From Long Term Classroom Programs and Medium / Short Classroom Program 4 in Top 10, 10 in Top 20, 43 in Top 100, 75 in Top 200, 159 in Top 500 Ranks & 3542 total selections in IIT-JEE 2012

ALL INDIA TEST SERIES

FIITJEE

JEE (Advanced), 2013

CONCEPT RECAPITULATION TEST
(Set – VI)

Paper 1

Time Allotted: 3 Hours **Maximum Marks: 240**

- 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

A. General Instructions

1. Attempt ALL the questions. Answers have to be marked on the OMR sheets.
2. This question paper contains Three Parts.
3. **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
4. Each part is further divided into two sections: **Section-A & Section-C**
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 black pen for each character of your Enrolment No. and write 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 Three Parts.

(i) **Section-A (01 – 07)** contains 7 multiple choice questions which have only one correct answer. Each question carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

Section-A (08 – 11) contains 4 multiple choice questions which have more than one correct answer. Each question carries **+4 marks** for correct answer. There is no negative marking.

Section-A (12 – 16) contains 2 paragraphs. Based upon paragraph, 2 and 3 multiple choice questions have to be answered. Each question has only one correct answer and carries **+3 marks** for correct answer and **– 1 mark** for wrong answer.

(ii) **Section-C (01 – 07)** contains 7 Numerical based questions with answers as numerical value and each question carries **+4 marks** for correct answer. There is no negative marking.

Name of the Candidate	
Enrolment No.	

Useful Data

PHYSICS

Acceleration due to gravity	$g = 10\ m/s^2$
Planck constant	$h = 6.6 \times 10^{-34}$ J-s
Charge of electron	$e = 1.6 \times 10^{-19}$ C
Mass of electron	$m_e = 9.1 \times 10^{-31}$ kg
Permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N\text{-}m^2$
Density of water	$\rho_{water} = 10^3\ kg/m^3$
Atmospheric pressure	$P_a = 10^5\ N/m^2$
Gas constant	$R = 8.314\ J\ K^{-1}\ mol^{-1}$

CHEMISTRY

Gas Constant	R	=	$8.314\ J\ K^{-1}\ mol^{-1}$
		=	0.0821 Lit atm $K^{-1}\ mol^{-1}$
		=	$1.987 \approx 2$ Cal $K^{-1}\ mol^{-1}$
Avogadro's Number	N_a	=	6.023×10^{23}
Planck's constant	h	=	6.625×10^{-34} J·s
		=	6.625×10^{-27} erg·s
1 Faraday		=	96500 coulomb
1 calorie		=	4.2 joule
1 amu		=	1.66×10^{-27} kg
1 eV		=	1.6×10^{-19} J

Atomic No: H=1, He = 2, Li=3, Be=4, B=5, C=6, N=7, O=8, N=9, Na=11, Mg=12, Si=14, Al=13, P=15, S=16, Cl=17, Ar=18, K =19, Ca=20, Cr=24, Mn=25, Fe=26, Co=27, Ni=28, Cu = 29, Zn=30, As=33, Br=35, Ag=47, Sn=50, I=53, Xe=54, Ba=56, Pb=82, U=92.

Atomic masses: H=1, He=4, Li=7, Be=9, B=11, C=12, N=14, O=16, F=19, Na=23, Mg=24, Al = 27, Si=28, P=31, S=32, Cl=35.5, K=39, Ca=40, Cr=52, Mn=55, Fe=56, Co=59, Ni=58.7, Cu=63.5, Zn=65.4, As=75, Br=80, Ag=108, Sn=118.7, I=127, Xe=131, Ba=137, Pb=207, U=238.

