Sri Chaitanya IIT Academy.,India.

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A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

SEC: Sr.S60, ELITE ,TARGET & LIIT	**JEE-MAIN**	**Date: 25-05-2022**
Time: 09.00Am to 12.00Pm	**GTM-15**	**Max. Marks: 300**

IMPORTANT INSTRUCTION:

1. Immediately fill in the Admission number on this page of the Test Booklet with **Blue/Black** Ball Point **Pen** only.
2. The candidates should not write their Admission Number anywhere (except in the specified space) on the Test Booklet/ Answer Sheet.
3. The test is of **3 hours** duration.
4. The Test Booklet consists of 90 questions. The maximum marks are **300.**
5. There are **three** parts in the question paper 1,2,3 consisting of **Physics, Chemistry** and **Mathematics** having **30 questions** in each subject and subject having **two sections.**
   (I) Section –I contains 20 **multiple choice** questions with only one correct option.
   Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases.
   (II) Section-II contains 10 **Numerical Value Type** questions. Attempt any 5 questions only, if more than 5 questions attempted, First 5 attempted questions will be considered.
   - The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**

   To cancel any attempted question bubble on the question number box.
   For example: To cancel attempted question 21. Bubble on 21 as shown below

Question Answered for Marking **Question Cancelled for Marking**

Marking scheme: +4 for correct answer, 0 if **not attempt** and **-1** in all other cases.

6. Use **Blue / Black Point Pen only** for writing particulars / marking responses on the Answer Sheet. **Use of pencil is strictly prohibited.**
7. No candidate is allowed to carry any textual material, printed or written, bits of papers, mobile phone any electron device etc, except the Identity Card inside the examination hall.
8. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
9. On completion of the test, the candidate must hand over the Answer Sheet to the invigilator on duty in the Hall. **However, the candidate are allowed to take away this Test Booklet with them.**
10. **Do not fold of make any stray marks on the Answer Sheet**

Name of the Candidate (in Capital): _____

Admission Number: | | | | | | | | | |

Candidate's Signature:_____ **Invigilator's Signature:** _____

25-05-22_Sr.S60, ELITE ,TARGET & LIIT_ Jee-Main_GTM-15_Test Syllabus

PHYSICS : 1st YEAR SYLLABUS
CHEMISTRY : 1st YEAR SYLLABUS
MATHEMATICS: 1st YEAR SYLLABUS

PHYSICS

Max Marks: 100

(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

1. The least count of the main scale of a screw gauge is 1mm. The minimum number of divisions on its circular scale required to measure $5\mu m$ diameter of a wire is

1) 50 **2)** 200 **3)** 500 **4)** 100

2. The pitch and the number of divisions, on the circular scale for a given screw gauge are 0.5 mm and 100, respectively. When the screw gauge is fully tightened without any object, the zero of its circular scale lies 3 divisions below the mean line. The readings of the main scale and the circular scale for a thin sheet are 5.5mm and 48 respectively, the thickness of this sheet is

1) 5.950 mm **2)** 5.725 mm **3)** 5.752mm **4)** 5.755mm

3. A person measures the depth of a well by measuring the time interval between dropping a stone and receiving the sound of impact with the bottom of the well. The error in his measurement of time is $=0.01s$ and he measures the depth of the well to be $L=20\,\text{m}$. Take the acceleration due to gravity $g=10\text{ms}^{-2}$ and the velocity of sound is 300ms^{-1}. Then the fractional error in the measurement, $\frac{dL}{L}$, is closest to

1) 1% **2)** 5% **3)** 3% **4)** 0.2%

4. The trajectory of a projectile near the surface of the earth is given as $y=2x-9x^2$. If it were launched at an angle θ_0 with speed v_0, then (Take, $g=10\text{ms}^{-2}$)

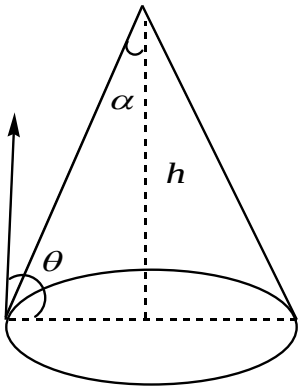
1) $\theta_0=\sin^{-1}\left(\frac{1}{\sqrt{5}}\right)$ and $v_0=\frac{5}{3}ms^{-1}$ **2)** $\theta_0=\cos^{-1}\left(\frac{1}{\sqrt{5}}\right)$ and $v_0=\frac{3}{5}ms^{-1}$

3) $\theta_0=\cos^{-1}\left(\frac{1}{\sqrt{5}}\right)$ and $v_0=\frac{5}{3}ms^{-1}$ **4)** $\theta_0=\cos^{-1}\left(\frac{2}{\sqrt{5}}\right)$ and $v_0=\frac{3}{5}ms^{-1}$

5. A body is projected at $t=0$ with a velocity $10ms^{-1}$ at an angle of 60^0 with the horizontal. The radius of curvature of its trajectory at $t=1s$ is R. Neglecting air resistance and taking acceleration due to gravity $g=10ms^{-2}$, the value of R is (nearly) (take $\cos 15^0=0.97$)

1) 10.3 m **2)** 2.8m **3)** 5.1 m **4)** 2.5 m

6. A particle is projected from the base of a cone with speed u at an angle of projection θ. The particle grazes the vertex of the cone and strikes again at the base. If α is half angle of cone and h is height, then find the value of $\left[\frac{u^2}{gh}-\frac{1}{2}\tan^2\alpha\right]$.

