FIITJEE FARIDABAD

MOCK PRACTICE PAPER FOR
JEE -Main- 2020

MOCK PRACTICE PAPER-22

Time: 3 hours   **Maximum marks: 360**

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.   The Test Booklet consists of **90** questions. The maximum marks are **360.**

3.   There are **three** parts in the question paper. **Part-1** consisting of **Physics, Part-2** consisting of **Chemistry & Part-3** consisting of **Mathematics.** Each question is allotted **4 (four)** marks for correct response.

4.   *Candidates will be awarded marks as stated above in instruction No. 3 for correct response of each question. –1 mark will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*

5.   There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 4 above.
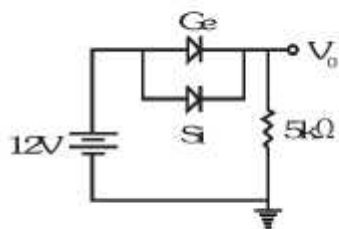
Name of the Candidate :_____

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

Enrolment Number :_____

PHYSICS

1. Ge and Si diodes conduct at 0.3 V and 0.7V respectively. In the following figure if Ge diode connection is reversed the value of V_0 change by.

   (1) 0.2 V   (2) 0.4 V
   (3) 0.6 V   (4) 0.8 V

2. In an FM system a 7 kHz signal modulates 108 MHz carrier so that frequency deviation is 50 kHz. modulation index is
   (1) 7.143   (2) 8
   (3) 0.71   (4) 350

3. A stone is thrown towards a pole of height 15 m and at a distance of 30 m. The stone passes just over the pole going downwards, making angle $45°$ with horizontal. The speed v of stone is $(g = 10 \text{ m/s}^2)$
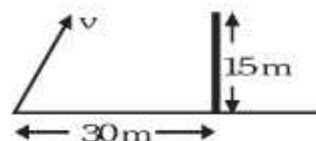


   (1) $\sqrt{200}$ (2) $\sqrt{300}$
   (3) 20 m/s   (4) $\sqrt{500}$

4. A uniform rod of mass m is kept in equilibrium making angle $30°$ with horizontal as shown with a thread. The tension in the thread is
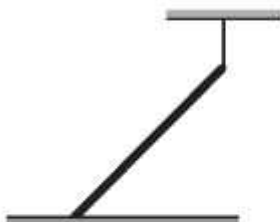
   (1) $\dfrac{mg}{2}$ (2) $mg\dfrac{\sqrt{3}}{2}$
   (3) mg   (4) data insufficient

5. A pendulum of length ℓ is hanging with the bob having charge 'q' and mass 'm'. An electric field of constant magnitude E making angle θ with vertical is established in the region, so that the thread of the pendulum reaches upto a position where string is parallel to field
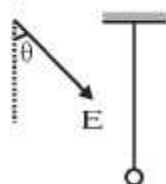

The value of E is

(1) $\dfrac{mg}{2q\cos\theta}$

(2) $\dfrac{mg}{q}$

(3) $\dfrac{mg\cos\theta}{q}$

(4) $\dfrac{mg\cos\theta}{2q}$

6. A conducting rod of length L is having from ceiling with help of two light metallic threads as shown. There is some potential difference between A & D so that some current flows in the rod. When displaced perpendicular to plane of diagram slightly, the system oscillates with time period T. Now magnetic field B perpendicular to plane of diagram is switched on. The time period of oscillation now becomes $\dfrac{T}{\sqrt{2}}$. The magnitude of current flowing through rod is. (The magnetic field cuts through the rod only and not the threads)
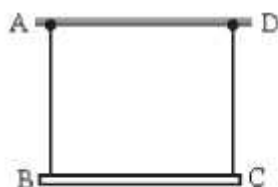

(1) $\dfrac{mg}{BL}$

(2) $\dfrac{mg}{2BL}$

(3) $\dfrac{2mg}{BL}$

(4) $\dfrac{\sqrt{2}mg}{BL}$

7. Super heated steam can be taken as an ideal gas. A sample of superheated steam of mass 180 g has internal energy of 60 K cal and is stored in a volume of 0.1 m^3. The pressure of the gas is (R = 2 cal/mol K)

(1) 8.3×10^5 Pa

(2) 2×10^5 Pa

(3) 8.3×10^3 Pa

(4) 16.2×10^5 Pa

8. A circuit element is placed in a closed box. At time $t = 0$ a constant current generator supplying a current of 1A is connected across box. Potential difference across box varies according to graph shown. The element in box.
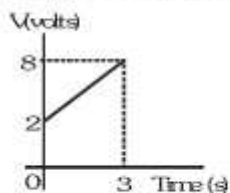

(1) Resistance 2Ω
(2) Battery of emf 6V
(3) Inductance of 2H
(4) Capacitance of 0.5

9. A uniform conducting wire ABC where angle between AB & BC is 37^0 has a mass of 10 g. The wire AB is parallel to y axis. A current of 2A flows through it. The wire is kept in a uniform magnetic field B = 2T (in wards) the acceleration of wire will be (assume no other force)
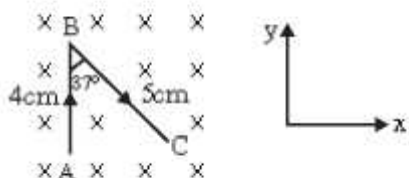
Angle between AB and BC is $37°$ with AB along y axis.
(1) zero
(2) 12 m/s^2 along y direction
(3) 36 m/s^2 along x direction
(4) 36 m/s^2 along y direction

