



**Sri Chaitanya**  
Educational Institutions



# JEE ADVANCED GRAND TEST



**Sri Chaitanya IIT Academy.,India.**

✿ A.P ✿ T.S ✿ KARNATAKA ✿ TAMILNADU ✿ MAHARASTRA ✿ DELHI ✿ RANCHI

*A right Choice for the Real Aspirant*

ICON Central Office - Madhapur - Hyderabad

Sec: **Sr.Super60\_NUCLEUS\_BT**

**Paper -2(Adv-2021-P2-Model)**

**Date: 01-10-2023**

**Time: 02.00Pm to 05.00Pm**

**GTA-03**

**Max. Marks: 180**

01-10-2023\_Sr.Super60\_NUCLEUS\_BT\_Jee-Adv(2021-P2)\_GTA-03\_Syllabus

**PHYSICS : TOTAL SYLLABUS**

**CHEMISTRY : TOTAL SYLLABUS**

**MATHEMATICS : TOTAL SYLLABUS**

**Sri Chaitanya Educational Institutions**  
**INDIA**

**Name of the Student:** \_\_\_\_\_

**H.T. NO:**

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**JEE-ADVANCE-2021-P2-Model**

Time: 3:00Hr's

**IMPORTANT INSTRUCTIONS**

Max Marks: 180

**PHYSICS:**

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 1 – 6)	Questions with Multiple Correct Choice with Partial mark	+4	-2	6	24
Sec – II(Q.N : 7 – 12)	Paragraph Questions with Numerical Value Answer Type	+2	0	6	12
Sec – III(Q.N : 13 – 16)	Paragraph Questions with Single Answer Type	+3	-1	4	12
Sec – IV(Q.N : 17 – 19)	Questions with Non-negative Integer Value Type	+4	0	3	12
<b>Total</b>				<b>19</b>	<b>60</b>

**CHEMISTRY:**

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 20 – 25)	Questions with Multiple Correct Choice with Partial mark	+4	-2	6	24
Sec – II(Q.N : 26 – 31)	Paragraph Questions with Numerical Value Answer Type	+2	0	6	12
Sec – III(Q.N : 32 – 35)	Paragraph Questions with Single Answer Type	+3	-1	4	12
Sec – IV(Q.N : 36– 38)	Questions with Non-negative Integer Value Type	+4	0	3	12
<b>Total</b>				<b>19</b>	<b>60</b>

**MATHEMATICS:**

Section	Question Type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 39 – 44)	Questions with Multiple Correct Choice with Partial mark	+4	-2	6	24
Sec – II(Q.N : 45 – 50)	Paragraph Questions with Numerical Value Answer Type	+2	0	6	12
Sec – III(Q.N : 51 – 54)	Paragraph Questions with Single Answer Type	+3	-1	4	12
Sec – IV(Q.N : 55 – 57)	Questions with Non-negative Integer Value Type	+4	0	3	12
<b>Total</b>				<b>19</b>	<b>60</b>

Sec: Sr.Super60\_NUCLEUS\_BT

Space for rough work

Page 2

Sri Chaitanya  
Educational Institutions**THE PERFECT HAT-TRICK WITH ALL- INDIA RANK 1  
IN JEE MAIN 2023 JEE ADVANCED 2023 AND NEET 2023**