Physics

PART – I

SECTION – A
Single Correct Choice Type

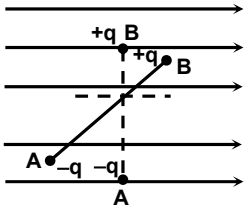
This section contains **7 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. A particle is projected with a speed u in air at angle θ with the horizontal. The particle explodes at the highest point of its path into two equal fragments, one of the fragments moving up straight with a speed u. The difference in time in which the two particle fall on the ground is (Assume it is at a height H at the time of explosion)

(A) $\frac{2u}{g}$ (B) $\frac{u}{g}\sqrt{u^2 - 2gH}$

(C) $\frac{1}{2g}\sqrt{u^2 + 2gH}$ (D) $\frac{2}{g}\sqrt{u^2 + 2gH}$

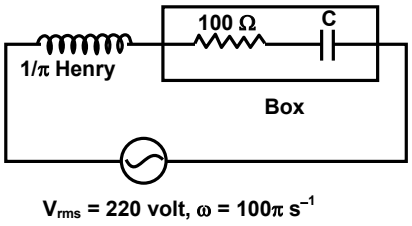
2. A dipole consists of a light rod of length ℓ, having two point charges +q and -q of same mass m joined at ends A and B of the rod. A uniform electric field E is present in the region and perpendicular to the length of the rod. The rod is released from rest. The angular velocity of the rod, when it becomes parallel to the electric field for the first time is



(A) $\sqrt{\frac{qE}{m\ell}}$ (B) $2\sqrt{\frac{qE}{m\ell}}$

(C) $\sqrt{\frac{qE}{2m\ell}}$ (D) $\frac{1}{2}\sqrt{\frac{qE}{m\ell}}$

3. In the circuit, as shown in the figure, if the r.m.s. current is 2.2 ampere, the power factor of the box is



(A) $\frac{1}{\sqrt{2}}$ (B) 1

(C) $\frac{\sqrt{3}}{2}$ (D) $\frac{1}{2}$

Rough work

4. A heavy nucleus of mass M_x decay in to two nuclei (Y and Z) of mass M_y and M_z. The Q value of the reaction is

(A) $(M_x - M_y - M_z)C^2$

(B) $(M_x - M_y - M_z)C^2 - \frac{p_y^2}{2M_y} - \frac{p_z^2}{2m_z}$

(C) $(M_x - M_y - M_z)C^2 + \frac{py^2}{2M_y} + \frac{pz^2}{2m_z}$

(D) none of these

5. If light of wavelength of maximum intensity emitted from a surface at temperature T_1 is used to cause photoelectric emission from a metallic surface, the kinetic energy of the emitted electron is 6 eV, which is 3 times the work function of the metallic surface. If light of wavelength of maximum intensity emitted from a surface at temperature T_2 ($T_2 = 2T_1$) is used to cause photo electric emission from the same metallic surface, the maximum kinetic energy of the photoelectron emitted is

(A) 2 eV
(B) 4 eV
(C) 14 eV
(D) 18 eV

6. Four moles of Hydrogen, two moles of Helium and one mole of saturated water vapour form a gas mixture. What is the molar specific heat at constant pressure of mixture? (Assume no vibrational modes of vibration for water molecules)

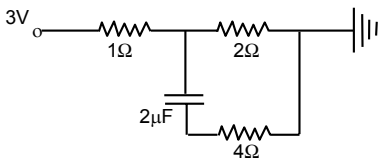
(A) $\frac{16}{7}R$

(B) $\frac{7}{16}R$

(C) R

(D) $\frac{23}{7}R$

7. Figure shows a network of capacitor and resistance. Potentials of some of the points are given. Find the charge on capacitor at steady state



(A) 2μC
(B) 4μC
(C) 6/7 μC
(D) 12/17 μC

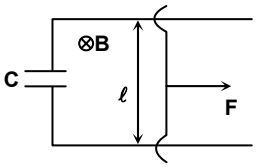
Rough work

Multiple Correct Answer(s) Type

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

8. Which of the following statements are true?
   (A) Hole in the wall of a cavity radiator behaves like a block body
   (B) Hole in the wall of a cavity radiator does not act like a block body.
   (C) When a body is kept in a surrounding of low temperature it does not absorb any energy from the surroundings
   (D) When a body is kept in surrounding of low temperature it simultaneously radiates heat to the surroundings and absorbs heat from the surroundings.

