z_2$ **(B)** $Y_2 > Z_2 > X_2$ **(C)** $Z_2 > Y_2 > X_2$ **(D)** $X_2 > Z_2 > Y_2$

9. An optically active alkene (A) has the molecular formula C_6H_{12}. The catalytic hydrogenation of (A) gives an achiral product. The structure of (A) would be

(A) $CH_3–\underset{\displaystyle CH_3}{\underset{|}{CH}}–CH=CH–CH_3$ **(B)** $CH_3–\underset{\displaystyle CH_3}{\underset{|}{CH}}–CH_2–CH=CH_2$

(C) $CH_3–\underset{\displaystyle C_2H_5}{\underset{|}{CH}}–CH=CH_2$ **(D)** $CH_3–\underset{\displaystyle C_2H_5}{\underset{|}{C}}=CH–CH_3$

10. Acidic strength of boron trihalide are in order of :

(A) $BF_3 < BCl_3 < BBr_3 < BI_3$ **(B)** $BI_3 < BBr_3 < BCl_3 < BF_3$

(C) $BBr_3 < BCl_3 < BF_3 < BI_3$ **(D)** $BF_3 < BI_3 < BCl_3 < BBr_3$

11. The correct order in which the O–O bond length increases in the following is :

(A) $O_2 < O_3 < H_2O_2$ **(B)** $H_2O_2 < O_3 < O_2$

(C) $O_3 < O_2 < H_2O_2$ **(D)** $O_2 < H_2O_2 < O_3$

12. Which of the following statements is incorrect on the basis of heat of combustion?

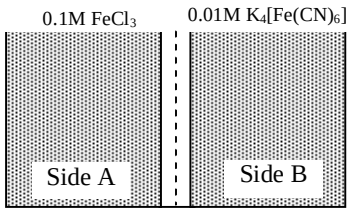
(A) *trans*-2-hexene has less heat of combustion than 2-methyl-2-pentene

(B) *cis*-2-pentene has higher heat of combustion than trans-2-pentene

(C) 1-hexene has higher heat of combustion than trans-2-hexene

(D) 2, 5-dimethylhexane has lower heat of combustion than octane

13. When $FeCl_3$ reacts with $K_4[Fe(CN)_6]$ in aqueous solution blue colour of ferri ferrocyanide, $Fe_4[Fe(CN)_6]_3$ is obtained. There are 0.1 M $FeCl_3$ and 0.01 M $K_4[Fe(CN)_6]$ solution are separated by a semi permeable membrane as shown and osmosis occurs then :



(A) Blue colour is seen in side B

(B) Blue colour is seen in side A

(C) Blue colour is seen in both sides A and B

(D) No blue colour is seen in either side

14. Select the correct statement(s) regarding phosphoric acid, Given that :

$$\Delta_f H^\circ\left(H_3PO_4\right) = -1290\,kJmol^{-1}, \Delta_f H^\circ\left(H_2PO_4^-\right) = -1302 kJ\,mol^{-1},$$

$$S^\circ\left(H_3PO_4\right) = 176\,Jmol^{-1}K^{-1}, S^\circ\left(H_2PO_4^-\right) = 89\,J\,mol^{-1}K^{-1}.$$

(A) It has a pK_{a_1} of 2.44 **(B)** pK_{a_2} of phosphoric acid is less than pK_{a_1}

(C) First dissociation of phosphoric acid is endothermic

(D) First dissociation of phosphoric acid is entropy driven

15. Fill in the blank : $^{235}_{92}U + ^{1}_{0}n \longrightarrow$ _____ $+ ^{92}_{36}Kr + 3\,^{1}_{0}n$

(A) $^{141}_{56}Ba$ **(B)** $^{139}_{56}Ba$ **(C)** $^{139}_{54}Ba$ **(D)** $^{141}_{54}B$

16. An electron in a hydrogen like species atom jumps in such a way that its kinetic energy changes from x to $x/4$. The change in potential energy will be :

(A) $+\frac{3}{2}x$ **(B)** $-\frac{3}{8}x$ **(C)** $+\frac{3}{4}x$ **(D)** $-\frac{3}{4}x$

17. If 1 molal solution of Benzoic acid in Benzene has a freezing point depression of 2.6°C (K_f = 5.12°C mol^{-1} kg) and boiling point elevation of 2.53°C (K_b = 2.53°C mol^{-1} kg), then select the incorrect statement(s).