**JEE MAIN  
2023**  
SINGARAJU  
VENKAT KOUNDINNYA  
RANK 1  
300  
300

**1**

**JEE Advanced  
2023**  
VAVILALA  
CHIDVILAS REDDY  
RANK 1  
341  
360

**1**

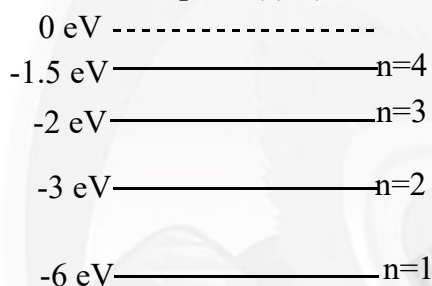
**NEET  
2023**  
BORA VARUN  
CHAKRAVARTHI  
RANK 1  
720  
720

**1**

**PHYSICS****Max. Marks: 60****SECTION-1(Maximum Marks: 24)****One or More Type**

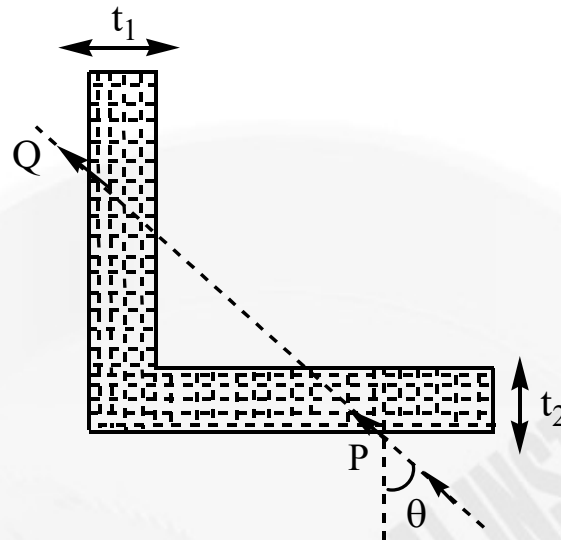
- This section contains SIX (06) questions.
- Each question has FOUR options (A), (B), (C) and (D). ONE OR MORE THAN ONE of these four option(s)
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated according to the following 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, 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 unanswered;  
 Negative Marks: -2 In all other cases.

1. Consider a hypothetical atom, the energy level of atoms are given in the figure. Choose the correct option(s). (Given  $hc = 1240 \text{ eV-nm}$ )



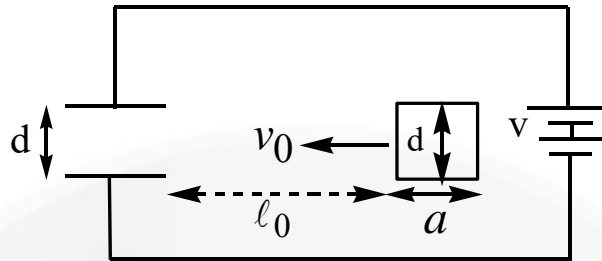
- A) An atom in the ground state gets excited by a photon and during de-excitation it emits photons, one of them has wavelength 1240 nm, then the incident photon may have wavelength of 310 nm.
- B) An atom in the ground state gets excited by a photon and during de-excitation it emits photons, one of them has wavelength 1240 nm, then the incident photon may have wavelength of 1240 nm.
- C) An atom in the ground state gets excited by a collision with an electron and during de-excitation it emits photons, one of them have wavelength 1240, then incident electron must have an energy of 4eV.
- D) An atom in the ground state gets excited by a photon of 8eV then as a result an ionized atom and an electron of 2eV is obtained.
2. Two glass slabs of thickness  $t_1$  and  $t_2$  are joined to make L shape as shown in the figure. The refractive indices of both glass slabs are same. A light ray is incident at point 'P' with an angle of incidence  $\theta$  as shown in the figure. It is assumed that refraction takes place from both the glass slabs. Then choose the correct option(s).