10. 10. A small conducting sphere of radius r_a is placed inside an equal and oppositely charged conducting shell of radius r_b four points A, B, C and D shown in figure. Choose wrong statement
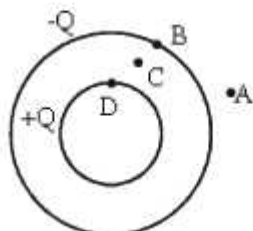

(1) $V_A = 0$
(2) $V_B = 0$
(3) $V_D = \dfrac{Q}{4\pi \epsilon_0}\left(\dfrac{1}{r_a} - \dfrac{1}{r_b}\right)$
(4) $V_C = 0$

11. On a horizontal table top there is a thin layer of oil of width d and viscosity η. A cubical block of side L and density ρ is attached to a spring which is attached to wall at other end. The block oscillates with decreasing amplitude. If at $t = 0$ the amplitude is A, the amplitude at any time t is

(1) $Ae^{-\frac{\eta t}{2\rho L d}}$
(2) $Ae^{-\frac{\eta L^3 t}{2\rho d}}$
(3) $Ae^{-\frac{\eta L^2 t}{2d\rho}}$
(4) $Ae^{-\frac{\eta t}{\rho L d}}$

12. A line charge (λ per unit length) is in the form of circular wheel of radius 'a' and moment of inertia is I, initial at rest. It is free to rotate in a horizontal plane. There is a coaxial magnetic field $B = B_0\hat{k}$ extending upto a radius $b(b < a)$. If the magnetic field is switched off, the angular velocity 'ω' of the wheel is given by

(1) $\dfrac{\pi a^2 b\lambda B}{I}$ clockwise as seen from above

(2) $\dfrac{\pi a b^2\lambda B}{I}$ clockwise as seen from above

(3) $\dfrac{\pi a b^2\lambda B}{2I}$ anticlockwise as seen from above

(4) $\dfrac{\pi a b^2\lambda B}{I}$ anticlockwise as seen from above
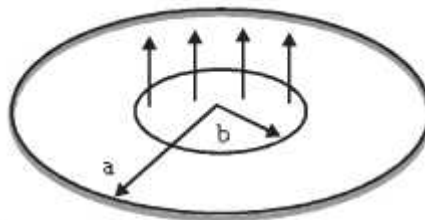
13. A small mirror is suspended by a thread a shown. A short pulse of monochromatic light rays is incident normally on the mirror and gets reflected. Which of the following statement is correct :
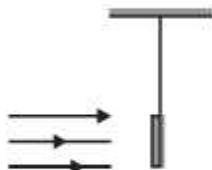
(1) Mirror will remain at some angle with vertical
(2) Wavelength of reflected rays will be greater than that of incident rays
(3) Wavelength of reflected rays may be less than that of incident rays
(4) None of these

14. When photons of energy 4.25 eV strike the surface of metal A the ejected photo electron have maximum kinetic energy T_A eV and De-Broglie wavelength λ_A. The maximum kinetic energy of photoelectrons liberated from other metal B by photons of energy 4.70 eV is $T_B = (T_A - 1.50)$ eV. If de Broglie wavelength of these photoelectrons is $\lambda_B = 2\lambda_A$ then. Which of following is not correct
(1) Work function of A is 2.25 eV   (2) Work function of B is 4.20 eV
(3) $T_A = 2.00$ eV   (4) $T_B = 2.75$ eV

15. An object O is placed at a point distance 'x' from F_1 of a convex lens and its image I is formed at distance x' from F_2 as shown. The magnification is
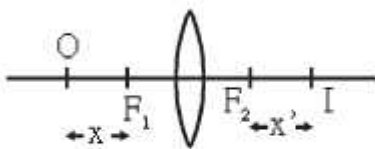
(1) $\dfrac{f}{x + x'}$ (2) $\dfrac{x'}{x}$

(3) $\dfrac{f}{x}$ (4) None of these

16. A gas cloud has a spherical shape in the space. The density of the cloud varies from centre to the surface. If distance from center is r, the density $\rho = \rho_0\left(1 - \dfrac{r^2}{R^2}\right)$, where R is radius of the sphere. The gravitational force on a unit mass at $r > R$ will be

(1) $\dfrac{2\pi G\rho_0 R^3}{5r^2}$

(2) $\dfrac{2\pi G\rho_0 R^4}{15r^3}$

(3) $\dfrac{8\pi G\rho_0 r}{15}$

(4) $\dfrac{8\pi G\rho_0 R^3}{15r^2}$

17. Volume of a solid cylinder is calculated by measuring the height using a ruler and the diameter using a vernier callipers. If the height was 10 cm and diameter 6 cm, the percentage error in volume will be
(1) 13.3
(2) 1.33
(3) 0.133
(4) 1.66

18. When length of a microscope tube increases, its magnifying power
(1) decreases
(2) increases
(3) does not change
(4) May increase or decrease

19. An organ pipe open at both ends is resonating with a tuning fork of frequency 400 Hz. The pipe can not have length of (velocity of sound 350 m/s)

(1) $\dfrac{7}{16}$ m

(2) $\dfrac{7}{8}$ m

(3) $\dfrac{7}{4}$ m

(4) $\dfrac{1}{4}$ m

20. A transverse wave is travelling through a string of a mass per unit length 100 g/m. The tension in the string is 10 N. If the equation of the wave is $y = 2$ cm sin $(20t - 2x)$, where x & t are in m and second, the linear energy density of a point when it passes through mean position is
(1) 1.6×10^{-2} J/m
(2) 1.6×10^{-4} J/m
(3) 1.6 J/m
(4) Zero

