Maximum Marks : 300

SATISH SCIENCE ACADEMY DHANORI PUNE - 411015

Paper 4 ENTRANCE EXAM - JEE MAIN

Time Allowed: 3 hours

General Instructions:

- All questions are compulsory.
- There are three parts and each part carries 25 questions where the first 20 questions are MCQs and the next 5 questions are numerical.
- You will get 4 marks for each correct response and 1 mark will be deducted for an incorrect answer.

PHYSICS

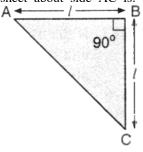
- 1) If the time period t of the oscillation of a drop of liquid of density d, radius r, vibrating under surface tension s is given by the formula $t = \sqrt{r^{2b}s^c d^{a/2}}$. It is observed that the time period is directly proportional to $\sqrt{\frac{d}{s}}$. The that the unit percent value of b should therefore be: [4] b) $\frac{3}{2}$ a) $\frac{2}{3}$ c) $\frac{3}{4}$ d) $\sqrt{3}$
- 2) A body falls from a height h = 200 m. The ratio of distance travelled in each 2 s, during t = 0 to t = 6s of the journey is: [4]
 - a) 1 : 4 : 9 b) 1 : 3 : 5 d) 1 : 2 : 4 c) 1 : 2 : 3
- 3) A shell is fired from a fixed artillery gun with an initial speed u such that it hits the target on the ground at a distance R from it. If t_1 and t_2 are the values of the time taken by it to hit the target in two possible ways, the product t_1t_2 is: [4]
 - \underline{R} b) $\frac{R}{2g}$ d) $\frac{2R}{g}$ a) $\frac{g}{R}{4g}$ c)
- 4) Two forces with equal magnitudes F act on a body and the magnitude of the resultant force is F/3. The angle between the two forces is [4]
 - a) $\cos^{-1}(-\frac{1}{3})$ b) $\cos^{-1}(\frac{8}{9})$ c) $\cos^{-1} \left(\frac{2}{3}\right)$ d) $\cos^{-1} \left(-\frac{17}{18}\right)$
- 5) The speed v reached by a car of mass m, driven with constant power P, is given by: [4]

a)
$$v = \frac{3xP}{m}$$

b) $v = (\frac{3xP}{m})^2$
c) $v = (\frac{3xP}{m})^{1/3}$
d) $v = (\frac{3xP}{m})^{1/2}$

(

6) Figure shows a thin metallic triangular sheet ABC. The mass of the sheet is M. The moment of inertia of the sheet about side AC is:



[4]	2		
a)	$\frac{Ml^2}{6}$	b)	$\frac{Ml^2}{12}$
c)	$\frac{\frac{Ml^2}{6}}{\frac{Ml^2}{18}}$	d)	$\frac{\frac{Ml^2}{12}}{\frac{Ml^2}{4}}$

- 7) A hydrometer takes the form of a glass cylindrical tube soldered at both ends having a length 20 cm and an external diameter D = 1.2 cm. The thickness of the wall is h = 1 mm. The density of glass is 2.6 g/cm³. The lower part of the tube contains 1 cc of mercury. The minimum density that can be measured with the aid of this hydrometer is: [4]
 - a) 1.2 g/cc b) 2 g/cc c) 2.6 g/cc d) 1.5 g/cc
- 8) If two metallic plates of equal thickness and thermal conductivities K1 and K2 are put together face to face and a common plate is constructed, then the equivalent thermal conductivity of this plate will be: [4]

a)
$$\frac{2K_1K_2}{K_1+K_2}$$

b) $\frac{(K_1^2+K_2^2)^{3/2}}{K_1K_2}$
c) $\frac{(K_1^2+K_2^2)^{3/2}}{2K_1K_2}$
d) $\frac{K_1K_2}{K_1+K_2}$

- 9) The internal energy of an ideal gas depends on: [4] Pressure b) Size of the molecule a) c) Temperature d) Volume
- 10) Two springs of constants k_1 and k_2 have equal highest velocities, when executing SHM. Then, the ratio of their amplitudes (given their masses are equal) will be: [4]
 - a) $\left(\frac{k_2}{k_1}\right)^{1/2}$ b) $\frac{k_2}{k_1}$ c) $\frac{k_1}{k_2}$ d) $\left(\frac{k_1}{k_2}\right)^{1/2}$
- 11) The work of electric field done during the displacement of a negatively charged particle towards a fixed positively charged particle is 9 J. As a result the distance between the charges has been decreased by half. What work is done by the electric field over the first half of this distance? [4]
 - a) 6 J b) 3 J c) 1.5 J d) 9 J
- 12) 10 mA current can pass through a galvanometer of resistance 25Ω . What resistance in series should be connected through it, so that it is converted into a voltmeter of 100 volt? [4]

a)	0.975Ω	b)	99.75Ω
c)	9975Ω	d)	975Ω

13) A current of 2 ampere produces a deflection of 30° in a tangent galvanometer. A deflection of 60° will be produced in it by a current of: [4]
a) 3 amp
b) 1 amp