- A) Emergent ray passes from Q if  $t_1 = 2t_2$ ,  $\theta = 30^\circ$ .
- B) Emergent ray passes from Q if  $t_1 = 2t_2$ ,  $\theta = 45^\circ$ .
- C) Emergent ray passes above 'Q' if  $t_2 > t_1$ ,  $\theta = 45^\circ$ .
- D) Emergent ray passes below 'Q' if  $t_2 < t_1$ ,  $\theta = 45^\circ$ .
3. A particle of mass  $m$  and charge  $q$  is projected in a region where an electric field by  $\vec{E} = E_0 \hat{i}$  exists with velocity  $v_0 \hat{j}$  from the origin at time  $t=0$ , then choose the correct statements (Assuming  $m^2 v_0^2 = 2qE_0 m x_0$ ).
- A) Radius of curvature of the particle when its x-coordinate becomes  $x_0$  is  $2x_0$ .
- B) Radius of curvature of the particle when its x-coordinate becomes  $x_0$  is  $4\sqrt{2}x_0$ .
- C) Speed of the particle when its x-coordinate becomes  $x_0$  is  $\sqrt{2}v_0$ .
- D) Speed of the particle when its x-coordinate becomes  $x_0$  is  $2v_0$ .
4. A parallel plates capacitor is made of square conducting plates of side  $a$  and the separation between plates is  $d$ . The capacitor is connected with battery of emf  $V$  volt as shown in the figure. There is a dielectric slab of dimension  $a \times a \times d$  with dielectric constant  $k$ . at  $t = 0$ , dielectric slab is given velocity  $v_0$  towards capacitor as shown in the figure. (Neglect the effect of gravity and electrostatic force acting on the dielectric when dielectric is outside the capacitor. Also ignore any type of frictional force acting on the dielectric during its motion) Let the  $x$  be the length of dielectric inside the capacitor at  $t = t$  sec, (Mass of the dielectric is  $m$  and Capacitor plates are fixed,  $\ell_0 \gg a$ )





- A) Motion of dielectric slab is periodic but not simple harmonic motion  
 B) Motion of dielectric slab is simple harmonic motion  
 C) At any time, the slope of graph of total energy of capacitor dielectric system verses  $x$  is twice the slope of graph of potential energy verses  $x$ .

D) The value of maximum energy stored in the system is  $\frac{1}{2}mv_0^2 + \frac{\epsilon_0 a^2 V^2}{2d}(2k-1)$

5. The universal gravitational constant is measured experimentally using Cavendish's experiment. This experiment is a very precise experiment which gives the value of  $G$  as  $(6.6742 \pm 0.0010) \times 10^{-11} \text{ N.m}^2 / \text{kg}^2$ . Since the universal gravitational constant has some error in it, using it if we find escape speed and acceleration due to gravity on Earth's surface, our values will have error in it. (Assume mass of Earth =  $6.0000 \times 10^{24} \text{ kg}$  & radius of Earth =  $6.4000 \times 10^6 \text{ m}$ ). The measurement of mass of Earth has an error of 0.01% and radius of Earth has an error of 0.02%  
 Choose the **CORRECT** option(s)  
 A) Maximum percentage error in acceleration due to gravity  $g = 0.065$   
 B) Maximum percentage error in acceleration due to gravity  $g = 0.025$   
 C) Value of acceleration due to gravity (approx. in  $\text{m/s}^2$ ) = 9.78  
 D) Value of acceleration due to gravity (approx. in  $\text{m/s}^2$ ) = 8.78
6. A fan operates at 200 V (d.c.) consuming 1000 W when running at full speed. Its internal wiring has resistance  $1\Omega$ . When the fan runs at full speed, its speed becomes constant. This is because the torque due to magnetic field inside the fan is balanced by the torque due to air resistance on the blades of the fan and torque due to friction between the fixed part and the shaft of the fan. The electric power going into the fan is spent (i) in the internal resistance as heat, sound etc., call it  $P_2$ . When the coil of fan rotates, an emf is also induced in the coil. This opposes the external e.m.f applied to send the current into the fan. This e.m.f is called back e.m.f., call it  $e$ . Answer the following question when the fan is running at full speed. Choose the **CORRECT** statement(s)