9. A conducting wire of length ℓ and mass m can slide without friction on two parallel rails and is connected to capacitance C. Whole system lies in a magnetic field B and a constant force F is applied to the rod. Then



   (A) the rod moves with constant velocity
   (B) the rod moves with an acceleration of $\frac{F}{m + B^2\ell^2 c}$
   (C) there is constant charge on the capacitor.
   (D) charge on the capacitor increases with time

10. At ordinary temperatures, the molecules of an ideal gas have only translational and rotational kinetic energies. At higher temperatures, they may also have vibrational energy. As a result, at higher temperatures
   (A) $C_v = 3R/2$ for monatomic gas
   (B) $C_v > 3R/2$ for monoatomic gas
   (C) $C_v < 5R/2$ for diatomic gas
   (D) $C_v > 5R/2$ for diatomic gas

11. An electric kettle heater has two coils when one coil is switched on, the water in the kettle begins to boil after 15 minutes, when the other coil is switched on the water boils in 30 minutes.
   (A) The waver will boil in 45 minutes if the coils are connected in series.
   (B) The water will boil in 10 minutes if the coils are connected in parallel.
   (C) Water boils in 22.5 minutes if coils are connected in series.
   (D) Water boils in 20 minutes if coils are connected in parallel.

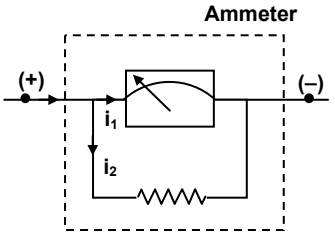
Rough work

Comprehension Type

This section contains **2 paragraphs**. Based upon one of paragraphs **2 multiple choice questions** and based on the other paragraph **3 multiple choice questions** have to be answered. Each of these questions has four choices (A), (B), (C) and (D) out of **which ONLY ONE** is correct.

Paragraph for Question Nos. 12 to 13

Ammeter is a device to measure an electric current. In order to convert a galvanometer into an ammeter, a resistance having small value is connected in parallel with the galvanometer coil.
This resistor is called the shunt. The current to be measured is passed through the ammeter by connecting it in series with the segment which carries the current.
When the ammeter is connected in a segment of a circuit, the resistance of the segment increases. Which reduces the main current to be measured.
To minimize the error, the equivalent resistance of ammeter circuit should be small. This is one reason why the shunt having a small resistance r is connected in parallel to the coil.
A galvanometer of resistance 100 Ω gives a full scale deflection for a current of 1 mA.



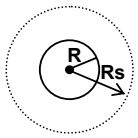
12. Shunt required to convert it into an ammeter giving full scale deflection for a current of 10 amp is
(A) $\frac{1}{100}\Omega$ (B) $\frac{100}{9999}\Omega$
(C) $\frac{100}{1999}\Omega$ (D) $\frac{100}{10001}\Omega$

13. When the current through ammeter is giving full scale deflection then heat generated by shunt per unit time is
(A) 1 Watt (B) 0.9999 Watt
(C) 1.0001 Watt (D) no heat will be dissipated

Rough work

Paragraph for Question Nos. 14 to 16

Supernova refers to the explosion of a massive star. The material in the central case of such a star continues to collapse under its own gravitational pull. If mass of the core is less than 1.4 times the mass of sun, its collapse finally results in a white dwarf star. However, if the core has a mass greater than this, it could end up soon as a neutron star and if its mass is more than about three solar masses, the collapse may still continue till the star becomes a very small object with an extremely high value of density called a 'Black hole'. Escape speed for a black hole is very large. The figure shows a block hole of radius R and another concentric sphere of radius R_S, called the 'Schwarzschild Radius'. It is the critical radius at which escape speed equals the speed of light c. Nothing even the light, can escape from within the sphere of Radius R_S. So light from a black hole cannot escape and hence the terminology 'black hole'.



There has been astronomical evidence of a small and massive object at the centre of our galaxy the 'Milky way'. Suppose that there is a particle at a distance about 6 light years that orbits this massive object with an orbital speed of about 2×10^5 m/s. Use the given data wherever necessary and answer the questions that follow.
$G = 6.67 \times 10^{-11}$ N – m^2/kg^2, Solar mass $M = 2 \times 10^{30}$ kg, $C = 3 \times 10^8$ m/s, 1 light year = 9.5×10^{15} m.