<i>a)</i>	5 amp	U)	1 amp
c)	6 amp	d)	4 amp

14) Flux ϕ (in weber) in a closed circuit of resistance 10 ohm varies with time t (in sec) according to the equation: $\phi = 6t^2 - 5t + 1$

What is the magnitude of the induced current at t = 0.25 sec? [4]

- a) 1.2 A b) 0.2 A c) 0.6 A d) 0.8 A
- 15) The output of a step down transformer is measured to be 24 V when connected to 12 watt light bulb. The value of the peak current is: [4]
 a) 2 A

a)	2 A			D)	$\sqrt{2} P$	1
c)	$\frac{1}{\sqrt{2}}$	А		d)	$2\sqrt{2}$	А

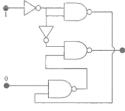
- 16) Radio wave diffracts around building although light waves do not. The reason is that radio waves: [4]
 - a) Are not electromagnetic waves
 - b) Carry news
 - c) Travel with speed larger than C
 - d) Have much larger wavelength than light
- 17) Given that a photon of light of wavelength 10,000 angstrom has an energy equal to 1.23 eV. When light of wavelength 5000 angstrom and intensity I_0 falls on a photoelectric cell, the saturation current is 0.40×10 6 ampere and the stopping potential is 1.36 volt; then the work function is: [4]

a)	1.36 eV	b)	2.47 eV
c)	0.43 eV	d)	1.10 eV

18) Electrons are bombarded to excite hydrogen atom and six spectral lines are observed. If E_g is the ground state energy of hydrogen, the minimum energy the bombarding electron should possess is : [4]

a)	$\frac{48E_g}{49}$	b)	$\frac{15E_g}{16}$
c)	$\frac{\frac{49}{35E_g}}{36}$	d)	$\frac{\frac{16}{8E_g}}{9}$

- Fission of nuclei is possible because the binding energy per nucleon in them: [4]
 - a) Decreases with mass number at high mass numbers
 - b) Increases with mass number at high mass numbers
 - c) Decreases with mass number at low mass numbers
 - d) Increases with mass number at low mass numbers
- 20) In the given circuit, the value of Y is:



[4]

- a) Will not execute
- b) 1

c) Toggles between 0 and 1 d) 0

21) If 20 J of work has to be done to move an electric charge of 4 C from a point, where potential is 10 V to another point, where potential is V volt, find the value of V: [4]

- 22) The initial velocity v_i required to project a body vertically upward from the surface of the earth to reach a height of 10 R, where R is the radius of the earth, may be described in terms of escape velocity v such that $v_i = \sqrt{\frac{x}{y}} \times v_e$. The value of x will be _____. [4]
- 23) A ray of light is incident from air on a glass plate having thickness $\sqrt{3}$ cm and refractive index $\sqrt{2}$. The angle of incidence of a ray is equal to the critical angle for glass air interface. The lateral displacement of the ray when it passes through the plate is _____ × 10⁻² cm. (given sin 15° = 0.26) [4]
- 24) When a resistance of 5Ω is shunted with a moving coil galvanometer, it shows a full scale deflection for a current of 250 mA, however when 1050 Ω resistance is connected with it in series, it gives full scale deflection for 25 volt. The resistance of galvanometer is ____ Ω . [4]
- 25) In a thermodynamic process, pressure of a fixed mass of a gas is changed in such a manner that the gas releases 20 J of heat and 8 J of work is done on the gas. If initial internal energy of the gas was 30 J, the final internal energy will be_____J. [4]