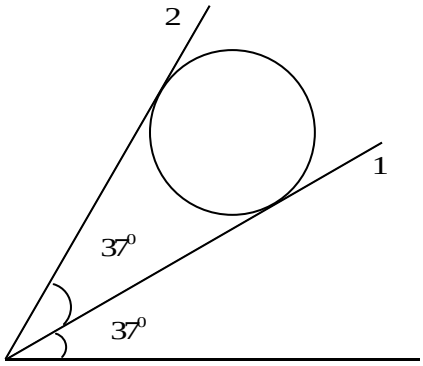


1) 1 **2)** 2 **3)** 3 **4)** 4

7. A particle is thrown from the origin, at an angle $\theta(0<\theta<90^0)$ such that it just crosses a wall of height 9m. Wall is at $x=12m.$ Speed of projection is $n\sqrt{30}\frac{m}{s}$ and particle strikes the ground at $x=48\text{m}.$ Value of n is $(g=10m/s^2)$

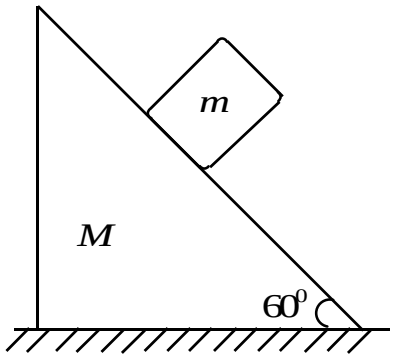
1) 1 **2)** 2 **3)** 3 **4)** 4

8. A sphere of mass m is held between two smooth inclined walls. For $\sin 37^0=3/5,$ the normal reaction of the wall (2) is equal to



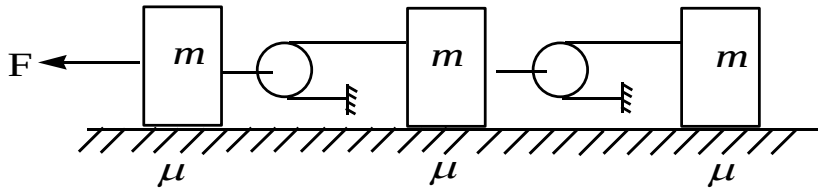
1) mg **2)** $mg\sin 74^0$ **3)** $mg\cos 74^0$ **4)** g

9. In the arrangement shown in figure, wedge of mass M moves towards left with an acceleration a. All surfaces are smooth. The acceleration of mass m relative to wedge is



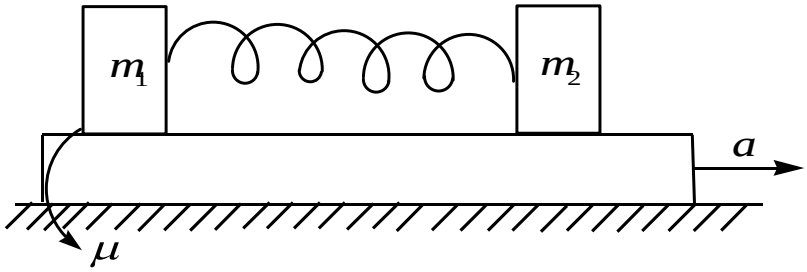
1) a/2 **2)** $\frac{2Ma}{m}$ **3)** $\frac{2(M+m)a}{m}$ **4)** $\frac{(M+m)a}{m}$

10. On a table, three blocks (including the first block) are placed as shown in the figure. Mass each block is *m* and coefficient of friction for each block is μ. A force F is applied on the block so as to move the system. The minimum value of F should be



1) $8\mu mg$ **2)** $9\mu mg$ **3)** $7\mu mg$ **4)** $5\mu mg$

11. Two blocks of masses m_1 and m_2 are connected with a massless unstretched spring and placed over a plank moving with an acceleration 'a' as shown in figure. The coefficient of friction between the blocks and platform is μ.



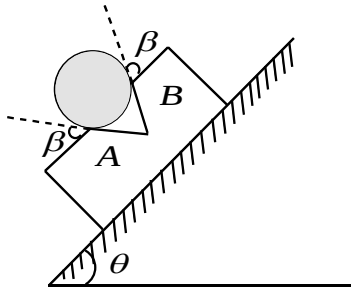
1) Spring will be stretched if $a > \mu g$

2) Spring will be compressed if $a \le \mu g$

3) Spring will be stretched if $a \le \mu g$

4) Spring will be in its natural Length under all conditions if velocity of blocks and platform is zero initially

12. A cylinder of mass m rests on a supporting block as shown. If $\beta = 60^0$ and $\theta = 30^0$, calculate the maximum acceleration 'a' of the block at which the cylinder does not lose contact at *B*. (neglect friction everywhere).



1) g/2 **2)** g **3)** g/3 **4)** g/4

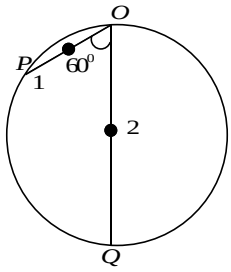
13. A ball is released from the top of a tower. The ratio of work done by force of gravity in 1st second, 2nd second and 3rd second of motion of the ball is

1) 1:2:3 **2)** 1:4:16 **3)** 1:3:5 **4)** 1:9:25

14. A force F acting on a body depends on its displacement s as $F \propto s^{-1/3}$. The power delivered by F will depend on displacement as

1) $s^{2/3}$ **2)** $s^{-5/3}$ **3)** $s^{1/2}$ **4)** s^0

15. Two particles 1 and 2 are allowed to descend on two friction less chords OP and OQ. The ratio of the speeds of the particles 1 and 2 respectively when they reach on the circumference is (circle lies in vertical plane)

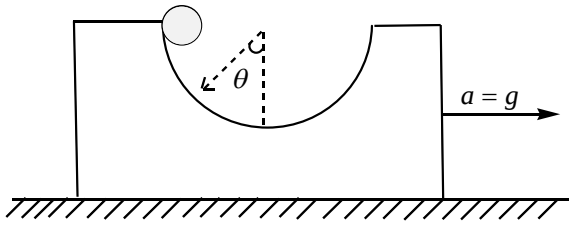


1) $\frac{1}{4}$ **2)** $\frac{1}{2}$ **3)** 1 **4)** $\frac{1}{2\sqrt{2}}$

16. A small mass slides down an inclined plane of inclination θ with the horizontal. The co-efficient of friction is $\mu = \mu_0 x$ where x is the distance through which the mass slides down and μ_0 a constant. Then, the distance covered by the mass before it stops is

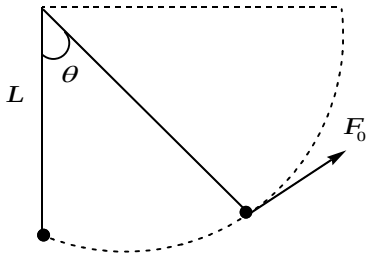
1) $\frac{2}{\mu_0}\tan\theta$ **2)** $\frac{4}{\mu_0}\tan\theta$ **3)** $\frac{1}{2\mu_0}\tan\theta$ **4)** $\frac{1}{\mu_0}\tan\theta$

17. Inside a smooth hemispherical cavity, a particle P can slide freely. The block having this cavity is moving with constant acceleration $a = g$ (where g is acceleration due to gravity). The particle is released from the state of rest from the topmost position of the surface of the cavity as shown. The angle θ with the vertical, when the particle will have maximum velocity with respect to the block is



1) 45^0 **2)** 60^0 **3)** 30^0 **4)** 0^0

18. A force of constant magnitude F_0 which always act in the tangential direction as shown in the figure. Assume that, the bob is at its lowest point initially.