14. Mass (in kg) of the massive object at the centre of the milky way galaxy is of the order.
(A) 10^{32} (B) 10^{37}
(C) 10^{43} (D) 10^{29}

15. Theories suggest that it is not possible for a single star to have a mass of more than 50 solar masses. The massive object at the centre of milky way galaxy is most likely to be a
(A) white dwarf (B) neutron star
(C) black hole (D) single ordinary star

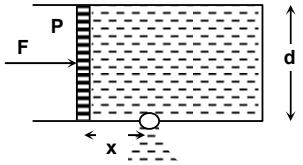
16. If mass of earth $M_E \approx 6 \times 10^{24}$ kg and its radius R_E = 6400 km, to what fraction of its presents radius does the earth need to be compressed in order to become a black hole? (give only the order of your answer)
(A) 10^{-4} (B) 10^{-9}
(C) 10^{-7} (D) 10^{-14}

Rough work

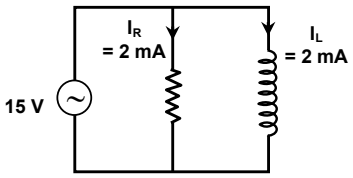
SECTION –C
Integer Answer Type

This section contains **7 questions.** The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).

1. A cylinder of diameter d, attached with a piston P has a small orifice at its bottom (see figure). The cylinder is filled with a liquid of density ρ and the piston is pushed with a constant force F. Find the speed (in m/s) with which water comes out the hole when the distance of the piston from the hole is x (x > 0). Assume the gravity to be absent and piston to be massless.
Given: d = 1m, g = 10 m/s^2, ρ = 100 kg/m^3 and F = 200 πN



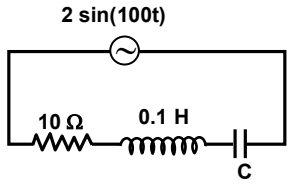
2. In the given circuit, the circuit impedance is (2λ) kΩ. Find the value of λ.



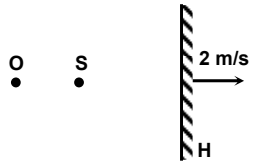
3. When an object is kept at a distance of 20 cm from a concave mirror, the image is formed at a distance of 10 cm. If the object is moved with a speed of 4 m/s. Then find the speed (in m/sec) with which the image moves.

Rough work

4. The power factor of the circuit is $1/\sqrt{2}$. If the capacitance of the circuit is $(125\lambda)\ \mu F$. Find the value of λ.



5. A stationary sound source 's' of frequency 334 Hz and a stationary observers 'O' are placed near a reflecting surface moving away from the source with velocity 2 m/sec as shown in the figure. If the velocity of the sound waves is air is V = 330 m/sec, the apparent frequency of the echo is $\frac{660}{k}$ Hz. Find the value of k.



6. A transverse wave is traveling in the +ve X – direction according to the equation y = 2sin[100t – x/50]. The ratio of the maximum velocity a particle can have to the velocity of wave propagation is $\frac{K}{25}$. Find the value of K.

7. A certain radioactive sample is obtained by mixing equal number of Nuclides of species A and species B. Half life of species A is T and that of B is 2T. After certain time it is found that the remaining radioactive nuclei of A and B combined together are 5/32 of the original total number of nuclei. Calculate the number of half life of A elapsed.

Rough work

Chemistry

PART – II

SECTION – A
Single Correct Choice Type

This section contains 7 multiple choice questions numbered 1 to 7. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.

1. Choose the incorrect pair of intensive properties
   (A) Critical temperature and critical pressure
   (B) molal boiling point elevation constant and molal freezing point depression constant
   (C) Critical temperature and molal boiling point elevation constant
   (D) Heat capacity and internal energy

2. The thermally most stable sulphate among the following is:
   (A) $BeSO_4$ (B) $BaSO_4$
   (C) $MgSO_4$ (D) $CaSO_4$

3. Which will have the lowest value of van der Waal's constant ('a') at constant temperature
   (A) Carbon moxide (B) Ethene
   (C) Dinitrogen (D) All have the same value of 'a'