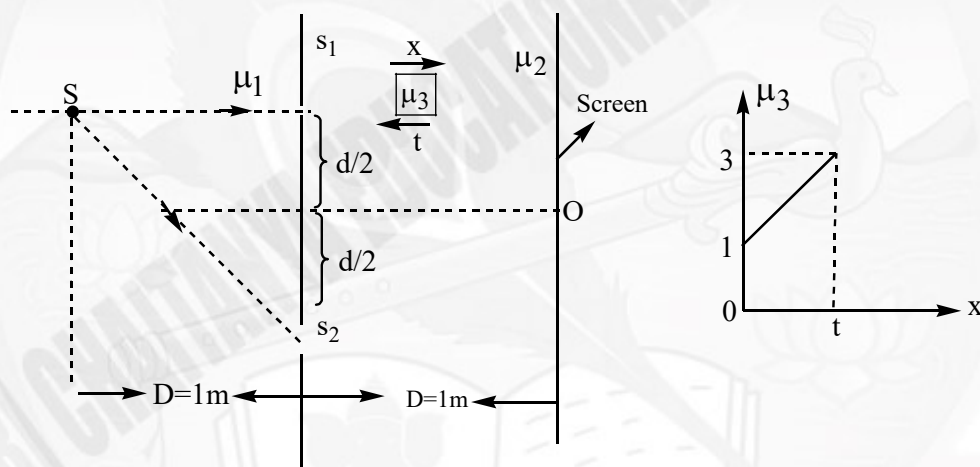




- A) Current flowing into the fan is 5 Amp.
- B) Current flowing into the fan is 10 Amp.
- C) The value of back emf is 195 volt.
- D) The value of back emf is 200 volt.

**SECTION-2(Maximum Marks: 12)****Paragraph with Numerical**

- This section contains THREE (03) question stems.
- There are TWO (02) questions corresponding to each question stem.
- The answer to each question is a NUMERICAL VALUE.
- For each question, enter the correct numerical value corresponding to the answer in the designated place using the mouse and the on-screen virtual numeric keypad.
- If the numerical value has more than two decimal places, truncate/round-off the value to TWO decimal places.
- Answer to each question will be evaluated according to the following marking scheme:  
Full Marks: +2 If ONLY the correct numerical value is entered at the designated place;  
Zero Marks: 0 In all other cases.

**Question Stem for Question Nos. 7 and 8****Question Stem**

In YDSE arrangement shown in figure, fringes are seen on screen using monochromatic source S having wavelength  $3000 \text{ \AA}$  (in air).  $S_1$  and  $S_2$  are two slits separated by  $d=1 \text{ mm}$  from each other and  $D=1 \text{ m}$ . Left of slits  $S_1$  and  $S_2$  medium of refractive index  $\mu_1 = 2$  is present & to the right of slits  $S_1$  and  $S_2$  medium of refractive index  $\mu_2 = \frac{3}{2}$  is present. A thin slab of thickness 't' is placed in front of  $S_1$ . The refractive index of slab  $\mu_3$  varies with distance from its starting face as shown in figure.

7. In order to get central maxima at the centre of the screen, the thickness of slab required (in  $\mu\text{m}$ ) is .....
8. If the thickness of the slab is selected  $1 \mu\text{m}$ , then the position of the central maxima (magnitude of Y- Coordinate in mm) taking O to be origin is .....





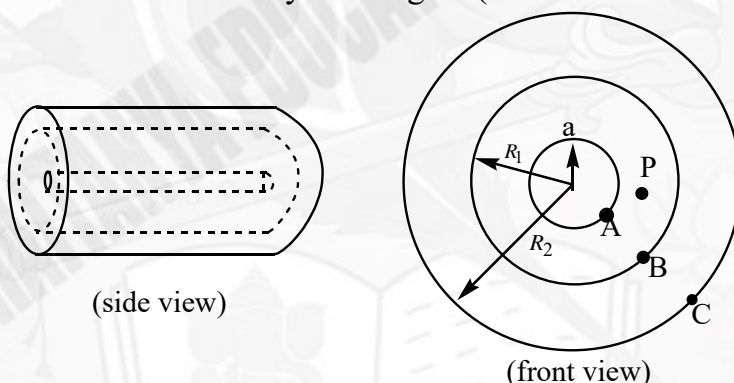
**Question Stem for Question Nos. 9 and 10****Question Stem**

In physics laboratory a student is trying to calculate the focal length of a convex lens. He measures the distance between screen and a light source lined up on the optical bench to be 120 cm. When he shifts the lens along the axis of optical bench, sharp image of source is obtained at two lens positions. He also measures the ratio of these two magnifications to be 1:9

9. The focal length (in cm) of convex lens measured by student is .....
10. The magnitude of object distance (in cm) for which image seen by the student is brighter is .....