I. There is formation of dimer of benzoic acid during freezing

II. There is no change in structure of benzoic acid during boiling

III. There is no change in structure of benzoic acid either during freezing or boiling

IV. Dimer formation in both freezing and boiling

(A) I, II **(B)** II, III **(C)** I, III **(D)** Only I

18. How many optically active isomers are possible for the complex $\left[Pt(ox)_2Cl_2\right]^{2-}$

(A) 2 **(B)** 3 **(C)** 4 **(D)** 1

19. Equal volume each of two sols of AgI, one obtained by adding KI to slight excess of $AgNO_3$ and another obtained by adding $AgNO_3$ to slight excess of KI are mixed together than :

(A) A true solution will be obtained **(B)** The two sols will stabilize each other

(C) Two sols will coagulate each other mutually

(D) The sol particle will acquire more electric charge

20. $ClCH_2CHCl_2 \xrightarrow[KOH,\Delta]{\text{Alcoholic}} X(\text{major product})$. What will be the major product 'X'?

(A) $CHCl=CHCl$ **(B)** $CH_2=CCl_2$ **(C)** $HC\equiv CH$ **(D)** $ClCH_2CHO$

21. Total number of monobromo (excluding stereo isomers), dibromo and tribromo derivatives of cyclopentane are :

(A) 4 **(B)** 6 **(C)** 8 **(D)** 10

22. The number of moles of lead nitrate needed to coagulate 2 moles of colloidal (AgI) I^- is :

(A) 2 **(B)** 1 **(C)** 1/2 **(D)** 2/3

23. 1 mole of equimolar mixture of ferric oxalate and ferrous oxalate will require x moles of $KMnO_4$ in acidic medium for complete oxidation, x is :

(A) 0.6 mole **(B)** 0.9 mole **(C)** 0.3 mole **(D)** 1.8 mole

24. Match List - 1 with List - 2 and select the correct answer using codes given below in the lists.

List - 1		List - 2	
I.	Cyanide process	**(a)**	Extraction of Au
II.	Zone refining	**(b)**	Extraction of Al
III.	Electrolytic reduction	**(c)**	Pine oil
IV.	Floatation process	**(d)**	Ultrapure Ge

Code:

(A) I-c, II-a, III-d, IV-b **(B)** I-d, II- b, III.-c, IV-a

(C) I-c, II-b, III-d, IV-a **(D)** I-a, II-d, III- b, IV- c

25. The cubic unit cell of Al(molar mass 27 g mol^{-1}) has an edge length of 405 pm. Its density is 2.7 g cm^{-3}. The cubic unit cell is :

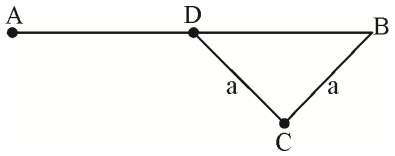
(A) face centered **(B)** body centered

(C) primitive **(D)** End centered

PART - II (PHYSICS) — 100 MARKS

This section contains 25 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct:

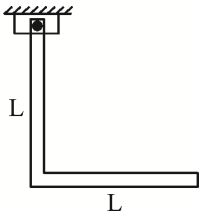
1. AB is a straight horizontal smooth rod. A bead D slides along the wire and is at A when a string DCB is horizontal.



At C, another bead of equal mass as D is fixed to the string and the end B is fixed to rod. DC = CB = a. The velocity of D when it is at a distance a from A will be:

(A) $\left(\frac{3\sqrt{3}ga}{4}\right)^{1/2}$ **(B)** $\left(\frac{3ga}{4}\right)^{1/2}$ **(C)** $\left(\frac{2\sqrt{3}ga}{5}\right)^{1/2}$ **(D)** $\left(\frac{3\sqrt{3}ga}{5}\right)^{1/2}$

2. An L-shaped object, made by welding together two identical rods of length L each is suspended from one end. Initially the object is held such that one rod is vertical and the other is horizontal. The object is now released from rest. Its maximum angular speed in the subsequent motion is given by:



(A) $\omega^2 = \frac{g}{L}\sqrt{\frac{18}{5}}$ **(B)** $\omega^2 = \frac{3g}{5L}\left(\sqrt{10}-3\right)$

(C) $\omega^2 = \frac{g}{L}\sqrt{\frac{21}{5}}$ **(D)** None of these

3. In figure (a) a solenoid produces a magnetic field whose strength increases into the plane of the page. An induced emf is established in a conduction loop surrounding the solenoid, and this emf lights bulbs A and B. In figure (b) point P and Q are shorted. After the short is inserted