21. A sonometer wire has a bridge at $\dfrac{1}{3}$ length from one end. The wire resonates with a tuning fork in its fundamental (lowest frequency). The mass hanging from other end is 12 kg. What should be the mass removed so that the wire resonates with the same tuning fork again ?
(1) 6 kg
(2) 4 kg
(3) 9 kg
(4) 10 kg

22. A rod having uniform density has a mass of 2.004 kg and length 1.0 m. It's moment of inertia about a perpendicular axis passing through end point is
(1) 0.668 kgm^2
(2) 0.67 kgm^2
(3) 0.6680 kgm^2
(4) 0.17 kgm^2

23. A glass bowl of water equivalent of 10 g is at room temperature of 20°C when 40 g water at 100°C is poured in it. Also 5g of ice at 0°C is put in the water. If no heat is lost to the surroundings, the final temperature of the mixture is
   (1) 74°C
   (2) 55°C
   (3) 80°C
   (4) 69°C

24. A cuboidal slab has square faces of area A and a width d. Across the square faces a temperature of T is maintained. The conductivity of the material varies linearly with the distance from each face from K to 2K at the middle. The rate of heat flow is

   (1) $\dfrac{KAT}{d \ln 2}$
   (2) $\dfrac{KAT \ln 2}{d}$

   (3) $\dfrac{3KAT}{2d}$
   (4) $\dfrac{3KAT}{d}$

25. In the circuit shown here $C_1 = 6\mu F$, $C_2 = 3\mu F$ and battery B = 20 V. The switch S_1 is first closed. It is then opened and afterwards S_2 is closed. What is the charge on C_2
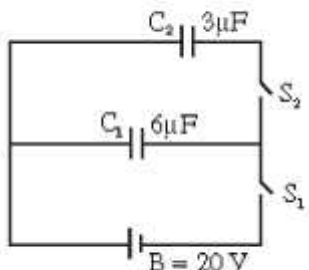

   (1) 120 µC
   (2) 80 µC
   (3) 40 µC
   (4) 20 µC

26. A point charge $q_1 = + 6e$ is fixed at origin. Another point charge $q_2 = - 10e$ is fixed at x = 8 nm, y = 0. The locus of all points in xy plane for which potential V = 0 is a circle centered on X axis as shown, find x coordinate of center of circle.
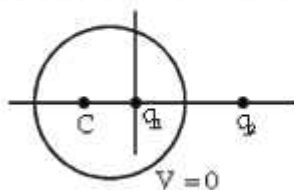

   (1) – 2nm
   (2) – 3 nm
   (3) – 4.5 nm
   (4) – 7.5 nm

27. A potentiometer wire of length 10 m and resistance 30Ω is connected in series with a battery of emf 2.5 V, internal resistance 5Ω and external resistance R. If a secondary cell of 0.4 V is balanced at 8 'm' length. Then value of R is
   (1) 100 Ω
   (2) 110 Ω
   (3) 105 Ω
   (4) 115 Ω

28. A block is placed over a long plank as shown. The plank is given an acceleration a varying with time as shown in the graph
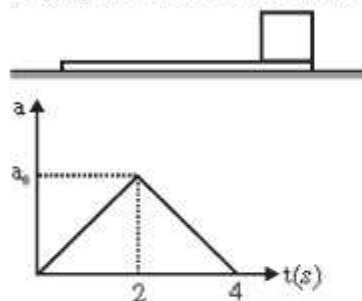

The coefficient of fiction between the plank and block is $\mu = 0.2$. The maximum value of acceleration $a_0 (> 2 \text{ m/s}^2)$ so that the block again comes to rest at $t = 4$ s with respect to plank.

(1) $(2 + \sqrt{3})$ m/s^2
(2) $(2 + \sqrt{2})$ m/s^2
(3) 3 m/s^2
(4) 2.5 m/s^2

29. Between two parallel long wires AB and CD is a soap flim S between another two transverse wires PQ & EF. The separation between PQ & EF is x which can be varied. The incorrect statement is
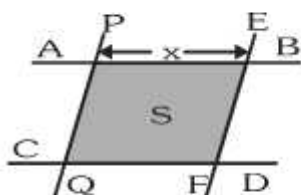
(1) Force due to surface tension on PQ equals in magnitude to that on EF
(2) Force of surface tension is proportional to the separation x
(3) Force of surface tension is proportional to length of PQ and EF
(4) Surface energy depends on x

30. From a block of dimensions $(20 \times 20 \times 10)$ cm^3 a part is removed at the middle as shown of the dimension $(10 \times 10 \times 5)$ cm^3. This system is kept on the surface of water and water is poured from above. What will be the level of liquid inside the cavity when it sinks ? density of block $= 1.1$ gm/cc.
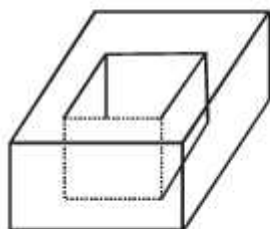
(1) 1 cm
(2) 1.5 cm
(3) 4 cm
(4) never sinks

CHEMISTRY

1. If a 100 mL solution of 0.1 M HBr is titrated using a highly concentrated solution of NaOH, then the conductivity (specific conductance) of this solution at the equivalence point will be (neglect volume change due to addition of NaOH and interaction between ions).