**Question Stem for Question Nos. 11 and 12****Question Stem**

A very long cylindrical plastic rod of radius  $a=2.5$  cm has electric charge per unit length  $\lambda=+6.0 \times 10^{-7}$  C/m distributed uniformly throughout its volume. This rod is surrounded by a concentric cylindrical metal shell of inner radius  $R_1=7.5$  cm and outer radius  $R_2=10$  cm, as shown. The metal shell is initially uncharged. (Take  $\ln 3 = 1.0986$ )



11. The potential difference between point A on the rod and point C on the outer shell in kV is .....
12. An electron is released at rest at point B on the inner surface of the shell. The kinetic energy of electron when it reaches the rod is  $x \times 10^{-15}$  J. Find the value of x

**SECTION-3(Maximum Marks: 12)**  
**Paragraph with Single Answer Type**

- This section contains TWO (02) paragraphs. Based on each paragraph, there are TWO (02) questions.
- Each question has FOUR options (A), (B), (C) and (D). ONLY ONE of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer
- Answer to each question will be evaluated according to the following marking scheme:

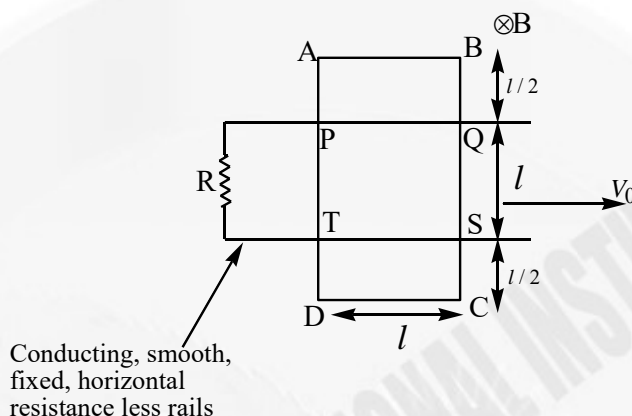
Full Marks: +3 If ONLY the correct option is chosen;

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

Negative Marks: -1 In all other cases.

**Paragraph-I**

Resistance per unit length of wire frame ABCDA is  $\frac{R}{2l}$ . The wire frame is moving with constant velocity  $V_0$  on two parallel conducting and smooth horizontal rails in uniform magnetic field  $B$  perpendicular to plane of rails as shown in figure.



13. Select correct option: -

- A) Current in resistor  $\frac{2BV_0l}{5R}$       B) Current in side AB is  $\frac{4BV_0l}{5R}$   
 C) Current in side CD is  $\frac{4BV_0l}{5R}$       D) Current in side ST is  $\frac{2BV_0l}{5R}$

14. Select correct option: -

- A) External force required to move to frame is  $\frac{2B^2l^2V_0}{5R}$ .  
 B) External force required to move to frame is  $\frac{4B^2l^2V_0}{5R}$ .  
 C) Potential difference between B and C is zero.  
 D) Potential difference between B and C is  $2BV_0l$

### Paragraph-II

Air Standard Otto cycle:

The air-standard-Otto cycle is the idealized cycle for the spark-ignition internal combustion engines. This cycle is shown on P-V diagram. The Otto cycle 1-2-3-4 consists of following four process:

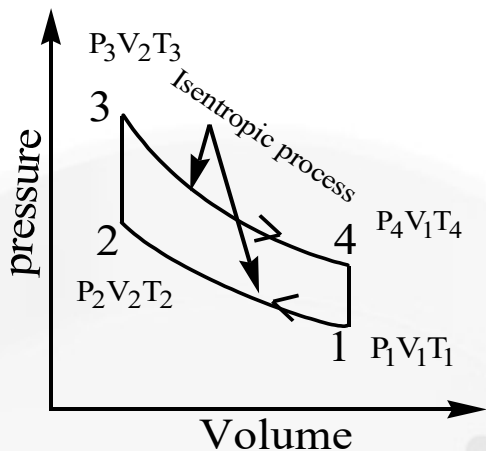
Process 1-2: Reversible adiabatic compression of air.