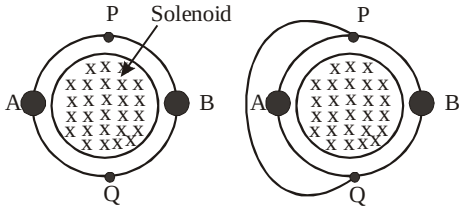


Figure (a) Figure (b)

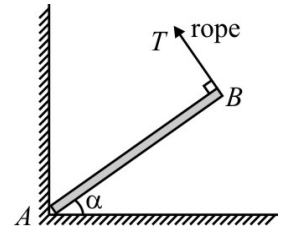
(A) Bulb A goes out bulb B gets brighter **(B)** Bulb B goes out bulb A gets brighter

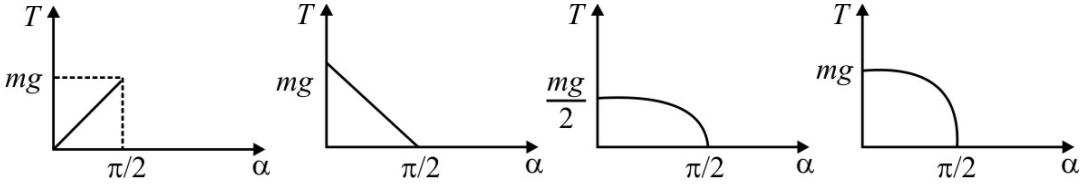
(C) Bulb A goes out bulb B gets dimmer **(D)** Bulb B goes out bulb A gets dimmer

4. A particle is projected form the ground at an angle of 60° with horizontal at speed $u = 20\ m/s$. The radius of curvature of the path of the particle, when its velocity makes an angle of 30° with horizontal is nearly : $(g = 10 m/s^2)$

(A) 10.6 *m* **(B)** 12.8 *m* **(C)** 15.4 *m* **(D)** 24.2 *m*

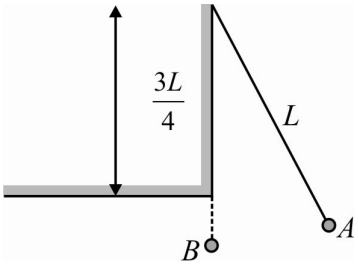
5. One end of a heavy uniform board of mass *m* and length *l*, presses against a corner between a wall and a floor. A light rope is attached to the other end *B* of the board. Angle between rope and board is always 90°. Board is rotating very slowly with constant angular velocity about *A* with the help of rope. Tension in the rope will change with angle α from the floor is :





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

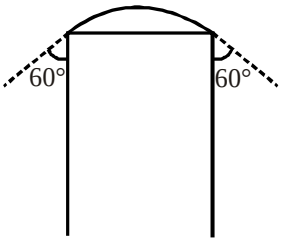
6. A pendulum has period *T* for small oscillations. An obstacle is placed directly beneath the pivot, so that only the lowest one quarter of the string can follow the pendulum bob when it swings in the left of its resting position as shown in the figure. The pendulum is released from rest at a certain point *A*. The time taken by it to return to that point is :



(A) *T* **(B)** *T*/2

(C) 3*T*/4 **(D)** *T*/4

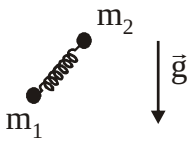
7. A soap bubble is being blown on a tube of radius 1 cm. The surface tension of the soap solution is 0.05 N/m and the bubble makes an angle of 60^O with the tube as shown. The excess of pressure over the atmospheric pressure in the tube is :



(A) 5 Pa **(B)** 1 Pa

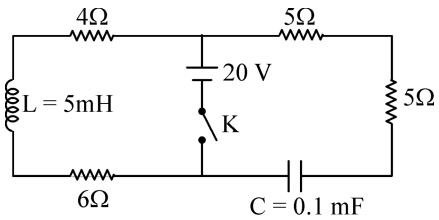
(C) 10 Pa **(D)** None of these

8. Two particles are inter connected by an ideal spring (see figure). The spring is compressed and system is projected in air under gravity. At an instant, if the acceleration of m_1 is $\vec{a}$ find acceleration of m_2 at this instant will be:



(A) $\vec{g}$ **(B)** $\vec{g}+\vec{a}$ **(C)** $\frac{m_1\vec{g}-m_1\vec{a}}{m_2}$ **(D)** $\frac{m_1\vec{g}+m_2\vec{g}-m_1\vec{a}}{m_2}$

