

FIITJEE

ALL INDIA TEST SERIES

FULL TEST – VIII

JEE (Advanced)-2021

PAPER –1

TEST DATE: 04-09-2021

Time Allotted: 3 Hours

Maximum Marks: 198

General Instructions:

- The test consists of total 54 questions.
- Each subject (PCM) has 18 questions.
- This question paper contains **Three Parts**.
- **Part-I** is Physics, **Part-II** is Chemistry and **Part-III** is Mathematics.
- Each **Part** is further divided into **Two Sections: Section-A & Section-C**.

Section-A (01 – 06, 19 – 24, 37– 42) contains **18 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 (07 – 12, 25 – 30, 43 – 48) this section contains **18 multiple** choice questions. Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).

For each question, choose the option(s) corresponding to (all) the correct answer(s)

Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If only (all) the correct option(s) is (are) chosen:

Partial Marks : +3 If all the four options are correct but ONLY three options are chosen;

Partial Marks : +2 If three or more options are correct but ONLY two options are chosen and both of which are correct;

Partial Marks : +1 If two or more options are correct but ONLY one option is chosen and it is a correct option;

Zero Marks : 0 If none of the options is chosen (i. e. the question is unanswered);

Negative Marks : –2 In all other cases.

Section-C (13 – 18, 31– 36, 49 – 54) contains **18 Numerical** answer type questions with answer XXXXX.XX and each question carries **+4 marks** for correct answer and **0 marks** for wrong answer.

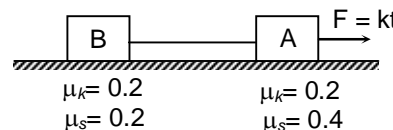
Physics

PART – I

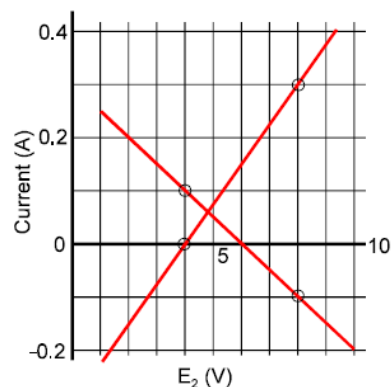
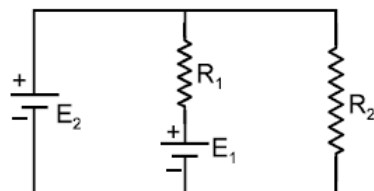
SECTION – A (One Options Correct Type)

This section contains **06 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

1. Two block A and B each of mass $\frac{1}{2}$ kg is connected by a massless inextensible string and kept on horizontal surface. Coefficient of friction between block and surface shown in figure. A force $F = kt$ (where $k = 1$ N/s and t is time in second) applied on A. Then which of the following is incorrect? ($g = 10$ m/s²)
- (A) work done by friction force on block B is zero in time interval $t = 0$ to $t = 3$ s.
 (B) work done by friction force on block A is zero in time interval $t = 0$ to $t = 3$ s.
 (C) work done by tension on B is also zero in time interval $t = 0$ to $t = 3$ s.
 (D) speed of blocks at $t = 10$ s is 27.5 m/s.



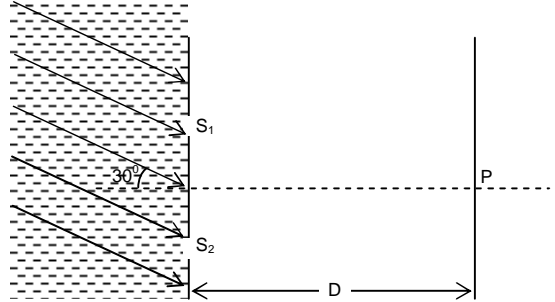
2. A traveling wave pulse is given by $y = \frac{6}{2 + (x + 3t)^2}$ where symbols have their usual meanings, x, y are in metre and t is in second. Then which of the following is incorrect?
- (A) the pulse is traveling along +ve x -axis with velocity 3 m/s.
 (B) the pulse is traveling along -ve x -axis with velocity 3 m/s.
 (C) the amplitude of the wave pulse is 3 m.
 (D) the pulse is a symmetric pulse.
3. In the circuit given below, both batteries are ideal. EMF E_1 of battery 1 has a fixed value, but emf E_2 of battery 2 can be varied between 1.0 V and 10.0 V. The graph gives the currents through the two batteries as a function of E_2 , but are not marked as which plot corresponds to which battery. But for both plots current is assumed to be negative when the direction of the current through the battery is opposite the direction of that battery's emf. (direction of emf is from negative to positive)