Process 2-3: Heat addition at constant volume.

Process 3-4: Reversible adiabatic expansion of air.

Process 4-1: Heat rejection at constant volume.





Mean Effective Pressure is defined as the ratio of the net work done to the displacement volume of the piston.

15. For a given mass of working gas of adiabatic experiment  $\gamma \left( = \frac{C_p}{C_v} \right)$  if the compression ratio  $r$  is defined as  $r = \frac{V_1}{V_2}$  (Where  $V_1$  is volume of gas at 1 and  $V_2$  is volume of gas at 2)

Then the efficiency of the cycle is given as.

A)  $\eta = 1 - \left( \frac{1}{r} \right)^{\gamma-1}$  B)  $\eta = 1 + \left( \frac{1}{r} \right)^{\gamma-1}$  C)  $\eta = 1 + \left( \frac{1}{r} \right)^{\gamma+1}$  D)  $\eta = 1 - \left( \frac{1}{r} \right)^{\gamma+1}$

- 16 If the displacement volume is given by  $(V_1 - V_2)$ , then the mean effective pressure of the above cycle is given as

A)  $\left( \frac{1}{\gamma-1} \right) \left( \frac{P_1}{T_1} \right) \left( \frac{r}{r-1} \right) \{ (T_3 - T_2) - (T_4 - T_1) \}$

B)  $\left( \frac{1}{\gamma+1} \right) \left( \frac{P_1}{T_1} \right) \left( \frac{r}{r-1} \right) \{ (T_3 - T_2) + (T_4 - T_1) \}$

C)  $\left( \frac{1}{\gamma-1} \right) \left( \frac{P_1}{T_1} \right) \left( \frac{r}{r+1} \right) \{ (T_3 - T_2) + (T_4 - T_1) \}$

D)  $\left( \frac{1}{\gamma-1} \right) \left( \frac{P_1}{T_1} \right) \left( \frac{r}{r-1} \right) \{ (T_3 + T_2) + (T_4 - T_1) \}$



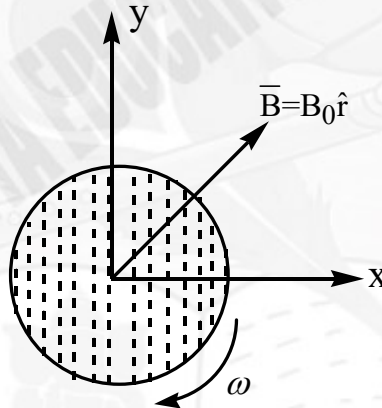
### SECTION-4(Maximum Marks: 12) Non-Negative Integer Answer Type

- This section contains THREE (03) questions.
- The answer to each question is a NON-NEGATIVE INTEGER.
- For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If ONLY the correct integer is entered;

Zero Marks : 0 In all other cases.

17. A thin non conducting disc of mass  $M=2\text{kg}$ , charge  $Q=2\times 10^{-2}\text{C}$  and radius  $R=\frac{1}{6}\text{m}$  is placed on a frictionless horizontal plane with its centre at the origin of the coordinate system. A non uniform, radial magnetic field  $\vec{B}=B_0\hat{r}$  exists in space, where  $B_0=10\text{T}$  and the disc is rotated with an angular velocity  $\omega=x\times 10^2\text{rad/sec}$  about an axis passing through its centre and perpendicular to its plane, as shown in the figure. At what value of  $x$  the disc will leave contact with the surface. (Take  $g=10\frac{\text{m}}{\text{s}^2}$ )



18. Two particles are thrown from same point with same velocity with some time interval between them. The horizontal component of projection velocity is  $u$ . The Relative angular velocity of the line joining the two particles when they are at same horizontal level is  $n\frac{g}{u}$ , then value of  $n$  is
19. A solid has a volume  $v_0$  when external pressure is  $P_0$ . Bulk modulus of the material is  $B$ . Now the pressure is increased to  $p$ . The additional energy per unit volume now stored in the material is  $\frac{3(p^2 - P_0^2)}{zB}$ . Find  $z$ ?