    Given $\lambda_{(Na^+)} = 8 \times 10^{-3}$ Sm^2 mol^{-1} $\lambda_{(Br^-)}$
    $= 4 \times 10^{-3}$ S m^2 mol^{-1}
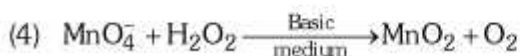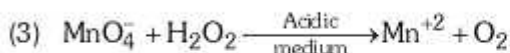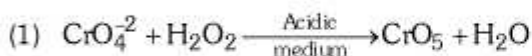
    (1) 0.6 Sm^{-1} (2) 1.2 Sm^{-1}
    (3) 1.5 Sm^{-1} (4) 2.4 Sm^{-1}

2. Optically pure isomers A and B were heated with NaN$_3$, in DMF. The correct statement from the following is
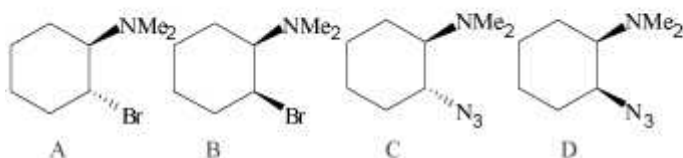
    (1) A gives optically pure D and B gives optically pure C
    (2) A gives racemic mixture of C and B gives optically pure C
    (3) A gives optically pure C and B gives racemic mixture of C
    (4) A gives optically pure D and B gives racemic mixture of D

3. Which of the following does not represent appropriate product.

    (1) $CrO_4^{-2} + H_2O_2 \xrightarrow[\text{medium}]{\text{Acidic}} CrO_5 + H_2O$

    (2) $Cr^{+3} + H_2O_2 \xrightarrow[\text{medium}]{\text{Basic}} CrO_4^{-2} + H_2O$

    (3) $MnO_4^- + H_2O_2 \xrightarrow[\text{medium}]{\text{Acidic}} Mn^{+2} + O_2$

    (4) $MnO_4^- + H_2O_2 \xrightarrow[\text{medium}]{\text{Basic}} MnO_2 + O_2$

4. The compressibility factor $\left(Z = \dfrac{PV}{nRT} \right)$ for N$_2$ at 223 K and 81.06 MPa is 1.95 and at 373 K and 20.265 MPa is 1.10. A certain mass of N$_2$ occupies a volume of 1 dm^3 at 223 K and 81.06 MPa, the volume occupied by same quantity of N$_2$ at 373 K and 20.265 MPa is (R = 8.314 MPa cm^3 mol^{-1} K^{-1})
    (1) 3.8 dm^3 (2) 10.4 dm^3
    (3) 15.6 dm^3 (4) 26.7 dm^3

5. A metal 'M' does not combine with reagent A & B individually but when combines with an appropriate mixture of reagents A & B produces a gas G_1. This gas can also be produced by reaction of other metal of same family and dil solution of reagent A. On the basis of above information which of following statements is/are true ?

(I) These metals may belongs to transition metals.

(II) Gas G_1 is paramagnetic & blue coloured gas.

(III) Metals of same family which are lighter than M produces same gas on reaction with reagent B.

(1) II & I   (2) only I
(3) only III   (4) II & III

6.

$\xrightarrow{\text{HOCl}} I \xrightarrow{\text{dil NaOH}} II \xrightarrow{\text{dil H}_2\text{SO}_4} III$
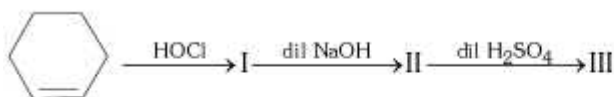
The final product (III) is
(1) epoxy cyclohexane   (2) 2-chloro cylohexanol
(3) ($\pm$) cis-1,2-cyclohexanediol   (4) trans-1,2-cyclohexanediol

7. Which of the following carbides when hydrolysed produces methane.
(1) BaC_2 (2) SrC_2
(3) Be_2C (4) All of these

8. Gold number of haemoglobin is 0.06. How much haemoglobin will n required for 100 ml of gold sol so that gold is not coagulated by 1 ml of 10 % NaCl solution ?
(1) 0.06 mg   (2) 60 mg
(3) 0.60 mg   (4) 6 mg

9. Which of the following form precipitate on reaction with Na_2CO_3 in presence of acetic acid
(1) $FeCl_3$ (2) $CaCl_2$
(3) $SrCl_2$ (4) $BaCl_2$

10. Select the correct sequence, regarding the following sentences ('T' represents true and 'F' represents false)
(i) Enthalpy is always greater than the internal energy of the system.
(ii) The difference between enthalpy and internal energy of the system increases with increase in temperature.
(iii) All naturally occuring processes are irreversible
(iv) Resonance energy is always +ve.
(1) FTTF   (2) TTTF
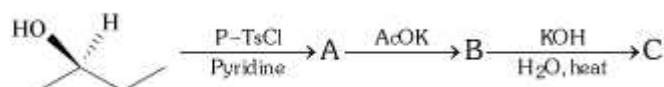(3) TTFF   (4) TTFT

11. Amphentamine, a CNS (central nervous system) stimulant has the structural formula $C_6H_5CH_2CH(NH_2)CH_3$. Which of the following set of reactants should be reacted in acidic condition and hydrogenated in the presence of nickel catalyst to prepare amphetamine ?
(1) $C_6H_5CH_2CHO$ and CH_3NH_2 (2) $C_6H_5CH_2COCH_3$ and NH_3
(3) $C_6H_5CH_2NH_2$ and CH_3CHO (4) $C_6H_5CH = CHCH_3$ and NH_3

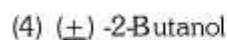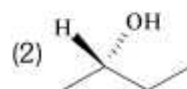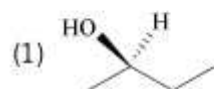12. Which of the following compound can produce H_2O_2 on electrolysis only.
(1) Na_2SO_4 (2) $NaHSO_4$
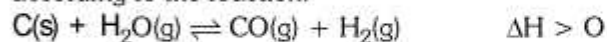(3) $KHSO_4$ (4) None of the above