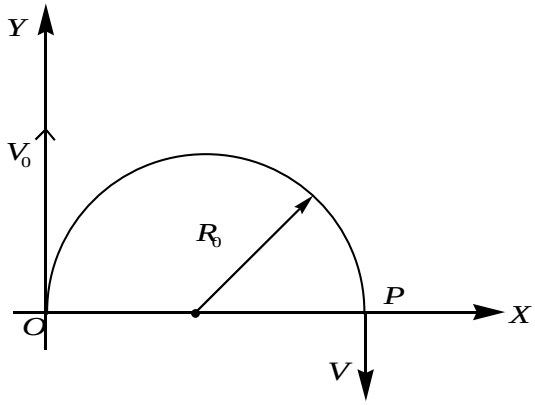
1) Speed of bob at 60^0 is $\sqrt{\frac{2L}{m}\left[\frac{F_0\pi}{3}+\frac{mg}{2}\right]}$

2) Speed of bob at $\theta = 60^0$ is $\sqrt{\frac{2L}{m}\left[\frac{F_0\pi}{3}+\frac{3}{2}mg\right]}$

3) Tension in thread at $\theta = 60^0$ is $\left[\frac{2F_0\pi}{3}-\frac{mg}{2}\right]$

4) Tension in thread at $\theta = 60^0$ is $\left[\frac{2F_0\pi}{3}+\frac{mg}{2}\right]$

19. A bead slides on a fixed frictionless wire bent into a horizontal semicircle of radius R_0 as shown in figure. In addition to any normal forces exerted by the wire, the bead is subjected to an external force that points directly away from origin and depends on distance r from the origin according to the formula $\vec{F} = F_0\left(\frac{r}{R_0}\right)^2\hat{r}$. Then the Incorrect statement of the following is.



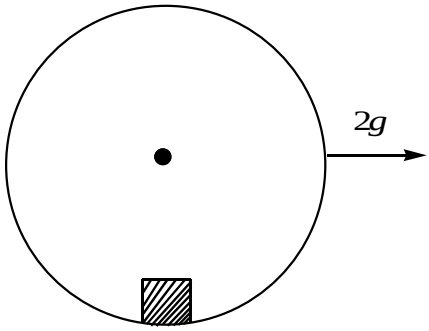
1) Given force is a central force

2) Given force is a conservative force

3) Work done by external force as bead leave the track (starting from origin) is $\frac{8F_0R_0}{3}$

4) Speed v of bead as it leaves the wire at P is $\sqrt{v_0^2+\frac{F_0R_0}{3m}}$

20. A block of mass m is placed inside a smooth hollow cylinder of radius R whose axis is kept horizontal. Initially system was at rest. Now, cylinder is given a constant acceleration 2g in the horizontal direction by external agent. The maximum angular displacement of the block with the vertical is



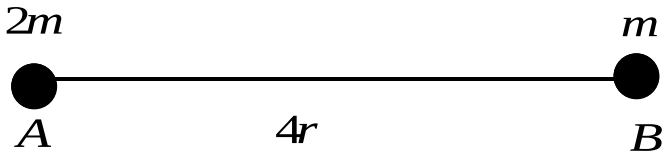
1) $2\tan^{-1}(2)$ **2)** $\tan^{-1}(2)$ **3)** $\tan^{-1}(1)$ **4)** $\tan^{-1}\left(\frac{1}{2}\right)$

(NUMERICAL VALUE TYPE)

Section-II contains 10 **Numerical Value Type** questions. Attempt any 5 questions only. First 5 attempted questions will be considered if more than 5 questions attempted. The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**

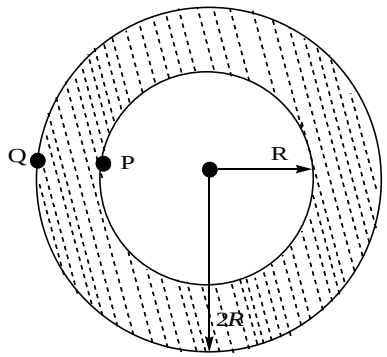
Marking scheme: +4 for correct answer, 0 if **not attempt** and **-1** in all other cases.

21. Two point masses *2m* and *m* are released from points A and B respectively as shown in the figure. Find the ratio of average speed of the particle having mass *m* to that of the particle having mass *2m* in time interval $t=0$ to $t=t_0$ (where, t_0 is the time when the distance between the particles *r*). Neglect any forces other their mutual gravitational forces.



22. A circular disc of mass M and radius R is rotating about its axis with angular speed ω_1. If another stationary disc having radius $\frac{R}{2}$ and same mass M is dropped co-axially on to the rotating disc. Gradually, both discs attain constant angular speed ω_2. The energy lost in the process is *p%* of the initial energy. Value of *p* is _____.

23. A solid sphere of radius R and mass density ρ is surrounded by another outer sphere of radius $2R$, density 2ρ. Let E_p is gravitational field at P and E_Q is Q. Find the value of E_Q / E_p.

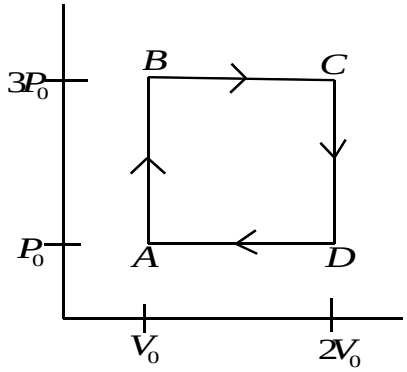


24. A wire of density $9\times10^{+3} kgm^{-3}$ is stretched between two clamps 1m apart. The resulting strain in the wire is 4.9×10^{-4}. The lowest frequency of the transverse vibrations in the wire is (Young's modulus of wire, $Y=9\times10^{10} Nm^{-2}$), (to the nearest integer) _____ .