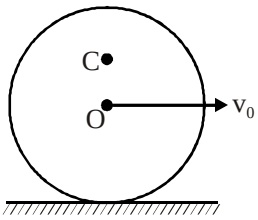
9. In the circuit shown, key (*K*) is closed at $t = 0$, the current through the key at the instant $t = 10^{-3}\ \ell n 2\, s$ is :



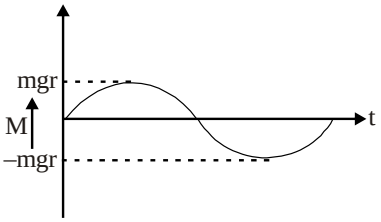
(A) 2 *A* **(B)** 3.5 *A*

(C) 2.5 *A* **(D)** 0

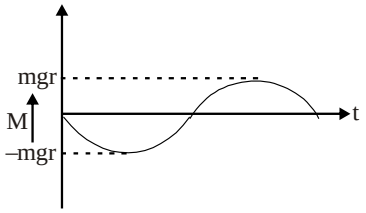
10. A disc of mass *m* and radius R is under pure rolling with a constant velocity V_0 on a smooth surface. The center of mass of the disc C is offset from center O by a distance *r*. A time varying couple *M* is applied such that the disc continues to roll with a constant velocity. Initial position of the point C is shown in the figure. The correct plot of variation of couple *M* with time *t* will be: (Take clockwise torque as positive)



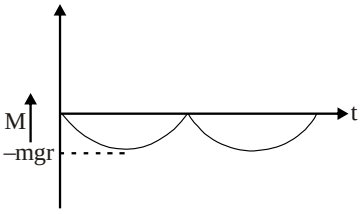
(A)



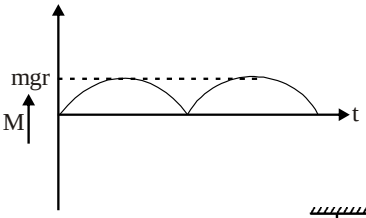
(B)



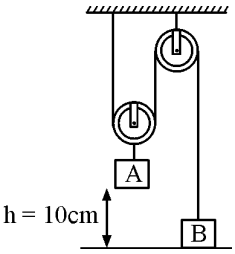
(C)



(D)



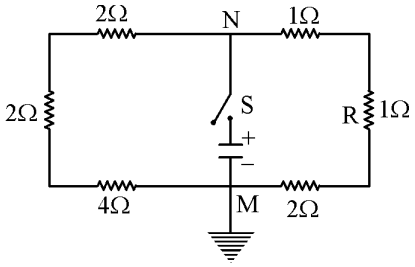
11. In the arrangement shown in figure the mass of 2 blocks A & B are 6 kg and 2 kg respectively. The height h = 10 cm. All the pulleys & thread are massless and frictionless. When the system is released from the instant shown, find the maximum height reached by block B. ($g = 10\,m/sec^2$)



(A) 20 cm **(B)** 25.7 cm

(C) 30 cm **(D)** 35.2 cm

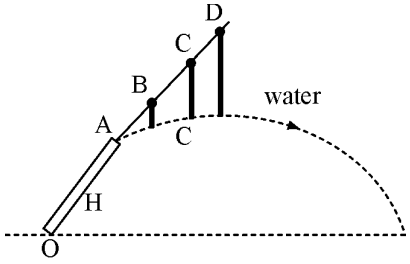
12. A capacitor of capacity $6\mu f$ and initial charge $160\,\mu c$ is connected with a key S and resistance as shown in figure. Point M is earthed. If key is closed at t = 0 then the current through resistance R = 1Ω at $t = 16\,\mu sec$ is



(A) $\frac{10}{3e}A$ **(B)** $\frac{10}{e}A$

(C) $\frac{20}{3e}A$ **(D)** None of these

13. A straight rod OABCD is strapped on to the end of a straight hose pipe H with 'A' at the nozzle of the pipe. Strings are tied to the rod at B, C and D and are allowed to drop down vertically. The lengths of the strings hanging at B, C and D just to touch the stream of water coming out of the hose pipe from its nozzle are in the ratio

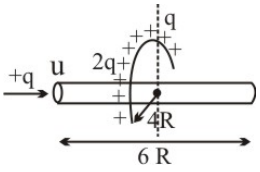


(A) AB:BC:CD **(B)** $\frac{1}{AB}:\frac{1}{BC}:\frac{1}{CD}$ **(C)** $AB^2 : AC^2 : AD^2$ **(D)** $\frac{1}{AB^2}:\frac{1}{AC^2}:\frac{1}{AD^2}$