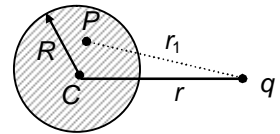
The value of emf E_1 is

- (A) 8 V
 (B) 6 V
 (C) 4 V
 (D) 2 V

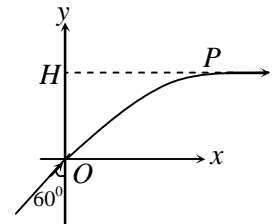
4. The given figure shows a YDSE apparatus. Parallel monochromatic coherent light rays are incident on slits S_1 and S_2 ($S_1 S_2 = \frac{2}{3}$ mm) at an angle 30° with the horizontal. The medium on left side of the slits is water ($\mu_w = 4/3$). To obtain the central maxima at point P, a glass slab ($\mu_g = 3/2$) inside water is introduced in front of slit S_1 . The thickness of the glass slab required for this purpose is
- (A) 2mm
 (B) $4/3$ mm
 (C) 4 mm
 (D) $8/3$ mm



5. A point charge is placed at a distance r from center of a conducting neutral sphere of radius R ($r > R$). The potential at any point P inside the sphere at a distance r_1 from point charge due to induced charge of the sphere is given by $[k = \frac{1}{4\pi\epsilon_0}]$



- (A) kq/r_1
 (B) kq/r
 (C) $kq/r - kq/r_1$
 (D) $-kq/R$
6. A system of coordinates is drawn in a medium whose refractive index varies as $\mu = \frac{2}{1+y^2}$, where $0 \leq y \leq 1$. A ray of light is incident at origin at an angle 60° with y -axis as shown in the figure. At point P ray becomes parallel to x -axis. The value of H is



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

(One or More than one correct type)

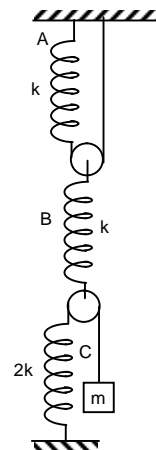
This section contains **06** multiple choice questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.

7. If the dimensions of length are expressed as $G^x c^y h^z$; where G , c and h are the universal gravitational constant, speed of light and Planck's constant respectively, then

- (A) $x = \frac{1}{2}, y = \frac{1}{2}$
 (B) $x = \frac{1}{2}, z = \frac{1}{2}$
 (C) $y = \frac{1}{2}, z = \frac{3}{2}$
 (D) $y = -\frac{3}{2}, z = \frac{1}{2}$

8. In the given figure, the block is attached with a system of three ideal springs A, B, C. The block is displaced by a small distance x from its equilibrium position vertically downwards and released. T represents the time period of small vertical oscillations of the block. Then (pulleys are ideal). Choose the correct alternative(s).

- (A) $T = 2\pi\sqrt{\frac{11m}{2k}}$
 (B) the deformation of the spring A is $(2/11)$ times the displacement of the block.
 (C) the deformation of the spring C is $(1/11)$ times the displacement of the block.
 (D) the deformation of the spring B is $(4/11)$ times the displacement of the block.