CHEMISTRY

- 26) The total energy of the electron in the hydrogen atom in the ground state is 13.6 eV. The KE of this electron is: [4]
 - a) 13.6 eV b) 13.6eV c) 6.8 eV d) Zero
- 27) Which of the following order is wrong? [4]
 - a) $NH_3 < PH_3 < AsH_3$ acidic
 - b) $Al_2O_3 < MgO < Na_2O < K_2O$ basic
 - c) Li < Be < B < C 1st IP
 - d) $Li^+ < Na^+ < K^+ < Cs^+$ ionic radius
- 28) Which of the following two are isostructural? [4]
 - a) NH_3 , BF_3
 - b) XeF_2, IF_2^-
 - c) PCl₅, ICl₅
 - d) CO_3^{2-}, SO_3^{2-}
- 29) The direct conversion of A to B is difficult, hence it is carried out by the following shown path
 - $\begin{array}{ccc} C & \longrightarrow D \\ A & B \end{array}$ Given that $\Delta S_{(A \to C)} = 50 \text{ eu}$ $\Delta S_{(C \to D)} = 30 \text{ eu}$ $\Delta S_{(D \to B)} = -20 \text{ eu}$ where, eu is entrophy unit Then, $\Delta S_{(A \to B)}$ is [4] a) - 100 eu b) +100 eu
 - c) +60 eu d) -60 eu
- 30) The K_{sp} of Ag_2CrO_4 , AgCl, AgBr and Agl are respectively, 1.1×10^{-12} , 1.8×10^{-10} , 5.0×10^{-13} and 8.3×10^{-17} . Which one of the following salts will precipitate last if AgNO₃ solution is added to the solution containing equal moles of NaCl, NaBr, Nal and Na₂CrO₄? [4]
 - a) AgCl b) Agl
 - c) AgBr d) Ag_2CrO_4
- 31) How many mole of electrons are involved in the reduction of one mole of MnO_4^- ion in alkaline medium to MnO_3^- : [4]

32) Ca +C₂ \longrightarrow CaC₂ $\xrightarrow{N_2}$ A Compound (A) is used as a/an: [4] a) Dehydrating agent b) Fertilizer c) Oxidising agent d) Reducing agent 33) Choose the correct name for compound given below: [4] a) (4E) - 5 - Bromohex - 2 - en - 4 - yne b) (2E) - 2 - Bromohex - 4 - yn - 2 - ene c) (4E) - 5 - Bromohex - 4 - en - 2 - yne d) (2E) - 2 - Bromohex - 2 - en - 4 - yne 34) The following two compounds are: 0) [4] a) Identical b) Conformational isomers c) Geometrical isomers d) Structural isomers 35) A 5% solution (by mass) of cane sugar in water has freezing point of 271 K and freezing point of pure water is 273.15 K. The freezing point of a 5% solution (by mass) of glucose in water is [4] a) 271 K 269.07 K b) d) 277.23 K c) 273.15 K 36) A graph of vapour pressure and temperature for three different liquids X, Y, and Z is shown below: 800 ng 200 t mm) 400 Vapour J 333 353 293 313 Temp The following inferences are made: i. X has higher intermolecular interactions compared to

- Y.
- ii. Y has lower intermolecular interactions compared to Υ.
- iii. Z has lower intermolecular interactions compared to Υ.
- The correct inference(s) is/are: [4]

- c) Option (ii) d) Option (iii)
- 37) In the electrolysis of aqueous sodium chloride solution which of the half cell reaction will occur at the anode? [4]

a)
$$2H_2O(1) \longrightarrow O_2(g) + 4H^+(aq) + 4e^-$$
; $E_{cell}^{\ominus} = 1.23$
V
b) $H^+(aq) + e^- \longrightarrow \frac{1}{2}$ $H_2(g)$; $E_{cell}^{\ominus} = 0.00$ V
c) $Na^+(aq) + e^- \longrightarrow Na(s)$; $E_{cell}^{\ominus} = -2.71$ V
d) $Cl^-(aq) \longrightarrow \frac{1}{2}$ $Cl_2(g) + e^-$; $E_{cell}^{\ominus} = 1.36$ V

- 38) In a first order reaction, the concentration of reactant decreases from 800 mol/dm³ to 50 mol /dm³ in 2 \times 10⁴ sec. The rate constant of reaction in \sec^{-1} is: [4] b) 3.45×10^{-1} a) 1.386×10^{-4} c) 2×10^{-4} d) 2×10^4
- 39) Select the correct statement about $[CoF_6]^3$:

i. It is labile complex

- ii. It is low spin complex
- iii. Spin only magnetic moment of complex is 3.87 B.M. iv. All of the above
- [4]

Only (D) b) Only (A) a) c) Only (B) d) Only (C)