13.

$$\text{(HO, H structure)} \xrightarrow[\text{Pyridine}]{\text{P-TsCl}} A \xrightarrow{\text{AcOK}} B \xrightarrow[\text{H}_2\text{O, heat}]{\text{KOH}} C$$

The major product (C) is

(1)

(2)

(3)

(4) ($\pm$) -2-Butanol

14. The production of hydrogen for industrial purpose is performed by producing water gas according to the reaction.

$$C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g) \qquad \Delta H > 0$$

For the system above at equilibrium which changes will increase amount of $H_2(g)$

(I) Adding C(s)
(II) Increasing volume of container
(III) Increasing temperature.
(IV) Adding inert gas at constant pressure
(V) Adding inert gas at constant volume

(1) I and IV
(2) I, II and III
(3) III, I and IV
(4) II, III and IV

15.

$$A \xrightarrow{\text{H}_2, \text{Ni}} B \xrightarrow{\text{HNO}_2} C_2H_5OH$$
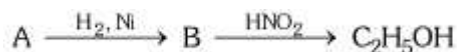
The starting compound (A) is

(1) CH_3CN
(2) CH_3NC
(3) C_2H_5CN
(4) CH_3NO_2
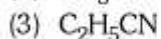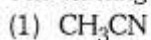
16. If SO_2 content in water is 0.06 ppm when dissolved from atmosphere under normal conditions, find pH of rain water (assume 100% ionization of acid rain as dibasic acid, and density of aqueous solution to be 1gm/ml) :

(1) 5.7
(2) 5.6
(3) 5.4
(4) 2.0

17.

$$\text{(cyclohexanone)} \xrightarrow[\text{H}^+]{\text{HS-CH}_2\text{-CH}_2\text{-SH}} A \xrightarrow[\text{Ni, Heat}]{\text{H}_2} B$$

the product B is

(1)

(2)

(3)

(4)

18. Which of the following is correct about splitting of d-orbitals in square planar complex, considering only axial e^- density get affected by field of ligand ?

(1) energy level $\uparrow$
$d_{x^2-y^2}$
d_{xy}
d_{z^2}
$d_{zx} = d_{yz}$

(2) energy level $\uparrow$
$d_{x^2-y^2}$
$d_{xy} = d_{yz} = d_{zx} = d_{z^2}$

(3) energy level $\uparrow$
$d_{x^2-y^2}$
d_{z^2}
$d_{xy} = d_{yz} = d_{zx}$

(4) energy level $\uparrow$
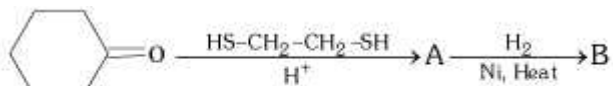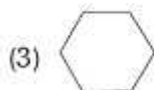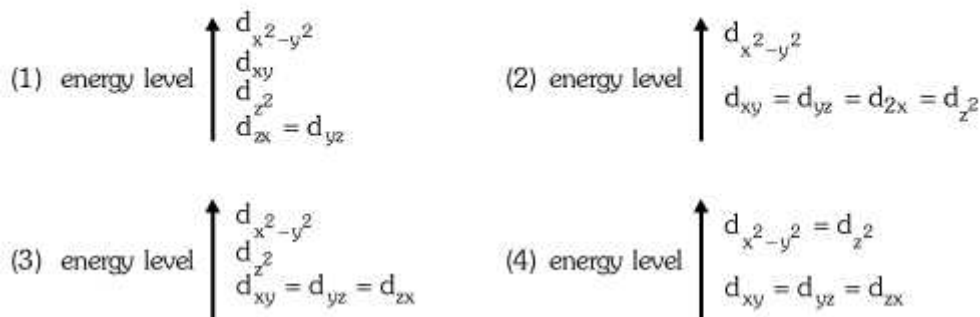$d_{x^2-y^2} = d_{z^2}$
$d_{xy} = d_{yz} = d_{zx}$

19. Identical solid atoms are arranged in a cubic packing which leads to formation of lattice of imperfect face centred unit cell in which no atom touches each other. If sepration between two corner atoms along edge length and body diagonal is a and b respectively, then the ratio of radius of atom to edge length of cube will be given by : (If
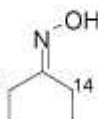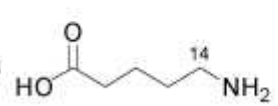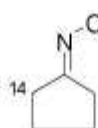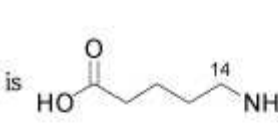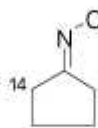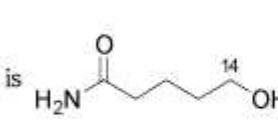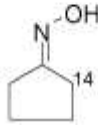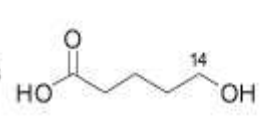
$$\frac{a}{b} = \frac{1}{2})$$

(1) 0.134   (2) 0.254
(3) 0.414   (4) 0.732

20. Diborane reacts with ammonia to form an adduct (A) and on heating produces compound B, hybridisation of boron in compound A and compound B respectivly.
(1) sp^2 only   (2) sp^3 only
(3) sp^2 and sp^3 4) sp^3 and sp^2

21.
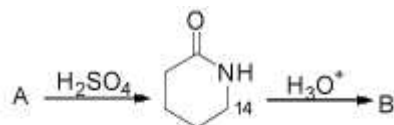
A and B are ?