14. Three long thin wires, each carrying current I in the same direction are in the x-y plane of a gravity free-space, mass per unit length of the central wire is λ. The central wire is along y-axis while the other two are along $x = \pm d$. If the central wire is displaced along the z-direction by a small amount and released keeping the other two wires fixed, the frequency of oscillation is :

(A) $\frac{I}{\pi d}\sqrt{\frac{\mu_0}{\lambda}}$ **(B)** $\mu_0 I\sqrt{\pi d\lambda}$ **(C)** $2\pi d\sqrt{\mu_0\lambda}$ **(D)** $\frac{I}{2\pi d}\sqrt{\frac{\mu_0}{\pi\lambda}}$

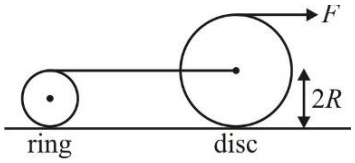
15. On a semicircular ring of radius $4R$, charge $+3q$ is distributed in such a way that on one quarter $+q$ is uniformly distributed and on another quarter $+2q$ is uniformly distributed. Along its axis a smooth non-conducting and uncharged pipe of length $6R$ is fixed axially as shown. A small ball of mass m and charge $+q$ is thrown from the other end of pipe with initial speed u. The minimum u for which the ball can come out of the pipe is just greater than :



(A) $\sqrt{\frac{7q^2}{40\pi\varepsilon_0 Rm}}$ **(B)** $\sqrt{\frac{3q^2}{40\pi\varepsilon_0 Rm}}$ **(C)** $\sqrt{\frac{6q^2}{40\pi\varepsilon_0 Rm}}$ **(D)** $\sqrt{\frac{9q^2}{40\pi\varepsilon_0 Rm}}$

16. A disc and ring of mass M and radius $2R$ and R respectively are connected by a light inextensible thread as shown. A force F is applied at the topmost point of disc. It was observed that the surface was rough enough for both of them to roll without slipping.

Which of the following statements is correct?



(A) Friction force between disc and ground is backward

(B) Friction force between ring and ground is forward

(C) Minimum value of coefficient of friction is $\frac{F}{2Mg}$

(D) Minimum value of coefficient of friction is $\frac{3F}{4Mg}$

17. A charged particle of unit mass and unit charge moves with velocity $\vec{v} = (8\hat{i} + 6\hat{j})$ m/s in a magnetic field of $\vec{B} = 2\hat{k}\ T$. Choose the INCORRECT alternative.

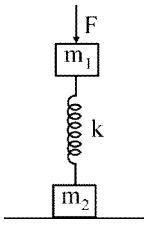
(A) The path of the particle may be $x^2 + y^2 - 4x - 21 = 0$

(B) The path of the particle may be $x^2 + y^2 = 25$

(C) The path of the particle may be $y^2 + z^2 = 25$

(D) The time period of the particle will be 3.14 s

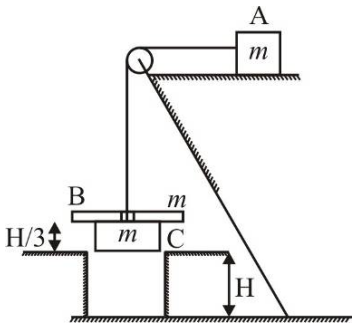
18. Two block of mass m_1 and m_2 respectively connected by a spring of force constant K. The force 'F' that should be applied to the upper block to hold it in its equilibrium position for which the lower one just lifts after the force is removed is



(A) $m_2 g$ **(B)** $m_1 g$

(C) $(m_1 + m_2)g$ **(D)** $\frac{m_1 m_2}{(m_1 + m_2)}g$

19. The system in figure is released from rest from the position shown (there is no friction). After blocks have moved distance $H/3$, collar B is removed and block A and C continue to move without any sudden change in their speeds due to removal of caller. The speed of C just before it strikes the ground is :



(A) $\frac{4}{3}\sqrt{gH}$ **(B)** $\frac{2}{3}\sqrt{gH}$

(C) $\frac{\sqrt{13gH}}{3}$ **(D)** $2\sqrt{2gH}$

20. Two identical objects A and B are at temperatures T_A and T_B, respectively. Both objects are placed in a room with perfectly absorbing walls maintained at a temperature T ($T_A > T > T_B$). The objects A and B attain the temperature T eventually. Select the correct statements from the following:

(A) A only emits radiation, while B only absorbs it until both attain the temperature T

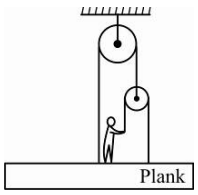
(B) B loses more heat by radiation than it absorbs, while A absorbs more radiation than it emits, until they attain the temperature T.