- 40) Select CORRECT order of dissociation constant (Ka) in aqueous solution at 298K: [4]
 - a) $H_2O > H_2Te > H_2Se > H_2S$ b) $H_2Te > H_2O > H_2Se > H_2S$ c) $H_2O > H_2S > H_2Se > H_2Te$ d) $H_2Te > H_2Se > H_2S > H_2O$
- 41) Which of the following statement is correct for complex $[Cr(NH_3)(CN)_4(NO)]^2$ (given that n = 1)? [4]
 - a) It is d²sp³ hybridized.
 - b) It is heteroleptic complex and its aqueous solution is coloured.
 - c) All of these
 - d) The chromium is in +1 oxidation state.
- 42) The alkane that will NOT be formed in Wurtz synthesis from isopropyl bromide and ethyl bromide together or separately with sodium in ether is ____. [4]

c) Isopentane d) N - butane
$$_{CH_3}$$

43)
$$H_3C - C_{CH_3} = CH_3 = CH_2 \xrightarrow{X} H_3C - C_{H_3} = CH_2 \xrightarrow{X} H_3C - C_{CH_3} = C_0HH - CH_3$$
. X can be: [4]
a) All of these b) H_3O^+
c) $Hg(OAc)_2/NaBH_4$, d) BH_3/THF , $H_2O_2/OH = NaOH$

44) Which one of the following is an example of Rosenmund's reduction? [4]

a) CH₃COCl
$$\xrightarrow{H_2}$$
 CH₃CHO + HCl
b) CH₃C \equiv N $\xrightarrow{(i) SnCl_2 - HCl}$ CH₃CHO + NH₄Cl
c) CH₃COCl $\xrightarrow{LiAIH_4}$ CH₃CH₂OH + HCl
d) CH₃COOH $\xrightarrow{LiAIH_4}$ CH₃CH₂OH + H₂O

45) Consider the following three amines,

i.
$$CH_3CH_2 - NH_2$$

ii. $CH_2 = CH - \ddot{N}H_2$
iii. \bigcirc $\neg\ddot{N}H_2$

Arrange C - N bond length of these compounds in decreasing order: [4]

a)
$$I > iii > ii$$

b) $I > iii > iii$
c) $Ii > iii > i$
d) $Iii > ii > i$

- 46) The work function of sodium metal is 4.41 \times 10 $^{-19}$ J. If photons of wavelength 300 nm are incident on the metal, the kinetic energy of the ejected electrons will be (h = 6.63×10^{-34} Js; c = 3×10^8 m/s) ____ × 10 - ²¹J. [4]
- 47) Consider the following reaction approaching equilibrium at 27°C and 1 atm pressure

$$A + B \underset{K_r=10^2}{\overset{K_{f=10^3}}{\rightleftharpoons}} C + D$$

The standard Gibb's energy change $(\Delta_r G^\circ)$ at 27°C is (-) _____ kJ mol⁻¹. (Nearest integer) (Given: $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$ and In 10 = 2.3) [4]

48) The total number of isoelectronic species from the given set is _____.

 O^{2} - , F - , Al, Mg²⁺, Na⁺, O⁺, Mg, Al³⁺, F [4]

- 49) The percentage composition of carbon by mole in methane is _____ %. [4]
- 50) Difference between total number of lone pairs and total number of bonds in Lewis dot structure of NO_3^- is: [4]

MATHEMATICS

51) The sum of all possible values of n where $n \in N$, x > 0 and $10 < n \le 100$ such that the equation $[2x^2] + x - n = 0$ has a solution, is equal to: [Note : [x]denotes largest integer less than or equal to

 x.][4]

 a) 210
 b) 190

 c) 175
 d) 150

52)	$\sum_{p=1}^{32}$	-1 (3p -	+ 2)	$\left[\sum_{q=1}^{10} \left(\sin \frac{2q\pi}{11} - i \cos \frac{2q\pi}{11}\right)\right]^P$	= [4]
		16(1 -			
	c)	48(1 -	i)	d) 32(1 - i)	