9. An open organ pipe has fundamental frequency 100 Hz. What frequencies will be produced if its one end is closed?

- (A) 50
 (B) 150
 (C) 200
 (D) 250

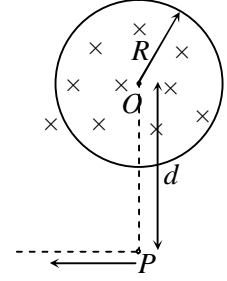
10. One mole of monoatomic gas expands with temperature according to the relation $V = KT^{2/3}$ where 'k' is constant. Then choose the correct alternative(s).

- (A) Work done to change the temperature by 30°C is $20 R$.
 (B) Change in internal energy when temperature is changed by 20°C is $30 R$.
 (C) If volume of gas is changed by 2% the temperature will change by 3%.
 (D) If temperature of gas is changed by 2% the pressure will change by 6%.

11. An ammeter has a resistance of 50Ω and a full scale deflection current of $50 \mu\text{A}$. It can be used as a voltmeter or as a higher range ammeter provided that a resistance is added to it. Choose the correct range and resistance combination from the following

- (A) 20 V range with approximately $400 \text{ k}\Omega$ resistance in series.
 (B) 100 V range with approximately $2 \times 10^6 \Omega$ resistance in series.
 (C) 1 mA range with 50Ω resistance in parallel.
 (D) 0.1 mA range with 50Ω resistance in parallel.

12. In a cylindrical region of radius R , there exists a time varying magnetic field B such that $\frac{dB}{dt} = k (> 0)$. A charged particle having charge q is placed at the point P at a distance $d (> R)$ from its centre O . Now, the particle is moved in the direction perpendicular to OP (see figure) by an external agent upto infinity so that there is no gain in kinetic energy of the charged particle. Choose the correct statement/s.

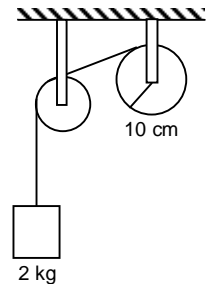


- (A) Work done by external agent is $\frac{q\pi R^2}{4}k$ if $d = 2R$
- (B) Work done by external agent is $\frac{q\pi R^2}{8}k$ if $d = 4R$
- (C) Work done by external agent is $\frac{q\pi R^2}{4}k$ if $d = 4R$
- (D) Work done by external agent is $\frac{q\pi R^2}{4}k$ if $d = 6R$

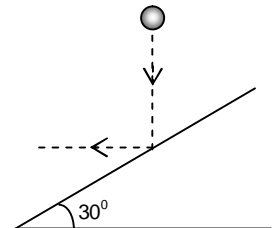
SECTION – C
(Numerical Answer Type)

This section contains **06** questions. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. XXXXX.XX).

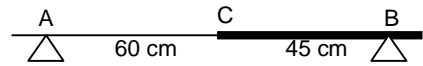
13. A point mass of 1 kg collides elastically with a stationary point mass of 5 kg. After their collision, the 1 kg mass reverses its direction and moves with a speed of 2 ms^{-1} . Then kinetic energy on centre of mass for the system of these two masses is
14. The thickness of a glass plate is measured to be 2.17 mm, 2.17 mm and 2.18 mm at three different places. Find the average thickness of the plate from this data. (in mm)
15. A string is wrapped on a wheel of moment of inertia 0.20 kg m^2 and radius 10 cm and goes through a light pulley to support a block of mass 2.0 kg as shown in figure. Find the acceleration of the block. (in m/s^2)



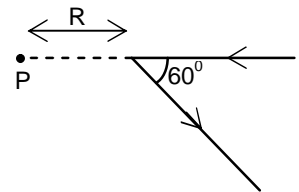
16. A ball is released from a point, it goes vertically downwards and collides with a fixed smooth inclined plane of angle of inclination of 30° . After the collision the ball goes horizontally. The coefficient of restitution between the ball and the inclined plane is