(C) Both A and B only absorb radiation, but do not emit it, until they attain the temperature T

(D) Each object continuous to emit and absorb radiation even after attaining the temperature T

21. With what force must a man pull on the rope to hold the plank in position if the weight of man is 60 kg? Neglect the wt. of the plank, rope and pulley.

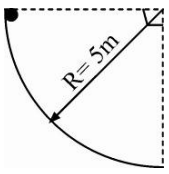
[Take $g = 10\ m/s^2$]



(A) 100 N **(B)** 150 N

(C) 125 N **(D)** None of these

22. A particle of mass 2 kg is released on a rough vertical quarter circular track from the highest point as shown in figure. Its velocity when it reaches the bottom point is 5 m/s. Work done by frictional force during the motion is :



(A) 25 J **(B)** 75 J

(C) 50 J **(D)** 125 J

23. 10 kg of water at $0^\circ C$ is placed in a large evacuated enclosure (vessel). If the latent heat of vaporization is seven times the latent heat of fusion, what fraction of water will ultimately freeze?

(A) $\frac{7}{8}$ **(B)** $\frac{1}{7}$ **(C)** $\frac{4}{7}$ **(D)** $\frac{3}{7}$

24. There are two pipes each of length 2 m, one is closed at one end and other is open at both ends. The speed of sound in air is 340 m/s. The frequency at which both can resonate is:

(A) 340 Hz **(B)** 510 Hz **(C)** 42.5 Hz **(D)** None of these

25. A spherical water drop of radius R has a charge q, distributed uniformly over its surface. The drop splits into two identical droplets and being separated by a large distance. These droplets have equal charges, distributed uniformly over the surface. Fractional change in electrostatic potential energy is :

(A) $2^{1/3}-1$ **(B)** $\frac{2^{1/3}-1}{2^{1/3}}$ **(C)** $\frac{\left(2^{2/3}-1\right)}{2^{2/3}}$ **(D)** $\frac{2^{4/3}-1}{2^{4/3}}$

PART - III (MATHEMATICS) | 100 MARKS

This section contains 25 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONLY ONE Choice is Correct:

1. The set of real values of a for which sum of the roots of the equation $\frac{1}{x}+\frac{1}{a}-\frac{1}{a^2}=\frac{1}{x+a-a^2}$ is less than $a^3/4$ is :

(A) $(0,\infty)-\{1,2\}$ **(B)** $(3,\infty)$ **(C)** $(-1,0)\cup(3,\infty)$ **(D)** $(2,\infty)$

2. If $\sum_{r=0}^{2n} a_r (x-100)^r = \sum_{r=0}^{2n} b_r (x-101)^r$ and $a_k = \frac{2^k}{{}^kC_n}\ \forall\ k \geq n$, then b_n equals :

(A) $2^n\left(2^{n+1}-1\right)$ **(B)** $2^n\left(2^n+1\right)$ **(C)** $2^n\left(2^n-1\right)$ **(D)** $2^{n+1}\left(2^n-1\right)$

3. If a, b, c are positive real numbers, such that $c^2 = a^2 + b^2 - ab$, $\alpha = min\{a,b\}$, $\beta = max\{a,b\}$, then :

(A) $\alpha > c$ **(B)** $\beta < c$ **(C)** $\alpha \leq c \leq \beta$ **(D)** $c < \beta$

4. C_1 and C_2 are circles of unit radius with centres at (0, 0) and (1, 0) respectively. C_3 is a circle of unit radius, passes through the centres of the circles C_1 and C_2 and have its centre above x-axis. Equation of the common tangent to C_1 and C_3 which does not pass through C_2 is

(A) $x-\sqrt{3}y+2=0$ **(B)** $\sqrt{3}x-y+2=0$ **(C)** $\sqrt{3}x-y-2=0$ **(D)** $x+\sqrt{3}y+2=0$

5. $p=\lim_{n\to\infty}\frac{\sum\sum_{1\leq i<j\leq n}(i+1)(j+1)}{n^4}$ is equal to :