- 53) In how many ways can the letters ABBCCDDDEEF be arranged such that D's are never together? [4]a) 423360b) 831600
 - c) 362880 d) 40320
- 54) The sum of the series $\frac{{}^{101}C_1}{{}^{101}C_0} + \frac{2{}^{.101}C_2}{{}^{101}C_1} + \frac{3{}^{.101}C_3}{{}^{101}C_2} + \frac{3{}^{.101}C_3}{{}^{101}C_2} + \frac{10{}^{.101}C_3}{{}^{101}C_{100}}$ equals: [4] a) 5051 b) 4950
 - c) 5050 d) 5151
- 55) Let a, b, c > 1, a³, b³ and c³ be in A.P., and log_ab, log_ca and log_bc be in G.P. If the sum of first 20 terms of an A.P., whose first term is $\frac{a+4b+c}{3}$ and the common difference is $\frac{a-8b+c}{10}$ is - 444, then abc is equal to [4] a) 216 b) $\frac{125}{8}$ c) 343 d) $\frac{343}{8}$
- 56) If $y(x) = x^x$, x > 0, then y" (2) 2y' (2) is equal to: [4] a) $4(\log 2)^2 - 2$ b) $4(\log_2 2)^2 + 2$

<i>a)</i>	$4(\log_e 2) - 2$	U)	$4(\log_{e^2}) + 2$
c)	$8 \log_{e} 2 - 2$	d)	$4 \log_{e} 2 + 2$

57) The area (in sq. units) of the largest rectangle ABCD whose vertices A and B lie on the x - axis and vertices C and D lie on the parabola, $y = x^2 - 1$ below the x - axis, is: [4]

a)	$\frac{1}{3\sqrt{3}}$		b)	
c)	$\frac{\frac{1}{3\sqrt{3}}}{\frac{4}{3\sqrt{3}}}$	_	 d)	$\frac{2}{3\sqrt{3}}$

- 58) The integral $\int \frac{3x^{13}+2x^{11}}{(2x^4+3x^2+1)^4} dx$ is equal to (where C is a constant of integration) [4]
 - a) $\frac{x^4}{6(2x^4+3x^2+1)^3} + C$ b) $\frac{x^{12}}{6(2x^4+3x^2+1)^3} + C$ c) $\frac{x^4}{(2x^4+3x^2+1)^3} + C$ d) $\frac{x^{12}}{(2x^4+3x^2+1)^3} + C$
- 59) Two vertices of a triangle are (0, 2) and (4, 3). If its orthocentre is at the origin, then its third vertex lies in which quadrant? [4]a) Firstb) Second

<i>u</i>)	1 1100	0)	beeona
c)	Fourth	d)	Third

60) $Ax^2 + 2y^2 + 2bxy + 2x - y + c = 0$ represents a circle through the origin, if [4]

a)	A = 1, b = 2, c = 0	b) $A = 0, b = 0, c = 2$
c)	A = 2, b = 2, c = 0	d) $A = 2, b = 0, c = 0$

61) A parabola with latus rectum 4a slides such that it touches the positive coordinate axes. Then the locus of its focus is: [4]

a)
$$\frac{1}{x^2} + \frac{1}{y^2} = \frac{1}{2a^2}$$
, $x > 0$, $y > 0$
b) $\frac{1}{x^2} + \frac{1}{y^2} = \frac{1}{a^2}$, $x > 0$, $y > 0$
c) $\frac{1}{x^2} + \frac{1}{y^2} = \frac{4}{a^2}$, $x > 0$, $y > 0$
d) $\frac{1}{x^2} + \frac{1}{y^2} = \frac{2}{a^2}$, $x > 0$, $y > 0$

62) If y = y(x) is the solution of the differential equation $\frac{dy}{dx} = (\tan x - y) \sec^2 x, x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$, such that y(0) = 0, then $y\left(-\frac{\pi}{4}\right)$ is equal to [4] a) $\frac{1}{e} - 2$ b) $2 + \frac{1}{e}$ c) $\frac{1}{2} - e$ d) E - 2