17. A steel wire of length 60 cm and area of cross section 10^{-6}m^2 is joined with an aluminium wire of length 45 cm and area of cross section $3 \times 10^{-6} \text{m}^2$. The composite string is stretched by a tension of 80 N. Density of steel is 7800 kg m^{-3} and that of aluminium is 2600 kg m^{-3} . The minimum frequency of turning fork, which can produce standing wave in it with node at joint is



18. A long straight wire, carrying a current I is bent at its mid point to form an angle of 60° . AT a point P, distance R from the point of bending the magnetic field is



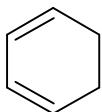
Chemistry**PART – II****SECTION – A**
(One Options Correct Type)

This section contains **06 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

19. The half-life of a chemical reaction is 20s, when the reaction starts with 0.4 M concentration of the reactant. The half-life remains the same when the reaction starts with 0.8 M concentration of the reactant. What is the unit of rate constant of the reaction?
- (A) $\text{mol L}^{-1}\text{s}^{-1}$
 (B) s^{-1}
 (C) $\text{mol}^{-1} \text{L}^2\text{s}^{-1}$
 (D) $\text{mol L}^2\text{s}^{-1}$
20. $2\text{NO}_2(\text{g}) \rightleftharpoons 2\text{NO}(\text{g}) + \text{O}_2(\text{g})$
 The correct statement regarding the above reaction is (Assume that only NO_2 is initially taken in the reaction container).
- (A) ' K_c ' changes by changing the concentrations of the species NO_2 , NO and O_2 .
 (B) $[\text{NO}] \propto [\text{O}_2]$
 (C) The reaction changes to backward direction by decreasing pressure at equilibrium
 (D) Inert gas has no effect at constant pressure
21. Which of the following solutions of complex compounds have maximum vapour pressure?
- (A) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$
 (B) $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$
 (C) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$
 (D) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$
22. Hydrolysis of which of the following compounds is an example of disproportionation reaction.
- (A) XeF_6
 (B) XeF_4
 (C) PCl_5
 (D) PCl_3
23. Which of the following compounds show π -back bonding?
- (A) AlCl_3
 (B) BF_3
 (C) SF_4
 (D) BH_3

24. Which of the following molecule in pure forms is unstable at room temperature?

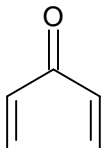
(A)



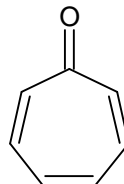
(B)



(C)



(D)



(One or More than one correct type)

This section contains **06** multiple choice questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.

25. Which of the following contain(s) unpaired electrons?

(A) Oxygen atom

(B) Dioxygen molecule

(C) Nitric oxide

(D) Dinitrogen molecule

26. Which of the following compounds can form silicates with SiO_2 ?

(A) NaOH

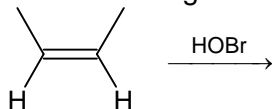
(B) Na_2CO_3

(C) NaCl

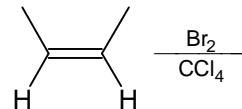
(D) NaNO_3

27. Which of the following reactions are stereospecific as well as stereoselective?

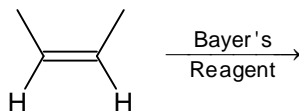
(A)



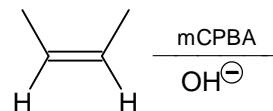
(B)



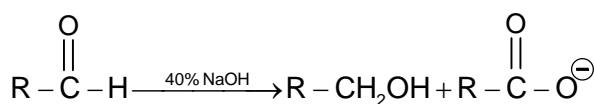
(C)



(D)

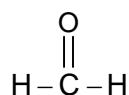


28.