(1) A is and B is

(2) A is and B is

(3) A is and B is

(4) A is and B is

22. The gas phase decomposition (in closed containes)

    $2A(g) \longrightarrow 4B(g) + C(g)$

    follows first order rate law. Specific reaction rate is $3 \times 10^{-3} s^{-1}$ at a given temperature. The initial pressure of A is 0.2 atm. Calculate the approximate time of decomposition of A so that the total presure becomes 0.35 atm.

    (1) 1000 sec   (2) 693 sec

    (3) 230 sec   (4) 301 sec

23. Pick out the group of metals in which all are refined by same operational technique in order to extract them from their common ores ?

    (1) Fe, Cu, Zn   (2) Si, B, Bi

    (3) Ni, Zr, Ti   (4) Al, Cr, Mn

24.
    $$\text{Ethanamine (P)} \xrightarrow[\substack{\text{(ii)}KMnO_4 \\ \text{(iii) } NH_3, \Delta \\ \text{(iv)}Br_2 + KOH, \Delta}]{\text{(i)}HNO_2} (Q)$$

    Choose the correct statement ?

    (1) P and Q are structural isomer

    (2) Q form yellow oily layer with HNO_2

    (3) Q is more basic than P

    (4) P and Q are homologue

25. 0.84gm carbon, 0.32gm oxygen and 0.06gm hydrogen were qualitatively analysed in a sample of benzoic acid. The identical sample is dissolved in 100 gm each of acetone and benzene seperately, the boiling point of mixture with acetone increased by 0.17°C and boiling point of mixture with benzene increased by 0.13°C.

    K_b (acetone) $= 1.7$ K Kg mol^{-1}

    K_b (benzene) $= 2.6$ K Kg mol^{-1}

    The molecular mass of benzoic acid in acetone and in benzene solutions are :

    (1) 61 and 122   (2) 122 and 122

    (3) 244 and 122   (4) 122 and 244

26. Arrange the following oxides in order Amphoteric, Basic, Acidic, Neutral and mixed oxides respectively.

    B_2O_3, SnO_2, CO, Pb_3O_4, CaO

    B_2O_3, SnO_2, CO, Pb_3O_4, CaO

    (1) Pb_3O_4, CaO, B_2O_3, CO, SnO_2 (2) SnO_2, CaO, B_2O_3, CO, Pb_3O_4

    (3) B_2O_3, CaO, SnO_2, CO, Pb_3O_4 (4) SnO_2, CaO, Pb_3O_4, CO, B_2O_3

27.
    $$Me \overset{\overset{H}{|}}{\underset{\underset{Br}{|}}{\quad}} CH_2 \overset{\overset{H}{|}}{\underset{\underset{Br}{|}}{\quad}} Me \xrightarrow[h\upsilon]{Cl_2} C_5H_9Br_2Cl$$

    How many of the products($C_5H_9Br_2Cl$) formed above are optically inactive ?

    (1) 1   (2) 2

    (3) 3   (4) 0

28. A solution containing Cu^{2+} and $C_2O_4^{2-}$ ions which is titrated with 20 ml of M/4 $KMnO_4$ solution in acidic medium completely. The resulting solution is treated with excess of KI after neutralisation. The evolved I_2 is then absorbs in 25 ml of N/10 hypo solution, the difference in milli moles of Cu^{2+} and $C_2O_4^{2-}$ ions in solution is :
   (1) 10   (2) 30
   (3) 40   (4) 50

29. Which of the following is a thermoplastic ?
   (1) Bakelite   (2) Glyptal
   (3) Polystyrene   (4) Neoprene

30. In which of the following cases X-F bond (where X: central atom) has partial double bond character ?
   (1) NF_3 (2) CF_4
   (3) PF_3 (4) OF_2

MATHEMATICS

1. Let $f : R^+ \to R$ be a negative decreasing function with $\lim\limits_{x\to\infty} \dfrac{f\left(x - \dfrac{x^3}{6}\right)}{f(x)} = k$, then

   $\lim\limits_{x\to\infty} \dfrac{f(\sin x)}{f(x)}$ is

   (1) less than k

   (2) greater than k

   (3) equal to k

   (4) Nothing can be said

2. Let $f(x) = \sin^3 x + \lambda \sin^2 x$ for $-\dfrac{\pi}{2} < x < \dfrac{\pi}{2}$ and $\lambda > 0$. The complete interval in which λ should lie in order that $f(x)$ has exactly one minimum and one maximum is

   (1) $0 < \lambda < 3/2$

   (2) $0 < \lambda < 1$

   (3) $1 < \lambda < 2$

   (4) $1 < \lambda < 3/2$

3. If $x^3 - x + \dfrac{1}{x} - \dfrac{k}{x^2} = 0$ is satisfied for positive values of x only and $\int\limits_0^1 x^6 dx \geq \dfrac{1}{10}$, then possible value of k is

   (1) $\dfrac{3}{5}$

   (2) $\dfrac{12}{17}$

   (3) $\dfrac{9}{16}$

   (4) $\dfrac{4}{15}$

4. Let $f : [2, \infty) \to [1, \infty)$ defined by $f(x) = 2^{x^4 - 4x^2}$ and $g : \left[\dfrac{\pi}{2}, \pi\right] \to [-5, -2]$ defined

   by $g(x) = \dfrac{\sin x + 4}{\sin x - 2}$ be two invertible functions, then number of integers in the domain

   of $f^{-1} \circ g^{-1}(x)$ is

   (1) 1

   (2) 2

   (3) 3

   (4) 4

5. If $A = \begin{bmatrix} 4 & 6 & 6 \\ 1 & 3 & 2 \\ -1 & -5 & -2 \end{bmatrix}$, then sum of all possible distinct values of λ for which $AX = \lambda X$,

   where X is a non-zero column matrix, is

   (1) 2

   (2) 3

   (3) 4

   (4) 5

6. Tangents are drawn from any point on directrix of $y^2 = 16x$ to parabola. If locus of mid point of chords of contact is a parabola whose focus is (h, k) then h + k is