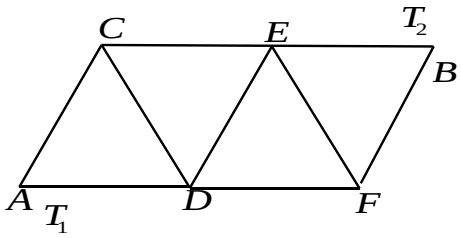
25. Two particles are in SHM with the same amplitude and frequency along the same line and about the same point. If the maximum separation between them is $\sqrt{3}$ times their amplitude, the phase difference between them is $\frac{2\pi}{n}$. Find value of *n*.

26. A horizontal platform with an object placed on it is executing SHM in the vertical direction. The amplitude of oscillation is $4\times10^{-3}m$. The least period of these oscillations, so that the object is not detached from the platform is $n\pi\times10^{-2}\sec$. Find value of n. (Take, $g=10m/s^2$)

27. An engine operates by taking a monatomic ideal gas through the cycle shown in the figure. The percentage efficiency of the engine is close to _____.



28. Nine identical conducting rods arranged as shown in the figure. The ends A and B are maintained at temperatures T_1 and T_2. Calculate the ratio of rate of flow of heat across *AD* to that of EB in the given arrangement in steady state



29. For an ideal heat engine, the temperature of the source is 127^0C. In order to have 60% efficiency the temperature of the sink (in degree Celsius) should be …… (Round off to the nearest integer)

30. M grams of steam at 100^0C is mixed with 200g of ice at its melting point in a thermally insulated container. If it produces liquid water at 40^0C (heat of fusion of ice is 80 cal/g), the value of *M* is _____ *g*.

CHEMISTRY

Max Marks: 100

(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

31. Which of the following reaction or transformation is an exothermic step?

1) $S^-(g) \rightarrow S^{2-}(g)$ **2)** $Na^+(g) + Cl^-(g) \rightarrow NaCl(s)$

3) $N(g) \rightarrow N^-(g)$ **4)** $Al^{2+}(g) \rightarrow Al^{3+}(g)$

32. Two particles A & B are in motion. If the wavelength associated with particle A is $5\times10^{-8}m$ then the wavelength associated with B, when its momentum is half of A

1) $10^{-2}m$ **2)** $10^{-7}m$ **3)** $10^{-10}m$ **4)** $10m$

33. In which of the following pairs hybridisation of the central atom is different

1) $ClF_3O,\quad ClF_3$ **2)** $ClF_3O,\quad ClF_3O_2$

3) $[ClF_2O]^+, [ClF_4O]^-$ **4)** $[XeOF_4], [ClF_4O]^-$

34. Alcohol level in blood can be determined by a redox titration with dichromate solution in acidic medium according to the balanced equation

$$C_2H_5OH_{(aq)} + 2Cr_2O_{7(aq)}^{2-} + 16H^+ \rightarrow 2CO_2(g) + 4Cr_{(aq)}^{3+} + 11H_2O(\ell)$$

What is blood alcohol level in mass per cent if 8.0 ml of 0.05 M $Cr_2O_7^{2-}$ solution is required for titration of a 10.00 gm sample of blood?

1) 0.092% **2)** 0.01% **3)** 1.4% **4)** 1.2%

35. Consider the reaction in aqueous solution of iron (III) and thiocyanate (SCN) ions to give an equilibrium mixture that contains the Fe – N bonded red complex ion

$$\underset{\text{pale yellow}}{Fe^{3+}(aq)} + \underset{\text{colourless}}{SCN^-(aq)} \rightleftharpoons \underset{\text{red}}{\left[Fe(NCS)^{2+}\right](aq)}$$

What happens if we add aqueous $FeCl_3$?

1) Red colour gets darker **2)** Solution becomes colourless

3) Solution turns pale yellow **4)** Solution turns blue

36. TC Match the following

Column-I	**Column-II**
A) $C(graphite)+O_2(g)\rightarrow CO_2(g);\Delta H=-ve$	P)Heat of reaction
B) $N_2(g)+O_2(g)\rightarrow 2NO(g);\Delta H=+ve$	Q) Heat of combustion
C) $H_2SO_{4(aq)}+2NaOH_{(aq)}\rightarrow Na_2SO_{4(aq)}+2H_2O_{(l)};\Delta H=-ve$	R) Heat of formation
D) $C(graphite)+\frac{1}{2}O_2(g)\rightarrow CO(g);\Delta H=-ve$	S) Heat of neutralisation
	T) Heat of Hydration

1) $A-PQ;B-PR;D-PR;$ **2)** $A-PQR;B-P;C-P;D-PR;$

3) $A-QR;B-P;C-PQR;D-PR;$ **4)** $A-PQR;B-P;C-P;D-PQR;$

37. 10 mole of perfect gas expands isothermally to 10 times its original volume. Then value of ΔS is

1) $-0.2303R$ **2)** $-2.303R$ **3)** $-10R$ **4)** $23.03R$

38. An electron falls from the 8th orbit in a hydrogen atom. The spectral line of longest wavelength in the Brackett series is from

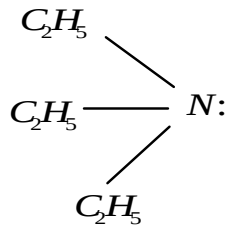
1) 5th orbit **2)** 6th orbit **3)** 4th orbit **4)** 7th orbit

39. An acid – base indicator has a Ka of 3×10^{-5}. The acid form of the indicator is red and the basic form is blue. The change in H^+ concentration in order to change the indicator from 75% red to 75% blue.