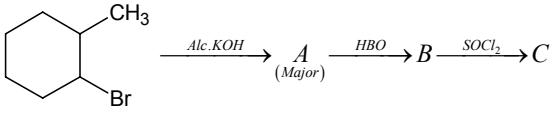
4. Select pair of salt which can react with $NaOH$
   (A) Na_2HPO_4 and NaH_2PO_3 (B) $NaHPO_3$ and NaH_2PO_2
   (C) Na_2HPO_4 and NaH_2PO_2 (D) Na_2CO_3 and Na_2SO_4

5. Which of the following electronic transition of the atom makes the excited state to have maximum magnetic moment
   (A) In phosphorous (3s → 3d) (B) In sulphur (3p → 3d)
   (C) In carbon (2s → 2p) (D) In Boron (2s → 2p)

Rough work

6. Which of the following pair will give positive baeyer's test
(A) Cyclopropane and propene (B) Propene and cyclohexane
(C) Cyclopropane and dimethyl ether (D) Cyclohexane and cyclopropane

7. Number of stereogenic centres present in product 'C' is …….



(A) 0 (B) 1
(C) 2 (D) 3

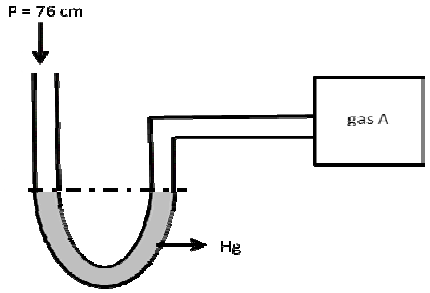
Multiple Correct Choice Type

This section contains 4 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D) for its answer, out which **ONE OR MORE** is/are correct.

8. Choose correct statement(s)
(A) Bond length of B- F bond in BF_3 is longer than bond length of B – F in BF_4^-
(B)  is more acidic than 
(C) Singlet carbene is more stable than triplet carbene
(D) $(CH_3)_3COH$ is more acidic than $(CH_3)_3-SiOH$

Rough work

9. A open ended mercury manometer is used to measure pressure exerted by a trapped gas shown in figure. Initially manometer shows no difference in mercury level in both column as shown in diagram.



After sparking 'A' dissociates according to following reaction

$A(g) \longrightarrow B(g) + 3C(g)$

If pressure of gas 'A' decreases to 0.9 atm. Then (Assume temperature to be constant and is 300K)

(A) Total pressure increase to 1.3 atm (B) Total pressure increased by 0.3 atm
(C) Total pressure increased by 22.8 mm of Hg (D) Difference in mercury level in 228 mm.

10. Choose the correct statement(s)

(A) $LiClO_4$ is much more soluble in water than $NaClO_4$

(B) Sodium metal can be used for drying diethyl ether but not for ethanol

(C) LiH is more basic than NaH

(D) All the above

11. HCOOH is a weak acid and hydrochloride acid is a strong acid. Then correct statement(s) is/are

(A) $[OH]$ of 0.01 M HCl(aq.) will be less than that of 0.01 M HCOOH (aq.)

(B) Solution containing 0.2 M NaOH(aq) and 0.1 M HCOONa (aq.) is buffer solution.

(C) pH of $10^{-9} M\ HCl(aq.)$ is approximately 7 at 25^0C

(D) Solution formed by mixing equimolar quantities of HCOOH and HCOONa will constitute a buffer.

Rough work

Comprehension Type

This section contains **2 paragraphs.** Based upon the first paragraph 2 multiple choice questions and based upon the second paragraph **3 multiple choice questions** have to be answered. Each of these questions has four choices A), B), C) and D) out of **WHICH ONLY ONE CORRECT.**

Paragraph for Question Nos. 12 to 13

Ionisation energies of five elements are given below

Element	I in (Kcal/mol)		
	I	II	III
A	300	549	926
B	99	734	100
C	118	1091	1652
D	176	347	1848
E	497	947	1500

12. Which represents a noble gas among given elements?
(A) A (B) E
(C) C (D) D

13. Which represents a non metal among given elements?
(A) A (B) B
(C) C (D) D

Rough work

Paragraph for Question Nos. 14 to 16

A hydrocarbon (C_6H_{12}) exists in different isomeric forms. Isomer (P) has three vinylic hydrogen atoms and two allylic hydrogen atoms. The isomer (Q) has 3 vinylic hydrogen and one allylic hydrogen. Another isomer (R) has three vinylic hydrogen and no allylic hydrogen atom.