   (1) 6

   (2) 10

   (3) 8

   (4) 14

---

7. Given that A = {(x, y) | $x^2 + 2y^2 = 3$} and
B = {(x, y) | y = mx + c}. If A ∩ B ≠ φ for all
A ∈ R, then range of 'c' is

   (1) $\left[-\dfrac{\sqrt{6}}{2}, \dfrac{\sqrt{6}}{2}\right]$

   (2) $\left(-\dfrac{\sqrt{6}}{2}, \dfrac{\sqrt{6}}{2}\right)$

   (3) $\left(-\dfrac{\sqrt{6}}{2}, \dfrac{\sqrt{6}}{2}\right]$

   (4) $\left[-\dfrac{2\sqrt{3}}{3}, \dfrac{2\sqrt{3}}{3}\right]$

8. If $\displaystyle\int_{1}^{e}\dfrac{\log x}{1-x}\,dx = I_1$, $\displaystyle\int_{1}^{e}\dfrac{\log^2 x}{1-x}\,dx = I_2$ then

   (1) $I_2 > I_1 > -1$
   (2) $I_2 < I_1 > -1$
   (3) $I_2 > 0, I_1 < 0$
   (4) $I_1 = I_2 < -1$

9. If $\cos^3 20° - \sin^3 10° - \sin^3 50° = \dfrac{a}{b}$, then (b – a) lies in

   (1) (0, 1]

   (2) $\left[1, \dfrac{3}{2}\right]$

   (3) $\left(\dfrac{3}{2}, \dfrac{5}{2}\right)$

   (4) $\left[\dfrac{5}{2}, 5\right]$

10. If $\displaystyle\sum_{r=1}^{5} {}^{20}C_{2r-1} = k$,

    then the remainder when k^6 is divisible by 11
    (1) 2   (2) 3
    (3) 5   (4) 9

11. Tiles in a Bag are numbered from {0, 1, 2, 3, ..., 98, 99}. Two tiles with the
    numbers a and b are randomly drawn from the bag with replacement. What is the
    probability that the number $3^a + 7^b$ has a digit equal to 8 at that unit place ?

    (1) $\dfrac{37}{198}$

    (2) $\dfrac{1}{10}$

    (3) $\dfrac{25}{132}$

    (4) $\dfrac{1}{8}$

12. If $S_n = \displaystyle\sum_{r=1}^{n}\dfrac{2r+1}{r^4 + 2r^3 + r^2}$, then S_{20} is equal to $\dfrac{n}{n+1}$, then find $\sqrt{n+1}$

    (1) 20   (2) 21
    (3) 22   (4) 23

13. A, B, C and D are points on a circle. PA is a tangent to the circle. $\angle PAD = 39°$ and $\angle BCD = 103°$. BD is not a diameter. Find the measure of $\angle ADB$ in degrees
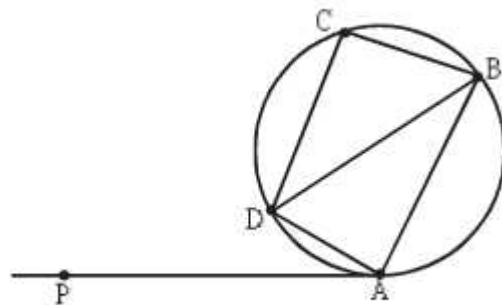
(1) 39°   (2) 77°
(3) 64°   (4) 51.5°

14. The number of possible rearrangements of the word 'NEWYEAR' such that there are always two letters in between the both E's
(1) 480   (2) 599
(3) 600   (4) 479

15. For the quadratic equation $kx^2 - 17x + 2k = 0$. The number of proper divisors of the maximum integral value of k for which the above quadratic equation has two distinct real roots.
(1) 6   (2) 4
(3) 2   (4) 8

16. The solution of the equation $\log \dfrac{dy}{dx} = 9x - 6y + 6$, given that $y = 1$ when $x = 0$ is
(1) $3e^{6y} = 2e^{9x-6} + 6e^6$ (2) $3e^{6y} = 2e^{9x+6} - 6e^6$
(3) $3e^{6y} = 2e^{9x+6} + e^6$ (4) None of these

17. A line is inclined at angle α with both planes $x = 0$ and $y = 0$, then $\alpha \in$

(1) $\left[0, \dfrac{\pi}{4}\right]$ (2) $\left[\dfrac{\pi}{3}, \dfrac{\pi}{2}\right]$

(3) $\left[\dfrac{\pi}{4}, \dfrac{\pi}{2}\right]$ (4) $\left[\dfrac{\pi}{6}, \dfrac{\pi}{3}\right]$

18. A triangle ABC right angled at C moves such that A & B always lie on the positive x & y axes. The locus of C is
(1) straight line   (2) circle
(3) parabola   (4) ellipse

19. Let $A(\vec{a})$ and $B(\vec{b})$ be points on two skew line $\vec{r} = \vec{a} + \alpha\vec{p}$ and $\vec{r} = \vec{b} + \beta\vec{q}$ and the shortest distance between the skew line is $\sqrt{3}$, where $\vec{p}$ & $\vec{q}$ are unit vectors forming adjacent sides of a parallelogram enclosing an area of $\frac{1}{2}$ units. If an angle between AB and the line of shortest distance is $30°$, then AB =