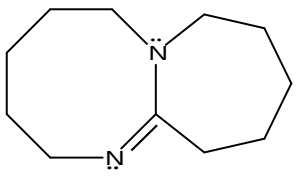
1) 2×10^{-5} **2)** 8×10^{-5} **3)** 9×10^{-5} **4)** 1×10^{-5}

40. Strongest base among the following is

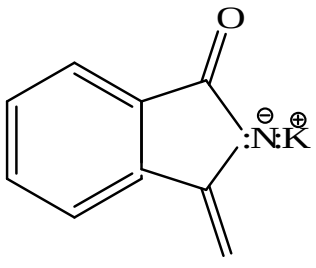
1)



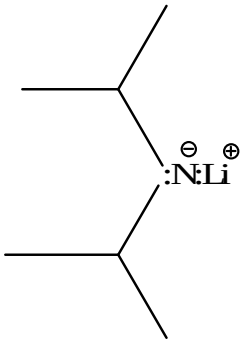
2)



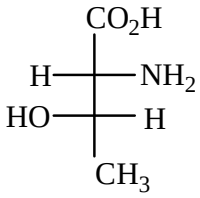
3)

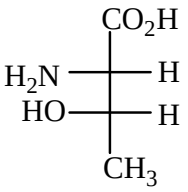


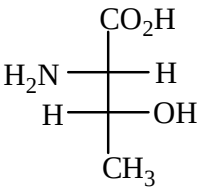
4)

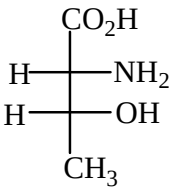


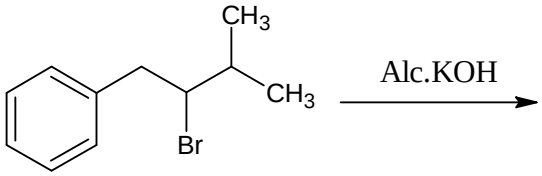
41. Threonine is (2S,3R)-2-amino-3-hydroxybutanoic acid. Which of the following is threonine?

1) 

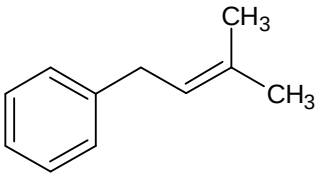
2) 

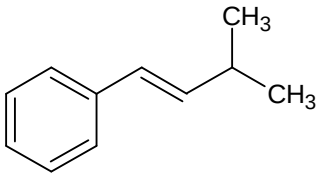
3) 

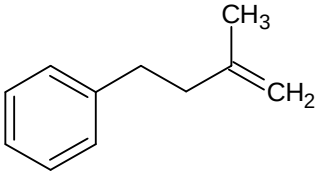
4) 

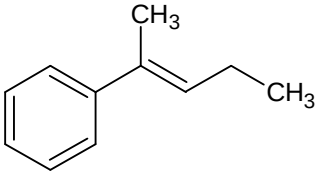
42. 

The major product of this reaction is

1) 

2) 

3) 

4) 

43. The fluoride which is most soluble in water is:

1) CaF_2 **2)** BaF_2 **3)** SrF_2 **4)** BeF_2

44. E^0 for $A\ell^{+3}/A\ell = -1.66V$ and $T\ell^{+3}/T\ell = 1.26V$. Based on above values identity the incorrect statement.

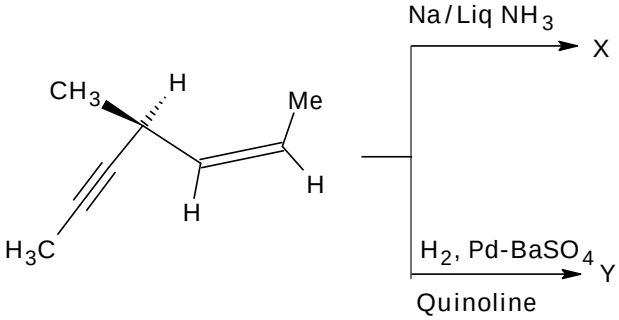
1) Al has high tendency to form $A\ell^{+3}(aq)$ ions And is more electro positive than Tl.

2) $T\ell^{+3}$ is unstable in aq. solution and acts as oxidising agent.

3) Al^{+3} more stable than Tl^{+3} in aq. solution

4) $A\ell^{+3}$ Can act as reducing agent.

45.



The correct statements regarding X and Y is/are

1) Both X and Y are optically inactive

2) Both X and Y are optically active

3) X is optically inactive and Y is active

4) X is optically active and Y is inactive

46. Which of the following is a good oxidising agent?

1) C^{4+} **2)** Pb^{4+} **3)** Sn^{4+} **4)** Ge^{4+}

47. The BOD values of four samples of water A, B, C and D are 165ppm, 120ppm, 20ppm and 5ppm respectively. The most polluted and least polluted water samples are

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

48. Which of the following is the correct order for increasing bond angle?

1) $NH_3 < PH_3 < AsH_3 < SbH_3$ **2)** $H_2O < OF_2 < Cl_2O$

3) $H_3Te^+ < H_3Se^+ < H_3S^+ < H_3O^+$ **4)** $BF_3 < BCl_3 < BBr_3 < BI_3$

49. Friedel Crafts alkylation is generally not preferred for the preparation of alkyl benzenes because

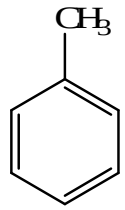
1) Electrophile undergoes rearrangement giving mixture of products

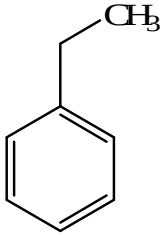
2) Poly alkylation takes place as alkyl group is activating

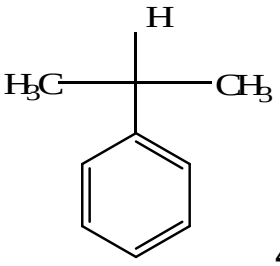
3) Both the above (A) and (B)

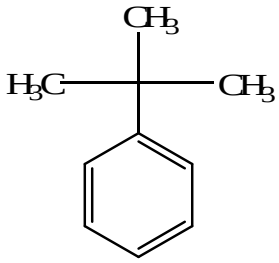
4) $AlCl_3$ complexes with alkyl benzene and deactivates it towards further reaction

50. In which of the following case, the rate of Electrophilic aromatic Substitution will be the fastest.

1) 

2) 

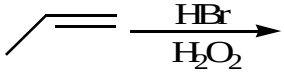
3) 

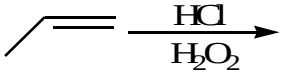
4) 

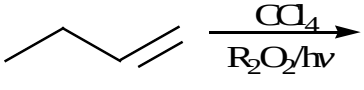
(NUMERICAL VALUE TYPE)

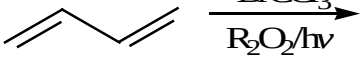
Section-II contains 10 **Numerical Value Type** questions. Attempt any 5 questions only. First 5 attempted questions will be considered if more than 5 questions attempted. The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**
Marking scheme: +4 for correct answer, 0 if **not attempt** and **-1** in all other cases.