14. Select the correct one regarding the above given isomers
(A) isomer (P) has terminal double bond (B) isomer (Q) has terminal double bond
(C) all have terminal double bond (D) all have non terminal double bond

15. Select the correct regarding the above given isomerism
(A) isomer (P) is optically active (B) isomer (Q) is optically active
(C) all isomers (P,Q & R) are optically active (D) all isomers (P,Q & R) are optically inactive

16. How many minimum carbon atoms are required in a saturated hydrocarbon to exhibit optical activity;
(A) 5 (B) 6
(C) 7 (D) 8

Rough work

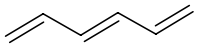
SECTION –C

Integer Answer Type

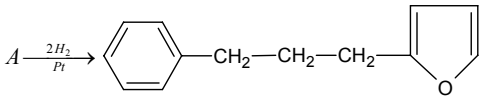
This section contains **7 questions.** The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).

1. 1.667×10^{x} chlorine atoms are ionized as $Cl \xrightarrow{+e^-} Cl^+ + e^-$ by the energy liberated for the process $Cl + e^- \longrightarrow Cl^-$ for 10^{-22} mole of Cl atoms.
(Given that IP = 13 eV and EA = 3.6 eV). The value of x is:

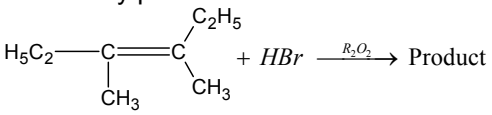
2. How many geometrical isomers are possible for the given compound.



3. Degree of unstauration in compound(A) is



4. How many products will be formed in the given reaction:



5. Find the quantum number ‘n’ corresponding to the excited state of He^+ ion, transition of electron to the ground state from which emits two photons in succession with wavelength 108.5 and 30.4 nm

6. Oxidation state of Cr in K_3CrO_8 is +x, where x is …

7. A hydrate of ferric thiocyanate $\left[Fe(SCN)_3\right]$ is found to contain 19% of water as water of crystallization. How many water, molecules are present in the empirical formula of the hydrate

Rough work

Mathematics

PART – III

SECTION – A
Single Correct Choice Type

This section contains **7 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. The area bounded by $x = x_1$, $y = y_1$ and $y = -(x + 1)^2$ where x_1, y_1 are the values of x, y satisfying the equation $\sin^{-1}x + \sin^{-1}y = -\pi$ will be, (nearer to origin)

   (A) $\frac{1}{3}$ (B) $\frac{2}{3}$

   (C) 1 (D) $\frac{3}{2}$

2. The value of $\int_a^b (x-a)^3(b-x)^4\,dx$ is $\frac{(b-a)^m}{n}$. Then (m, n) is

   (A) (6, 260) (B) (8, 280)

   (C) (4, 240) (D) none of these

3. If x_1, x_2, x_3, x_4 are positive roots of the equation $x^4 - 8x^3 + ax^2 - bx + 16 = 0$ then $\tan^{-1}(x_1) + \tan^{-1}(x_2) + \tan^{-1}(x_3) + \tan^{-1}(x_4)$ can be equal to

   (A) $\pi + 4\tan^{-1}(2)$ (B) $4\tan^{-1}(2)$

   (C) $\pi - 4\tan^{-1}(2)$ (D) none of these

4. If $A = \int_1^{\sin\theta} \frac{t\,dt}{1+t^2}dt, B = \int_1^{\operatorname{cosec}\theta} \frac{1}{t(1+t^2)}dt$ then $\begin{vmatrix} A & A^2 & B \\ e^{A+B} & B^2 & -1 \\ 1 & A^2+B^2 & -1 \end{vmatrix} = ?$