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

(2) 2

(3) $\sqrt{3}$

(4) 4

20. If $\vec{r} = \alpha(\vec{a} \times \vec{b}) + \beta(\vec{b} \times \vec{c}) + \gamma(\vec{c} \times \vec{a})$

and $[\vec{a}\ \vec{b}\ \vec{c}] = \frac{1}{8}$, then $\alpha + \beta + \gamma$ is equal to

(1) $\vec{r} \cdot (\vec{a} + \vec{b} + \vec{c})$

(2) $8\vec{r} \cdot (\vec{a} + \vec{b} + \vec{c})$

(3) $4\vec{r} \cdot (\vec{a} + \vec{b} + \vec{c})$

(4) None of these

21. The area of the region bounded by $x + 1 = 0$, $y = 0$, $y = x^2 + x + 1$ and tangent to $y = x^2 + x + 1$ at $x = 1$ will be

(1) $\frac{5}{6}$

(2) $\frac{7}{6}$

(3) $\frac{11}{6}$

(4) $\frac{13}{6}$

22. If a variable takes the value 0, 1, 2, ... n with frequencies proportional to the binomial coefficients $^nC_0$, $^nC_1$, $^nC_2$, ..., ^nC_n, then mean of distribution is

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

(2) $\frac{n(n+1)}{2}$

(3) $\frac{n(n-1)}{2}$

(4) $\frac{2}{n}$

23. $P(z_1)$ lies on a circle with OP as diameter, where O is the origin. Points $Q(z_2)$ and $R(z_3)$ are taken on the circle such that $\angle POQ = \angle QOR = \theta$. The ratio $\frac{z_1 z_3}{z_2^2}$ is given by

(1) $\frac{\cos 2\theta}{\cos^2 \theta}$

(2) $\frac{\sin 2\theta}{\sin^2 \theta}$

(3) $\frac{\cos^2 \theta}{\cos 2\theta}$

(4) $\frac{\sin^2 \theta}{\sin 2\theta}$

24. The function 'f' satisfies the relation $f(x)f'(-x) = f(-x)f'(x)$, $\forall x$ and $f(0) = 3$. Now if $f(3) = 3$ then $f(3) \cdot f(-3)$ is equal to

(1) 8

(2) 9

(3) 10

(4) 11

25. Consider a square ABCD of diagonal length 2a. The square is folded along the diagonal AC. So that the plane of $\triangle ABC$ is perpendicular to plane of $\triangle ADC$. The shortest distance between AB & CD is

(1) $\dfrac{a}{2\sqrt{3}}$

(2) $\dfrac{a}{\sqrt{3}}$

(3) $\dfrac{2a}{\sqrt{3}}$

(4) None

26. $\displaystyle\int \dfrac{1}{\cos^2\left(\ln\left(\dfrac{1+x}{1-x}\right)\right)(1-x^2)}\,dx$

(1) $\tan\left(\ln\left(\dfrac{1+x}{1-x}\right)\right) + C$

(2) $\dfrac{1}{2}\tan\left(\ln\left(\dfrac{1+x}{1-x}\right)\right) + C$

(3) $2\ln(1+x) + C$

(4) None of these

27. Let $f(x) = \min\{1 - \tan^{2n}x,\ 1 - \sin^{2n}x,\ 1 - x^{2n}\},\ \forall\, x \in \left(-\dfrac{\pi}{2}, \dfrac{\pi}{2}\right)$ where $n \in N$. Then the

value of $\left[\sec\left(f\left(\dfrac{\pi}{4}\right) + \dfrac{\pi}{4}\right)\right]$ is where $[\ ] = $ G.I.F.

(1) 0

(2) 2

(3) $\dfrac{1}{2}$

(4) 1

28. Find the range of the function,
$f(x) = (2 + \sec^{-1}x)(3 + \cos^{-1}x)(1 + x^2)$
(1) $(-\infty, \infty)$

(2) $\{12,\ 2\pi^2 + 10\pi + 12\}$

(3) $\{2,\ \pi^2 + 5\pi + 6\}$

(4) None of these

29. Let $P_n = \displaystyle\prod_{k=1}^{n}\cos(x\cdot 2^{-k})$ and $g(x) = \lim_{n\to\infty} x(P_n)$ then the number of solution of $g(x) = -1$

in $[0, 4\pi]$ is :
(1) 0

(2) 1

(3) 2

(4) 3

30. The contrapositive of the following statement,
"If the side of a cube doubles, then its volume increases eight times" is
(1) If the volume of the cube does not increases eight times, then its side is not doubled
(2) If the volume of the cube increases eight times, then its sides is not doubled
(3) Here contrapositive of above statement is not possible
(4) None of these

Q. No.	Physics	Q. No.	Chemistry	Q. No.	Mathematics
1	B	1	B	1	B
2	A	2	B	2	A
3	D	3	A	3	D
4	A	4	A	4	D
5	B	5	B	5	B
6	A	6	D	6	A
7	A	7	C	7	A
8	D	8	C	8	A
9	B	9	A	9	D
10	D	10	B	10	B
11	A	11	B	11	A
12	C	12	D	12	B
13	B	13	B	13	C
14	D	14	D	14	D
15	C	15	A	15	C
16	D	16	A	16	C
17	B	17	C	17	A
18	A	18	C	18	A
19	D	19	A	19	B
20	A	20	D	20	B
21	C	21	B	21	B
22	B	22	C	22	A
23	D	23	C	23	A
24	A	24	D	24	B
25	C	25	D	25	C
26	C	26	B	26	B
27	D	27	B	27	D
28	B	28	A	28	B
29	B	29	C	29	C
30	B	30	C	30	A