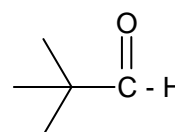


In the above case $\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$ can be

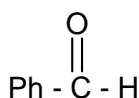
(A)



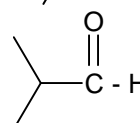
(B)



(C)



(D)



29. Choose incorrect statements:
- (A) AlCl_3 undergoes hydrolysis to form $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$
- (B) Amalgamated Al reacts with cold water to liberate H_2
- (C) The ash formed on burning magnesium in air fumes on wetting and exposing to HCl
- (D) B^{3+} ion can exist in aqueous solution in the hydrated form
30. Given $\Delta H_f^\circ(\text{C}_2\text{H}_6, \text{g}) = -85 \text{ kJ/mole}$,
 $\Delta H_f^\circ(\text{C}_3\text{H}_8, \text{g}) = -104 \text{ kJ/mole}$,
 $\Delta H_{\text{sub}}^\circ(\text{C}, \text{s}) = 718 \text{ kJ/mole}$ & B.E. of (H-H) = 436 kJ/mole.
 Then, in kJ/mole, the
- (A) C-C bond enthalpy is 218
- (B) C-H bond enthalpy is 414
- (C) C-C bond enthalpy is 345
- (D) C-H bond enthalpy is 448

SECTION – C
(Numerical Answer Type)

This section contains **06** questions. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. XXXXX.XX).

31. $\text{Cr}_2(\text{SO}_4)_3 \xrightarrow[\text{(ii) Na}_2\text{O}_2]{\text{(i) NaOH}} \text{Yellow solution}$
 If the oxidation number of chromium in the compound that provides yellow colour is +x, then 'x' is
32. The pH of 0.1 M aqueous solution of the sodium salt of a weak monobasic acid(HA) is 12.8. What is the $\text{p}K_a$ value of the acid?
33. Two moles of glycol is dissolved in 891.24 g of water. The solution is cooled to -4.8°C . How many gram of ice is formed in the cooling process? [K_f of water = $1.86 \text{ K kg mol}^{-1}$]
34. Calculate the boiling point of water at 700 mm pressure of Hg. The heat of vapourisation of water in 540 cal g.
35. Calculate the resonance energy of N_2O from the following data: (ΔH_f° of $\text{N}_2\text{O} = 82 \text{ kJ/mol}$)
 $\text{BE}_{\text{N}=\text{N}} = 946.2 \text{ kJ/mol}$
 $\text{BE}_{\text{N}=\text{N}} = 418 \text{ kJ/mol}$
 $\text{BE}_{\text{O}=\text{O}} = 497 \text{ kJ/mol}$
 $\text{BE}_{\text{N}=\text{O}} = 605.3 \text{ kJ/mol}$
36. Two buffers(X) and (Y) of pH 4.0 and 6.0 respectively are prepared from acid HA and the salt NaA. Both the buffers are 0.5 M in HA. What would be the pH of the solution obtained by mixing equal volume of two buffers?
 $K_{\text{HA}} = 1.0 \times 10^{-5}$
 $\log 5.05 = 0.7$

Mathematics

PART – III

SECTION – A (One Options Correct Type)