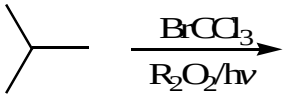
51. How many of the following are free radical additions majorly?

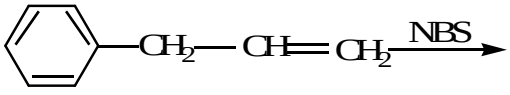
I. 

II. 

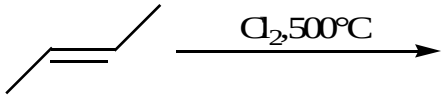
III. 

IV. 

V. 

VI. 

VII. 

VIII. 

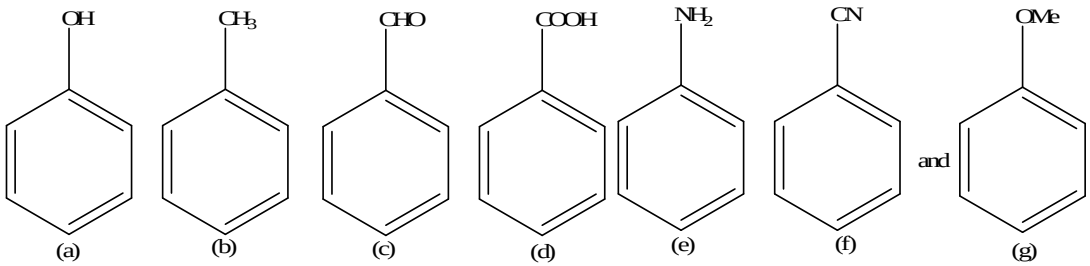
52. At high temperature the compound S_4N_4 decomposes completely into N_2 & sulphur vapour. When all measurements are made under same T and P, it is found that for each volume of S_4N_4 decomposed, 2.5 volume of gaseous products formed. The molecular formula of sulphur vapours obtained is given as S_x. Then 'x' is

53. Calculate the temperature (in K) at which the reaction given below is at equilibrium,

$Ag_2O\,(s) \rightarrow 2Ag(s) + \frac{1}{2}O_2\,(g)$; [Given, $\Delta H = 30.5\ kJ/mol$ and $\Delta S = 0.066\ kJ\ K^{-1}mol^{-1}$, $0^0C = 273K$]

54. Borax and kernite are complex borates of sodium. What is the difference in the number of water molecules that exist only as water of crystallization as per structure?

55. How many of the following compounds are more reactive than benzene for EAS reaction?



56. An alkene C_6H_{12} (A) undergoes oxidative ozonolysis to give two different acids (B) and (C). Neither (B) nor (C) contains more than four carbon atoms. How many alkenes can satisfy these criteria? (Consider only structural isomers)

57. A bubble of gas released at the bottom of a lake increases to four times its original volume when it reaches the surface. Assuming that atmospheric pressure is equivalent to the pressure exerted by a column of water 10m high. What is the depth (in m) of the lake?

58. Specific heat capacity of iron is $0.45\ J^0C^{-1}g^{-1}$. How much amount of energy needed (in kJ) to raise temperature of 10 grams of iron from 25^0C to 500^0C? Round off your answer to the nearest integer.

59. How many of the following can be used as parameters for knowing the water pollution

i) Dissolved oxygen

ii) Chemical oxygen demand

iii) Biological oxygen demand iv) Bio amplification

v) Food chain vi) Threshold limit value vii) Acid rains

60. Ka for HCN is 5×10^{-10}.For maintaining a constant pH of 9.6020, what will be the volume(in mL) of 5M KCN solution required to be added to 10ml of 2M HCN solution? [Given $\log 2 = 0.3010$]

MATHEMATICS

Max Marks: 100

(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (1), (2), (3) and (4) for its answer, out of which ONLY ONE option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.

61. If the equation of pair of straight lines passing through (1,1), one making an angle θ with the positive direction of $x-$ axis and other making the same angle with positive direction of y-axis is $x^2-(a+2)xy+y^2+a(x+y-1)=0, a\neq -2,$ then $\sin 2\theta$ is

1) $(a-2)$ **2)** $a+2$ **3)** $\frac{2}{a+2}$ **4)** $\frac{2}{a}$

62. $\lim\limits_{n\to\infty}\sum\limits_{r=1}^{n}\cot^{-1}\left(\frac{r^3-r+\frac{1}{r}}{2}\right)$ is equal to

1) 0 **2)** π **3)** $\frac{\pi}{2}$ **4)** $\frac{\pi}{4}$

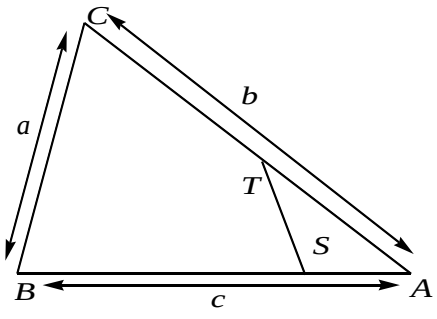
63. Let $f:[0,1]\to R$ (the set of all real numbers) be function. Suppose the function f is twice differentiable, $f(0)=f(1)=0$ and satisfies $f''(x)-2f'(x)+f(x)\geq e^x, x\in[0,1].$

If the function $e^{-x}f(x)$ assumes its minimum in the interval $[0,1]$ at $x=\frac{1}{4},$ which of the following is true?