   (A) $\sin\theta$ (B) $\operatorname{cosec}\theta$

   (C) 0 (D) 1

Rough work

5. If $g(x)$ is a curve which is obtained by the reflection of $f(x)=\frac{e^x-e^{-x}}{2}$ about the line $y=x$ then

(A) $g(x)$ has more than one tangent parallel to x–axis

(B) $g(x)$ has more than one tangent parallel to y–axis

(C) $y=-x$ is a tangent to $f(x)$ at $(0,0)$

(D) $g(x)$ has no extremum

6. If $\left[\sin^{-1}x\right]+\left[\cos^{-1}x\right]=0$, where 'x' is a non-negative real number and $[.]$ denotes the greatest integer function, then complete set of values of x is

(A) $(\cos 1,\ 1)$ (B) $(-1,\ \cos 1)$

(C) $(\sin 1,\ 1)$ (D) $(\cos 1,\ \sin 1)$

7. If the points with position vectors $A(\vec{a})=(2-x)\hat{i}+2\hat{j}+2\hat{k}$, $B(\vec{b})=2\hat{i}+(2-y)\hat{j}+2\hat{k}$, $C(\vec{c})=2\hat{i}+2\hat{j}+(2-z)\hat{k}$ and $D(\vec{d})=\hat{i}+\hat{j}+\hat{k}$ are co–planer then

(A) $\frac{1}{x-2}+\frac{1}{y-2}+\frac{1}{z-2}=1$ (B) $\frac{1}{1-x}+\frac{1}{1-y}+\frac{1}{1-z}=1$

(C) $x+y+z=1$ (D) $\frac{1}{x}+\frac{1}{y}+\frac{1}{z}=1$

Multiple Correct Answer(s) Type

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

8. The directrix of a parabola is $2x-y=1$. The focus lies on y-axis. The locus of one end of the latus rectum is

(A) $7x-y-1=0$ (B) $2x-y-1=0$

(C) $2x+y+1=0$ (D) $3x+y+1=0$

9. The normal at a general point (a, b) on a curve makes an angle θ with x-axis which satisfies $b\left(a^2\tan\theta-\cot\theta\right)=a\left(b^2+1\right)$. The equation of curve can be

(A) $y=e^{x^2/2}+c$ (B) $\log\left(ky^2\right)=x^2$

(C) $y=ke^{x^2/2}$ (D) $x^2-y^2=k$

Rough work

10. K subsets of a set $A \equiv \{1, 2, 3, \ldots, n\}$ are chosen at random with replacement. The probability that their intersection is

(A) empty is $\left(\frac{1}{2}\right)^n$ for K = 2

(B) empty is $\left(\frac{3}{4}\right)^n$ for K = 2

(C) empty is $\left(\frac{7}{8}\right)^n$ for K = 3

(D) singleton is $n\left(\frac{7}{8}\right)^{n-1}$ for K = 3

11. Let $f(x) = \lim_{n\to\infty} \frac{\tan x^2 + (1+x)^n \sin x}{x^2 + (1+x)^n}, n \in N$ then

(A) f(x) is continuous at x = 0

(B) $\lim_{x\to 0} f(x) = 0$

(C) $\lim_{x\to 0^+} f(x) = 0$

(D) $\lim_{x\to 0^-} f(x) = 1$

Comprehension Type

This section contains **2 paragraphs**. Based upon one of paragraphs **2 multiple choice questions** and based on the other paragraph **3 multiple choice questions** have to be answered. Each of these questions has four choices (A), (B), (C) and (D) out of **which ONLY ONE** is correct.

Paragraph for Question Nos. 12 to 13

Read the following write up carefully and answer the following questions:
A curve C which is not a straight line lies in the first quadrant. The tangent at any point on C meets the positive directions of the coordinate axes at the points A, B. Let 'd' be the minimum distance of the curve C from the origin O

12. If $OA + OB = 1$ then d is equal to

(A) $\frac{1}{2\sqrt{2}}$

(B) $\frac{1}{2}$

(C) $\frac{1}{\sqrt{2}}$

(D) $\sqrt{2}$

13. If $OA.OB = 4$ then d is equal to

(A) $\frac{1}{2\sqrt{2}}$

(B) $\frac{1}{2}$

(C) $\frac{1}{\sqrt{2}}$

(D) $\sqrt{2}$

Rough work

Paragraph for Question Nos. 14 to 16

Read the following write up carefully and answer the following questions:

Suppose that an ellipse and a circle are respectively given by the equation $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$

(1) and $x^2 + y^2 + 2gx + 2fy + c = 0$

(2) The equation, $\left(\frac{x^2}{a^2}+\frac{y^2}{b^2}-1\right)+\lambda\left(x^2+y^2+2gx+2fy+c\right)=0$

(3) Represent a curve which passes through the common points of the ellipse (1) and the circle (2).
We can choose λ so that the equation (3) represent a pair of straight lines. In general we get three values of λ, indicating three pair of straight lines can be drawn through the points. Also when (3) represents a pair of straight lines they are parallel to the lines $\frac{x^2}{a^2}+\frac{y^2}{b^2}+\lambda\left(x^2+y^2\right)=0$ which represents a pair of lines equally inclined to axes (the term containing xy is absent). Hence two straight lines through the points of intersection of an ellipse and any circle make equal angles with the axes. Above description can be applied identically for a hyperbola and a circle.

14. The radius of the circle passing through the point of intersection of $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ and $x^2-y^2=0$ is

(A) $\frac{ab}{\sqrt{a^2+b^2}}$ (B) $\frac{\sqrt{2}ab}{\sqrt{a^2+b^2}}$

(C) $\frac{a^2-b^2}{\sqrt{a^2+b^2}}$ (D) $\frac{a^2+b^2}{\sqrt{a^2+b^2}}$

15. Suppose two non–horizontal lines are drawn through the common points of intersection of $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ and $x^2+y^2+2gx+2fy+c=0$. If these lines are inclined at an angle α, β to x-axis then

(A) $\alpha = \beta$ (B) $\alpha + \beta = \frac{\pi}{2}$

(C) $\alpha + \beta = \pi$ (D) $\alpha+\beta=2\tan^{-1}\left(\frac{b}{a}\right)$

16. The number of distinct straight lines through the points of intersection of $x^2 – y^2 = 1$ and $x^2+y^2-4x-5=0$

(A) 0 (B) 1
(C) 2 (D) 3

Rough work

SECTION – C
Integer Answer Type

This section contains **7 questions.** The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).

1. Angle between the asymptotes of the hyperbola $x^2 + 2xy - 3y^2 + x + 7y + 9 = 0$ is θ. Then $\tan\theta$ is equal to _____.

2. If $\int \sin 4x\, e^{\tan^2 x} dx = c - A\cos^4 x.e^{\tan^2 x}$ then A is equal to _____.

3. Given that
$\int_1^y \sec^{-1} x\, dx = \lambda$ then $\int_{-y}^{-1} \sec^{-1} x - \tan^{-1}\left(\sqrt{x^2-1}\right)dx + \int_1^y \sec^{-1} x - \tan^{-1}\left(\sqrt{x^2-1}\right)dx =$ ___(| y |≥ 1)
equals to $\pi(y-a) - b\lambda$ then a+b is equal to _____.

4. If $\vec{a},\vec{b},\vec{c}$ be non-coplanar unit vectors equally inclined to one another at an acute angle θ, and if $\vec{a}\times\vec{b} + \vec{b}\times\vec{c} = p\vec{a} + q\vec{b} + r\vec{c}$ then $p - r$ is equal to _____. $(p,q,r \in R)$

5. Let the point P(x, y) satisfy $\sin^{-1} x + \sin^{-1} y = \frac{\pi}{2}$, if the area bounded by the locus P and y = x with x–axis, is λ, then find $\frac{16\lambda}{\pi}$ _____.

6. If $A_0A_1A_2A_3A_4A_5$ be a regular polygon of six sides inscribed in a circle of unit radius with centre at origin then, the product of the lengths of the sides A_0A_1, A_0A_2 and A_0A_4 is _____.

7. Let z_1, z_2 be two complex numbers whose principle argument are θ_1 and θ_2. If principle argument of z_1z_2 is $\theta_1 + \theta_2 - 2\pi$ and least value of $\theta_1 + \theta_2$ is $\lambda\pi$, then find λ _____.

Rough work