This section contains **06 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

37. 3 Tangents are drawn at random to a given circle in a plane. The probability that the circle is inscribed in the triangle formed by them is
- (A) $\frac{1}{2}$
 (B) $\frac{1}{3}$
 (C) $\frac{1}{4}$
 (D) $\frac{1}{8}$
38. Let $z_1 = a + ib$ and $z_2 = c + id$ be two complex numbers such that $|z_1| = |z_2| = 1$ and $\operatorname{Re}(z_1 \bar{z}_2) = 0$. If $a, b > 0$ and $c < 0$, then
- (A) $0 \leq |z_1 - \bar{z}_2| \leq 2$
 (B) $0 < |z_1 - \bar{z}_2| < \sqrt{2}$
 (C) $\sqrt{2} < |z_1 - \bar{z}_2| \leq 2$
 (D) $\sqrt{2} < |z_1 - \bar{z}_2| < 2$
39. If $\vec{r} \cdot \vec{a} = 0$, $\vec{r} \cdot \vec{b} = 1$ and $[\vec{r} \ \vec{a} \ \vec{b}] = 1$, $\vec{a} \cdot \vec{b} \neq 0$, $(\vec{a} \cdot \vec{b})^2 - |\vec{a}|^2 |\vec{b}|^2 = 1$ the value of \vec{r} in terms of \vec{a} and \vec{b} is
- (A) $\vec{a} \times (\vec{a} \times \vec{b}) + \vec{a} \times \vec{b}$
 (B) $\vec{a} \times (\vec{a} \times \vec{b}) + \frac{\vec{a} \times \vec{b}}{|\vec{a} \times \vec{b}|^2}$
 (C) $\vec{a} \times (\vec{b} \times \vec{a}) + \frac{\vec{b} \times \vec{a}}{|\vec{b} \times \vec{a}|^2}$
 (D) $\frac{\vec{a} \times (\vec{a} \times \vec{b})}{|\vec{a} \times (\vec{a} \times \vec{b})|} + \vec{a} \times \vec{b}$

40. The value of $\sum_{r=0}^{n-1} \left(\frac{n+1}{n} \right) \left(\frac{{}^n C_r \cdot {}^n C_{r+1}}{r+2} \right)$ is
- (A) $2^{n-1} C_{n+1}$
 (B) $2^n C_{n-1}$
 (C) $2^{n-1} C_{n-1}$
 (D) $2^n C_{n-2}$
41. If a pair of variable straight lines $x^2 + 4y^2 + \alpha xy = 0$ (where α is a real parameter) cut the ellipse $x^2 + 4y^2 = 4$ at two points A and B, then the locus of the point of intersection of tangent at A and B is
- (A) $x^2 - 4y^2 + 8xy = 0$
 (B) $(2x - y)(2x + y) = 0$
 (C) $x^2 - 4y^2 + 4xy = 0$
 (D) $(x - 2y)(x + 2y) = 0$
42. A variable circle is drawn to pass through (1, 0) and to touch the line $x + y = 0$. Let $S = 0$ represent the locus of the centre of the circle, then $S = 0$ represents
- (A) pair of parallel straight lines
 (B) circle
 (C) parabola
 (D) none of these

(One or More than one correct type)

This section contains **06** multiple choice questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four options is(are) correct.

43. Let $S = \{1, 2, 3, 4, \dots, n\}$ and f_n be the number of those subsets of S which do not contain consecutive elements of S , then
- (A) $f_n = \frac{n(n-1)(n-2)}{6}$
 (B) $f_n = 2f_{n-1}$
 (C) $f_n = f_{n-1} + f_{n-2}$
 (D) $f_4 = 8$
44. Let $f(x)$ be twice differentiable function such that $f''(x) < 0$ in $[0, 2]$. Then
- (A) $f(0) + f(2) = 2f(c), 0 < c < 2$
 (B) $f(0) + f(2) = 2f(1)$
 (C) $f(0) + f(2) > 2f(1)$
 (D) $f(0) + f(2) < 2f(1)$