1) $f'(x)<f(x)$, $\frac{1}{4}<x<\frac{3}{4}$ **2)** $f'(x)>f(x)$, $0<x<\frac{1}{4}$

3) $f'(x)<f(x)$, $0<x<\frac{1}{4}$ **4)** $f'(x)<f(x)$, $\frac{3}{4}<x<1$

64. Given a triangular plot of land as per the figure, the owner wants to build a fence ST such that the plot is divided into 2 equal parts. The minimum length of fencing required is (where s is the semi-perimeter of ΔABC)



Where $a\leq b\leq c$

1) $\sqrt{2(s-b)(s-c)}$ **2)** $\sqrt{s(s-a)}$ **3)** $\sqrt{a(b+c)}$ **4)** $\frac{s}{2}$

65. For $\Delta ABC, \frac{a}{1+m^2n^2}=\frac{b}{m^2+n^2}=\frac{c}{\left(1-m^2\right)\left(1+n^2\right)}$, where $m,n\in R^+$. Given three statement(s):

(I) $\angle BAC=2\tan^{-1}\frac{m}{n}$, (II) $\angle ABC=2\tan^{-1}mn$ and (III) area $\Delta ABC=\frac{mnbc}{m^2+n^2}$.

Which of the following options lists all the correct statements about ΔABC

1) I only **2)** II and III only **3)** I and II only **4)** I, II and III

66. Find the maximum possible area of rectangle such that it two vertices are on y-axis and other two vertices on the lines $y=x$ and $3x+2y=6$ respectively and the rectangle is inscribed in triangle, $y\ge 0, y\ge x, 3x+2y\le 6$

1) $\frac{3}{10}$ **2)** $\frac{7}{10}$ **3)** $\frac{9}{10}$ **4)** $\frac{11}{10}$

67. If $g(x)=2f\left(2x^3-3x^2\right)+f\left(6x^2-4x^3-3\right), \forall x\in R,$ then $g(x)$ is increasing on the interval given that $f''(x)>0$

1) $\left(-\infty,-\frac{1}{2}\right)\cup(0,1)$ **2)** $\left(-\frac{1}{2},0\right)\cup(1,\infty)$ **3)** $(0,\infty)$ **4)** $(-\infty,1)$

68. Two lines $L_1: x=5, \frac{y}{3-\alpha}=\frac{z}{-2}$ *and* $L_2: x=\alpha, \frac{y}{-1}=\frac{z}{2-\alpha}$ are coplanar. Then α can take the value

1) 1 **2)** 2 **3)** 3 **4)** 7

69. Let $X=\begin{bmatrix}3 & 0\\ 3 & 3\end{bmatrix}_{2\times 2}$, $Y=\begin{bmatrix}\sqrt{\frac{7}{8}} & \sqrt{\frac{1}{8}}\\ -\sqrt{\frac{1}{8}} & \sqrt{\frac{7}{8}}\end{bmatrix}_{2\times 2}$ and $Z=Y^TXY$. If $M=YZ^{2012}Y^T$ where $M=\left[m_{ij}\right]_{2\times 2}$ then the sum of the digits of λ where $\lambda=\frac{m_{21}-m_{11}-m_{22}}{3^{2012}}$ is

1) 3 **2)** 4 **3)** 5 **4)** 7

70. If $y=1+\frac{1}{x-1}+\frac{2x}{(x-1)(x-2)}+\frac{3x^2}{(x-1)(x-2)(x-3)}$, then the value of $-9y'(4)$ is equal to

1) 104 **2)** 52 **3)** 208 **4)** 416

71. If $m\sin(\alpha+\beta)=\cos(\alpha-\beta)$, then $\frac{1}{1-m\sin 2\alpha}+\frac{1}{1-m\sin 2\beta}$ equals to $(m\neq\pm1)$

1) $\frac{1}{1-m^2}$ **2)** $\frac{2}{1-m^2}$ **3)** $\frac{2}{(1-m)^2}$ **4)** $\frac{m}{1-m^2}$

72. Let $f(x)=\begin{bmatrix} px^3+q, & x\in[0,1] \\ 2\cos(\pi x)+\tan^{-1}x, & x\in(1,2] \end{bmatrix}$. If $f(x)$ is differentiable in $(0,2)$, then

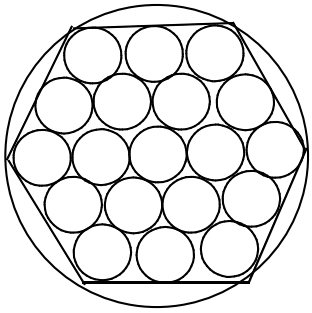
1) $p=\frac{1}{6};q=\frac{13}{6}-\frac{\pi}{6}$ **2)** $p=\frac{1}{6};q=\frac{\pi}{4}+\frac{13}{6}$

3) $p=\frac{1}{6};q=\frac{\pi}{4}-\frac{7}{3}$ **4)** $p=\frac{1}{6};q=\frac{\pi}{4}-\frac{13}{6}$

73. If $y=\frac{\sin^4 x-\cos^4 x+\sin^2 x\cos^2 x}{\sin^4 x+\cos^4 x+\sin^2 x\cos^2 x}$, $x\in\left(0,\frac{\pi}{2}\right)$, then the most exhaustive values of y satisfies

1) $-\frac{3}{2}\le y\le\frac{1}{2}$ **2)** $\frac{1}{2}\le y\le 1$ **3)** $-\frac{5}{3}\le y<1$ **4)** $-\frac{5}{3}\le y\le\frac{3}{2}$

74. A circular disk of unit radius is filled with a number of smaller circular disks arranged in the form of hexagon. Let A_n denotes a stack of disks arranged in the shape of a hexagon having 'n' disks on each side of the hexagon. The figure shows the configuration A_3. If 'A' be the area of large disk, S_n be the number of disks in A_n configuration and r_n be the radius of each disk in A_n configuration, then $\lim_{n\to\infty}(nr_n)=$



1) $\frac{1}{2}$ **2)** $\frac{1}{4}$ **3)** $\frac{1}{3}$ **4)** $\frac{1}{11}$

75. If two diagonals of two rhombuses are represented by vectors $\overline{d_1}=\overline{a}+2\overline{b},\overline{d_2}=2\overline{a}-\overline{b}$ and $\overline{d_3}=2\overline{a}+\overline{b},\overline{d_4}=\overline{a}-2\overline{b}$ respectively, then $\left[\vec{a}\ \vec{b}\ \vec{a}\times 2\vec{b}\right]$ equals