(A) $\frac{1}{4}$ **(B)** $\frac{1}{6}$ **(C)** $\frac{1}{8}$ **(D)** $\frac{1}{3}$

6. The number of solutions of the equation $8[\log x]+6[e^x]=13+12[\cos x]$, where [ ] denotes greatest integer function is

(A) 1 **(B)** 2 **(C)** infinitely many **(D)** 0

7. $\lim_{n\to\infty}\frac{1}{2}\tan\frac{x}{2}+\frac{1}{2^2}\tan\frac{x}{2^2}+\frac{1}{2^3}\tan\frac{x}{2^3}+\ldots+\frac{1}{2^n}\tan\frac{x}{2^n}$ is :

(A) $-\cot x$ **(B)** $-\sin x$ **(C)** $\cot x+\frac{1}{x}$ **(D)** $-\cot x+\frac{1}{x}$

8. Consider the parabola $x^2=8y$, then number of normals that can be drawn from the point $(1,-5)$ to the parabola is :

(A) 1 **(B)** 2 **(C)** 3 **(D)** None of these

9. If the function $f(x)=-4e^{\frac{1-x}{2}}+1+x+\frac{x^2}{2}+\frac{x^3}{3}$ and $g(x)=f^{-1}(x)$ then the value of $g'\left(-\frac{7}{6}\right)$ equals to

(A) $\frac{1}{5}$ **(B)** $-\frac{1}{5}$ **(C)** $\frac{6}{7}$ **(D)** $-\frac{6}{7}$

10. If $f(x)$ and $g(x)=f(x)\sqrt{1-2\left(f(x)\right)^2}$ are monotonically increasing functions, then $\forall\, x \in R$,

(A) $|f(x)|\le 1$ **(B)** $|f(x)|<\frac{2}{3}$ **(C)** $|f(x)|<\frac{1}{\sqrt{3}}$ **(D)** $|f(x)|\le\frac{1}{2}$

11. Let $f(x)$ be a polynomial one-one function such that $f(x)f(y)+2=f(x)+f(y)+f(xy)$, $\forall\, x,\, y \in R-\{0\}$, $f(1)\neq 1$, $f'(1)=3$. Let $g(x)=\frac{x}{4}\{f(x)+3\}-\int_0^x f(x)dx$, then :

(A) $g(x)=0$ has exactly one root for $x\in(0,1)$

(B) $g(x)=0$ has exactly two roots for $x\in(0,1)$

(C) $g(x)\neq 0,\ \forall\, x\in R-\{0\}$ **(D)** $g(x)=0,\ \forall\, x\in R-\{0\}$

12. Two equilateral triangles are constructed from a line segment of length *L*. If *M* and *m* are maximum and minimum values of the sum of areas of two plane figures then :

(A) $M=2m$ **(B)** $M=\sqrt{3}m$ **(C)** $2M=3\sqrt{3}m$ **(D)** $M=4m$

13. For any real value of $\theta\neq\pi$, the value of expression $\frac{\cos^2\theta-1}{\cos^2\theta+\cos\theta}\in R-(a,b]$ then $(b-a)$ is :

(A) 0 **(B)** 1 **(C)** 2 **(D)** None of these

14. The locus of the point of intersection of the tangents at the extremities of a chord of the circle $x^2+y^2=a^2$ which touches the circle $x^2+y^2-2ax=0$ passes through the point :

(A) $\left(\frac{a}{2},0\right)$ **(B)** $\left(0,\frac{a}{2}\right)$ **(C)** $(0, a)$ **(D)** None of these

15. Identify following statements for True (**T**) and False (**F**):

S_1 : An old man while dialing a 7 digit telephone number remembers that the first four digits consist of one 1's, one 2's and two 3's. He also remembers that the fifth digit is either a 4 or 5 while has no memory of the sixth digit, he remembers that the seventh digit is 9 minus the sixth digit. Maximum number of distinct trials he has to try to make sure that he dials the correct telephone number, is 240.

S_2 : A woman has 11 close friends. The number of ways in which she can invite 5 of them to dinner, if two particular of them are not on speaking terms and will not attend together is 378.

S_3 : 10 IIT and 2 PET students sit in a row. If the total number of ways in which exactly 3 IIT students sit between 2 PET students is $\lambda\times 10!$, then λ is 6.

Which of the following choice is correct?