45. In which of the following situations, it is possible to have a triangle ABC?
(All symbols used have usual meaning in a triangle.)
- (A) $(a + c - b)(a - c + b) = 4bc$
 (B) $b^2 \sin 2C + c^2 \sin 2B = ab$
 (C) $a = 3, b = 5, c = 7$ and $C = \frac{2\pi}{3}$
 (D) $\cos\left(\frac{A - C}{2}\right) = \cos\left(\frac{A + C}{2}\right)$
46. Which of the following statement(s) is (are) correct?
- (A) If $f(x)$ is differentiable $\forall x \in [0, 1]$, then $f'(x)$ must be bounded in $[0, 1]$
 (B) There exist a bijective function $f : [0, 1] \rightarrow [0, 1]$ which is not continuous
 (C) Let $f : [-1, 2] \rightarrow \mathbb{R}$ be defined as $f(x) = x^2 - \cos \pi x + 4$, then $f(c) = 2\pi$ for some $c \in (-1, 2)$.
 (D) If $f(x) = 3 + x + e^x$, then $(f^{-1})'(4)$ is equal to $\frac{1}{2}$
47. Equation of plane passing through the line $\frac{x-1}{1} = \frac{y-2}{1} = \frac{z-2}{-2}$ and making an angle of 30° with the plane $x + y + z = 5$ is.
- (A) $(x - y - 1) + (2 - \sqrt{2})(2y + z - 6) = 0$
 (B) $(x - y + 1) + (2 + \sqrt{2})(2y + z - 6) = 0$
 (C) $(x - y - 1) + (2 + \sqrt{2})(2y + z - 6) = 0$
 (D) $(x - y + 1) + (2 - \sqrt{2})(2y + z - 6) = 0$
48. The volume of the parallelepiped whose coterminous edges are represented by the vectors $2\vec{b} \times \vec{c}$, $3\vec{c} \times \vec{a}$ and $4\vec{a} \times \vec{b}$, where $\vec{a} = (1 + \sin \theta)\hat{i} + \cos \theta \hat{j} + \sin 2\theta \hat{k}$,
 $\vec{b} = \sin\left(\theta + \frac{2\pi}{3}\right)\hat{i} + \cos\left(\theta + \frac{2\pi}{3}\right)\hat{j} + \sin\left(2\theta + \frac{4\pi}{3}\right)\hat{k}$,
 $\vec{c} = \sin\left(\theta - \frac{2\pi}{3}\right)\hat{i} + \cos\left(\theta - \frac{2\pi}{3}\right)\hat{j} + \sin\left(2\theta - \frac{4\pi}{3}\right)\hat{k}$ is 18 cubic units, then the value of θ ,
 in the interval $\left(0, \frac{\pi}{2}\right)$, is are
- (A) $\frac{\pi}{9}$
 (B) $\frac{2\pi}{9}$
 (C) $\frac{\pi}{3}$
 (D) $\frac{4\pi}{3}$

SECTION – C
(Numerical Answer Type)

This section contains **06** questions. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. XXXXX.XX).

49. A bag contain 4 tickets numbered 1, 2, 3, 4 and another bag contains 6 tickets numbered 2, 4, 6, 7, 8, 9. One bag is chosen and a ticket is drawn. The probability that the ticket bears the number 4, is equal to $\frac{A}{B}$ (where A and B are co prime) then the value of $\frac{100A}{B}$ is

50. If $f : \mathbb{R} \rightarrow \mathbb{R}$ is a function such that $f(x) = x^3 + x^2 f'(1) + x f''(2) + f'''(3)$ for all $x \in \mathbb{R}$, then $\frac{f(1) - f(2)}{4}$ is

51. $\left(\frac{\sum_{r=1}^{30} (r^2 - 30r + 450)}{4} \right)$ is _____

52. Let $f(x) = ax^4 + bx^2 + 3x + 7$ and $f(-4) = 2286$ and $f(4) = N$. If K be the number of ways in which the number N can be resolved as a product of two divisors which are relatively prime then $\frac{K-7}{4}$

53. Let $a_r = 1 + 2 + 3 + \dots + r$ for $r \in \mathbb{N}$. If

$$S = \frac{1}{\binom{1}{a_1}} + \frac{2}{\binom{1}{a_1} + \binom{1}{a_2}} + \frac{3}{\binom{1}{a_1} + \binom{1}{a_2} + \binom{1}{a_3}} + \dots + \frac{30}{\binom{1}{a_1} + \binom{1}{a_2} + \dots + \binom{1}{a_{30}}}, \text{ then}$$

find the value of S.

54. Let $a, b, c \in \mathbb{R}$ and $a^2 + b^2 + c^2 = 1$, then the maximum value of $|a-b| + |b-c| + |c-a|$ is?