1) $\frac{|\vec{a}|^2|\vec{b}|^2}{4}$ **2)** $\frac{|\vec{a}|^2|\vec{b}|^2}{2}$ **3)** $2|\vec{a}|^2|\vec{b}|^2$ **4)** $4|\vec{a}|^2|\vec{b}|^2$

76. If $A=\begin{bmatrix} e^{t} & e^{-t}\cos t & e^{-t}\sin t \\ e^{t} & -e^{-t}\cos t-e^{-t}\sin t & -e^{-t}\sin t+e^{-t}\cos t \\ e^{t} & 2e^{-t}\sin t & -2e^{-t}\cos t \end{bmatrix}$, then A is

1) Not invertible for any $t\in R$ **2)** Invertible only if $t=\frac{\pi}{2}$

3) Invertible for all $t\in R$ **4)** Invertible only if $t=\pi$

77. $A=\begin{bmatrix} 0 & 1 \\ 3 & 0 \end{bmatrix}$ and $\left(A^{8}+A^{6}+A^{4}+A^{2}+I\right)V=\begin{bmatrix} 0 \\ 11 \end{bmatrix}$ where I is the 2×2 identity matrix) then the product of all elements of matrix V is

1) 8 **2)** 1 **3)** 0 **4)** 24

78. The minimum value of $f(\theta)=\frac{\cos^{3}\theta+\sin^{3}\theta+1}{(\cos\theta+\sin\theta+1)^{2}}$

1) $1+\frac{1}{\sqrt{2}}$ **2)** $\frac{1}{\sqrt{2}}-1$ **3)** $1-\frac{1}{\sqrt{2}}$ **4)** $-1-\frac{1}{\sqrt{2}}$

79. The locus of the point which is equidistant from the lines $y=x, z=1$ and $y=-x, z=-1$ is

1) $xy=z$ **2)** $xy=2z$ **3)** $xy=-z$ **4)** $xy=-2z$

80. Let $f(x)=\sin^{2}(x+\alpha)+\sin^{2}(x+\beta)-2\cos(\alpha-\beta)\sin(x+\alpha)\sin(x+\beta)(\alpha<\beta)$. Which of the following is TRUE?

1) $f(x)$ is strictly increasing in (α,β)

2) $f(x)$ is strictly decreasing (α,β)

3) $f(x)$ is strictly increasing in $\left(\alpha,\frac{\alpha+\beta}{2}\right)$ and strictly decreasing in $\left(\frac{\alpha+\beta}{2},\beta\right)$

4) $f(x)$ is a constant function

(NUMERICAL VALUE TYPE)

Section-II contains 10 **Numerical Value Type** questions. Attempt any 5 questions only. First 5 attempted questions will be considered if more than 5 questions attempted. The Answer should be within **0 to 9999.** If the Answer is in **Decimal** then round off to the **nearest Integer** value (Example i,e. If answer is above **10** and less than **10.5** round off is **10** and If answer is from **10.5** and less than **11** round off is **11).**

Marking scheme: +4 for correct answer, 0 if **not attempt** and **-1** in all other cases.

81. The plane $x+2y+3z=7$ is rotated about the line where it cut yz-plane by an angle θ. In the new position the plane contains the point $(-1,0,2)$. If $|\cos\theta|=\frac{p}{q}$ (where p and q are coprime) then the absolute value of $(p-q)$ is

82. A plane (P) is parallel to the line $L \equiv \frac{x-1}{1} = \frac{y-2}{1} = \frac{z-3}{1}$. If the image of origin in P lies on the line L, then the square of distance of $(3, 2, 1)$ from P is equal to

83. If $f(x+y) = f(x).f(y)$, where $x, y \in N$, $f(1) = 3$ and $\sum_{r=1}^{n} 2f(a+r) = 81\left(3^n - 1\right)$, then the value of a is

84. If $f(\theta) = \begin{vmatrix} \cos^2 2\theta & \cos^2 4\theta & \cos^2 6\theta \\ \sin 2\theta & \sin 4\theta & \sin 6\theta \\ 1 & 1 & 1 \end{vmatrix}$, then number of distinct solutions of $f(\theta) = 0$, in $0 < \theta \le \frac{\pi}{2}$ is

85. The number of values of 't' for which the system of equations $(t+1)x + 8y = 4t$, $tx + (t+3)y = 3t - 1$ has no solution is:

86. The value of $\lim\limits_{x \to \frac{\pi}{4}} \left(\frac{4\sqrt{2} - (\cos x + \sin x)^5 - 10\cos x + 10\cos x \sin 2x}{1 - \sin 2x} \right)$

87. Let $\bar{a}$, $\bar{b}$, $\bar{c}$ are three non-coplanar vectors such that $3(\bar{a} \times \bar{b}) + 5(\bar{b} \times \bar{c}) = \bar{a}$ and $\bar{d}$ is the unit vector coplanar with $\bar{b}$ and $\bar{a} \times \bar{b}$, then value of $\frac{(2\bar{a} + \bar{c} + 3\bar{d}).\bar{a}}{[\bar{a}\ \bar{b}\ \bar{c}]}$ is

88. If $f(x) = \begin{cases} |x| \sin \pi \{x\};\ x \in (-1, 2] \\ (x-2)^2 |x-3|^3 - 2\sin \pi x,\ x \in (2, 4) \end{cases}$

(where $\{.\}$ represents fractional part function) Then number of values (s) of x where f(x) is not differentiable is/are

89. The point on the line $\frac{x+2}{2} = \frac{y+6}{3} = \frac{z-34}{-10}$ which is nearest to the line $\frac{x+6}{4} = \frac{y-7}{-3} = \frac{z-7}{-2}$ is (a, b, c) then the value of $a + b + c =$

90. Let $\overrightarrow{PR} = 3\hat{i} + \hat{j} - 2\hat{k}$ and $\overrightarrow{SQ} = \hat{i} - 3\hat{j} - 4\hat{k}$ determine diagonals of a parallelogram PQRS and $\overrightarrow{PT} = \hat{i} + 2\hat{j} + 3\hat{k}$ be another vector. Then the volume of the parallelopiped determined by the vectors $\overrightarrow{PT}, \overrightarrow{PQ}$ and $\overrightarrow{PS}$ is