(A) TTT **(B)** TTF **(C)** TFF **(D)** FTF

16. In a G.P., the ratio of the sum of the first eleven terms to the sum of the last eleven terms is 1/8 and the ratio of the sum of all the terms without the first nine to the sum of all terms without the last nine is 2. Then the number of terms of the G.P. is :

(A) 15 **(B)** 43 **(C)** 38 **(D)** 28

17. A circle with centre in the first quadrant is tangent to $y=x+10$, $y=x-6$ and the *y*-axis. Let (h, k) be the centre of the circle. If the value of $(h+k)=a+b\sqrt{a}$, where $(a, b\in Q)$, find the value $(a + b)$.

(A) 10 **(B)** 12 **(C)** 14 **(D)** None of these

18. The minimum value of the quantity $\frac{\left(a^2+3a+1\right)\left(b^2+3b+1\right)\left(c^2+3c+1\right)}{abc}$, where a, b, and c are positive real the numbers is :

(A) $\frac{11^3}{2^3}$ **(B)** 125 **(C)** 25 **(D)** 27

19. Let $f(x) = \begin{Bmatrix} \frac{e^{x^2} - \frac{2}{\pi}\sin^{-1}\sqrt{1-x}}{\ln\left(1+\sqrt{x}\right)} & ; & x \in (0,1) \\ k & ; & x \le 0 \end{Bmatrix}$. If $f(x)$ is continuous at $x = 0$, then the value of k is :

(A) $1+\frac{2}{\pi}$ **(B)** $1-\frac{2}{\pi}$ **(C)** $\frac{2}{\pi}$ **(D)** $\frac{-2}{\pi}$

20. If $p = \frac{1}{z}+\frac{2}{z^2}+\frac{3}{z^3}+.....\infty$ where $z = 1-2i$, can be written in the form of $a+ib$ then the value of $\left|\frac{b}{a}\right|$ where $a,b \in R$

(A) 1 **(B)** 2 **(C)** 4 **(D)** 6

21. If the value of $I_m = \int_0^{2a} x^m\sqrt{2ax-x^2}\,dx$ is :

(A) $I_m = \frac{(4m+1)a}{m+1}I_{m-1}$ **(B)** $I_m = \frac{(2m+1)a}{m+2}I_{m-1}$

(C) $I_m = \frac{(2m+1)a}{m+4}I_{m-1}$ **(D)** $I_m = \frac{(4m+1)a}{m+2}I_{m-1}$

22. Let f and g are two functions such that $f(x)$ and $g(x)$ are continuous in $[a, b]$ and differentiable in (a, b). Then at least one $c \in (a,b)$ such that $f'(c) = \frac{f(b)-f(a)}{b-a}$

I. If $f(x) = f(b)$, then $f'(c) = 0$ (RMVT)

II. If $f(a) \ne f(b)$ and $a \ne b$, then $f'(c) = \frac{f(b)-f(a)}{b-a}$ (LMVT)

III. If $g'(x) \ne 0$, then $\frac{f(b)-f(a)}{g(b)-g(a)} = \frac{f'(c)}{g'(c)}$ (Cauchy theorem)

Let $0 < \alpha < \theta < \beta < \frac{\pi}{2}$, then $\frac{\sin\alpha - \sin\beta}{\cos\alpha - \cos\beta}$ is equal to :

(A) $\tan\theta$ **(B)** $-\tan\theta$ **(C)** $\cot\theta$ **(D)** $-\cot\theta$

23. The area of the region bounded by the curve $y = x^2$ and $y = \sec^{-1}[-\sin^2 x]$, (where [.] denotes the greatest integer function) is:

(A) $\pi\sqrt{\pi}$ square unit **(B)** $\frac{4}{3}\pi\sqrt{\pi}$ square unit

(C) $\frac{2}{3}\pi\sqrt{\pi}$ square unit **(D)** $\frac{1}{3}\pi\sqrt{\pi}$ square unit

24. Given $f(x)=\sqrt{\frac{8}{1-x}+\frac{8}{1+x}}$ and $g(x)=\frac{4}{f(\sin x)}+\frac{4}{f(\cos x)}$ the $g(x)$ is :

(A) Periodic with period $\frac{\pi}{2}$ **(B)** Periodic with period π

(C) Periodic with period 2π **(D)** Not periodic

25. Consider the function $g(x)$ defined as

$$g(x).\left(x^{\left(2^{2008}-1\right)}-1\right)=(x+1)\left(x^2+1\right)\left(x^4+1\right)\ldots\left(x^{2^{2007}}+1\right)-1$$

The value of $g(2)$ equals to :

(A) 1 **(B)** 2 **(C)** 3 **(D)** 4