- 63) Let S be the set of all values of λ , for which the shortest distance between the lines $\frac{x-\lambda}{0} = \frac{y-3}{4} = \frac{z+6}{1}$ and $\frac{x+\lambda}{3} = \frac{y}{-4} = \frac{z-6}{0}$ is 13. The $8\left|\sum_{\lambda \in S} \lambda\right|$ is equals to [4] a) 306 b) 308 c) 302 d) 304
- 64) The set of all the values of c so that the vectors $cx\hat{i} 6\hat{j} + 3\hat{k}$ and $x\hat{i} + 2\hat{j} + 2cx\hat{k}$ make obtuse angle between them for all real x, is [4]
 - a) $\left(-\frac{4}{3},0\right)$ b) $\left(0,\frac{4}{3}\right)$ c) $\left(-\infty,\frac{4}{3}\right)$ d) $\left(-\frac{4}{3},\infty\right)$
- 65) The mean deviation from the mean of the A. P. a, a + d, a + 2d, ... a, a + 2nd is [4]
 - a) $\frac{n(n+1)d}{2n+1}$ b) N(n + 1)d c) $\frac{n(n+1)d}{2n}$ d) $\frac{n(n-1)d}{2n+1}$
- 66) Two dice A and B are rolled. Let the numbers obtained on A and B be α and β respectively. If the variance of $\alpha - \beta$ is $\frac{p}{q}$, where p and q are co - prime, then the sum of q the positive divisors of p is equal to [4] a) 72 b) 36 c) 31 d) 48
- 67) If $\tan \alpha = \frac{1}{7}$ and $\sin \beta = \frac{1}{\sqrt{10}}$ where, $\alpha, \beta \in (0, \frac{\pi}{2})$, then $\tan (\alpha + 2\beta)$ is : [4] a) 3 b) 0 c) 1 d) 2
- 68) The product of the lengths of perpendiculars drawn from any point on the hyperbola x² 2y² 2 = 0 to its asymptotes is [4]
 a) ¹/₂
 b) ³/₂
 c) ²/₃
 d) 2
- 69) Considering only the principal values of inverse functions, the set A = $x \ge 0$: $\tan^{-1}(2x) + \tan^{-1}(3x) = \frac{\pi}{4}$ [4]
 - a) Contains two elements
 - b) Contains more than two elements
 - c) Is an empty set
 - d) Is a singleton

70) If the system of equations x + 2y + 3z = 3; 4x + 3y - 4z = 4 $8x + 4y - \lambda z = 9 + \mu$ has infinitely many solutions, then the ordered pair (λ , μ) is equal to [4] a) $\left(\frac{-72}{5}, \frac{21}{5}\right)$

b)
$$\left(\frac{72}{5}, \frac{-21}{5}\right)$$

c) $\left(\frac{72}{5}, \frac{21}{5}\right)$
d) $\left(\frac{-72}{5}, \frac{-21}{5}\right)$
71) Let $f(x) = \begin{vmatrix} \sin^2 x & -2 + \cos^2 x & \cos 2x \\ 2 + \sin^2 x & \cos^2 x & \cos 2x \\ \sin^2 x & \cos^2 x & 1 + \cos 2x \end{vmatrix}$, $x \in [0, \pi]$ Then the maximum value of $f(x)$ is equal to _____.
[4]
72) Let $f(x) = \lim_{n \to \infty} \underbrace{\frac{3^n \sin(\sin \dots \sin(x))}{(x + \sin x)(\sqrt{2}\cos x + 2)^n + 2^n \cos x}}_{3^n + \sin x)(\sqrt{2}\cos x + 2)^n}$

, if $1 = \lim_{x \to \frac{\pi^+}{4}} f(x)$ and $m = \lim_{x \to \frac{\pi^-}{4}} f(x)$ then find the value of $l^2 + m^2$. [4]

- 73) Let the vectors $\vec{a}, \vec{b}, \vec{c}$ be such that $|\vec{a}| = 2$, $|\vec{b}| = 4$ and $|\vec{c}| = 4$. If the projection of \vec{b} on \vec{a} is equal to the projection of \vec{c} on \vec{a} and \vec{b} is perpendicular to \vec{c} , then the value of $|\vec{a} + \vec{b} - \vec{c}|$ is _____. [4]
- then the value of $|\vec{a} + \vec{b} \vec{c}|$ is _____. [4] 74) If $\frac{\sqrt{2} \sin \alpha}{\sqrt{1 + \cos 2\alpha}} = \frac{1}{7}$ and $\sqrt{\frac{1 - \cos 2\beta}{2}} = \frac{1}{\sqrt{10}}$, $\alpha, \beta \in (0, \frac{\pi}{2})$, then tan $(\alpha + 2\beta)$ is equal to _____. [4]
- 75) Let a, b and c be three real numbers satisfying

$$\begin{bmatrix} a & b & c \end{bmatrix} \begin{bmatrix} 1 & 9 & 7 \\ 8 & 2 & 7 \\ 7 & 3 & 7 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 \end{bmatrix} \dots (i)$$

Let b = 6, with a and c satisfying Eq. (i). If α and β are the roots of the quadratic equation $ax^2 - bx + c = 0$, then $\sum_{n=0}^{\infty} \left(\frac{1}{\alpha} + \frac{1}{\beta}\right)^n$ is equal to _____. [4]