## CHEMISTRY

Max. Marks: 60

SECTION-1(Maximum Marks: 24)  
One or More Type

- This section contains SIX (06) questions.
- Each question has FOUR options (A), (B), (C) and (D). ONE OR MORE THAN ONE of these four option(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, 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 unanswered;  
Negative Marks: -2 In all other cases.

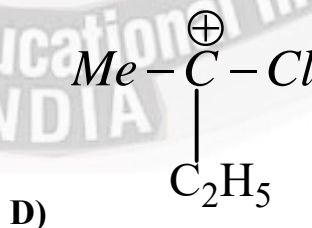
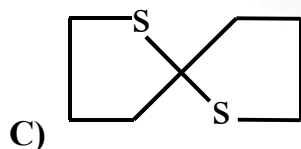
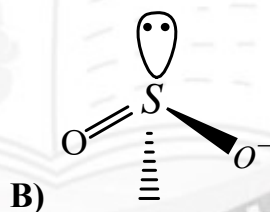
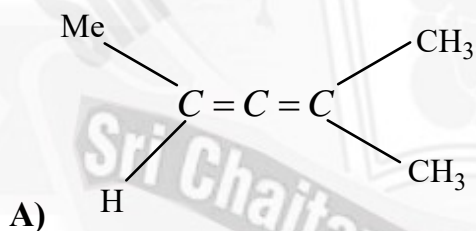
20. Which of the following are correct options?

- A) EMF is an intensive property.  
B) Melting point of Ice decreases on increasing pressure  
C) Boiling point of water Increases on increasing pressure  
D) Entropy of  $H_2(g)$  is more than  $H(g)$  at same conditions

21. If temperature of a fixed amount of gas is raised, which of the following would be true?

- A) Fraction of the molecules possessing most probable velocity will increase  
B) Fraction of the molecules possessing most probable velocity will decrease  
C) Fraction of the molecules possessing very low velocity will decrease  
D) Fraction of the molecules possessing very high velocity will increase

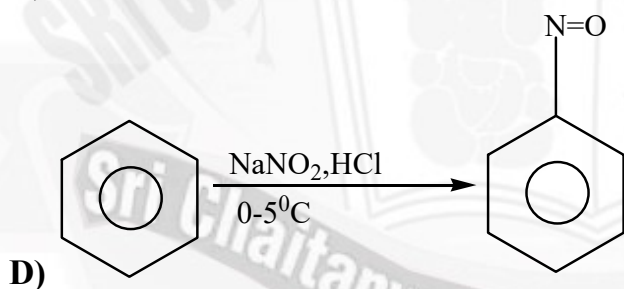
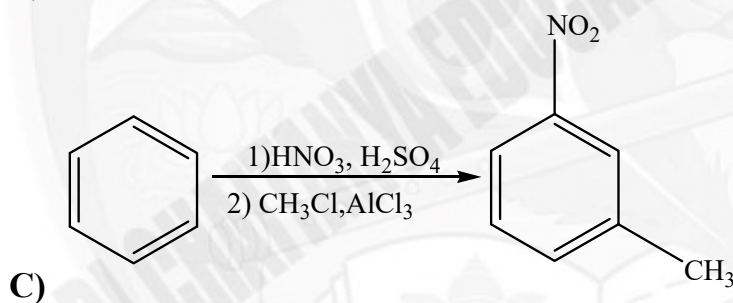
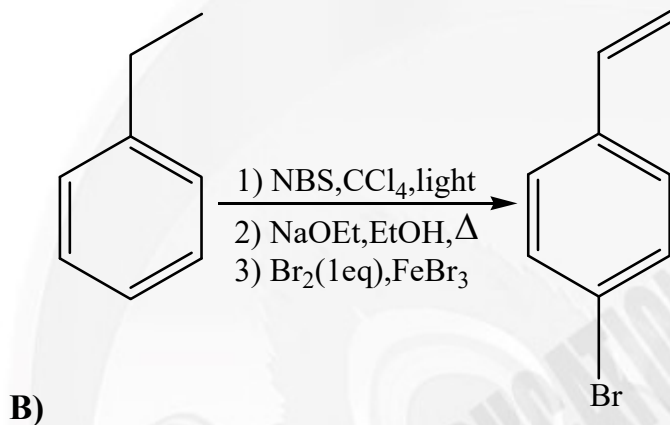
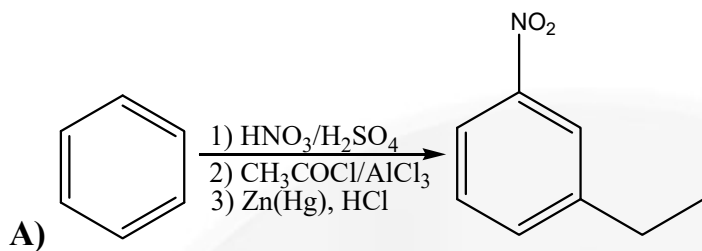
22. Which of the following is/are resolvable:







23. How many of the following synthesis will fail to give following as final major product



24. Which of the following represent correct order with respect to the property mentioned?

A)  $Cl_2 > F_2$  : Bond dissociation enthalphy

B)  $HOCl > HClO_3$  : Acidic strength

C)  $H_2O(s) < D_2O(s)$  : Density

D)  $HF > HCl > HBr > HI$  : Boiling point





25. Which of the following statement(s) is/are correct?

- A) Both  $KMnO_4$  and  $K_2Cr_2O_7$  are coloured due to charge transfer spectra
- B) E.A.N of Co in  $Co_2(CO)_8$  is 35
- C)  $[Co(en)_3]^{3+}$  is optically active
- D) Both cis and trans isomers of  $[CoCl_2(NH_3)_4]^+$  are optically inactive

### SECTION-2(Maximum Marks: 12)

#### Paragraph with Numerical

- This section contains THREE (03) question stems.
- There are TWO (02) questions corresponding to each question stem.
- The answer to each question is a NUMERICAL VALUE.
- For each question, enter the correct numerical value corresponding to the answer in the designated place using the mouse and the on-screen virtual numeric keypad.
- If the numerical value has more than two decimal places, truncate/round-off the value to TWO decimal places.
- Answer to each question will be evaluated according to the following marking scheme:  
Full Marks: +2 If ONLY the correct numerical value is entered at the designated place;  
Zero Marks: 0 In all other cases.

#### Question Stem for Question Nos. 26 and 27

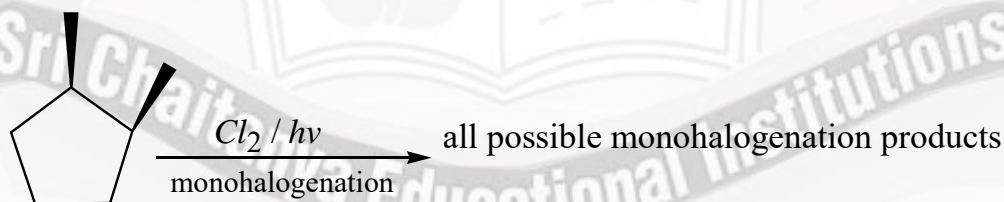
##### Question Stem

Some amount of “20V”  $H_2O_2$  is mixed with excess of acidified solution of KI. The iodine so liberated required 200 ml of 0.1 N  $Na_2S_2O_3$  for complete titration.

26. The volume of  $H_2O_2$  solution (in ml) is:
27. The mass of  $K_2Cr_2O_7$  needed to oxidise the above volume of  $H_2O_2$  solution:  
(Given M.wt of  $K_2Cr_2O_7 = 294$ )

#### Question Stem for Question Nos. 28 and 29

##### Question Stem



28. Find the total number of possible mono chloro products (including stereo)
29. Find the total number of enantiomeric pairs present in the monochloro products

#### Question Stem for Question Nos. 30 and 31

##### Question Stem

Reaction of 3 moles of  $Br_2$  with excess NaOH in aqueous solution gives sodium bromide, sodium bromate and  $H_2O$ .





30. The number of sodium bromide moles involved in the balanced chemical equation is \_\_\_\_
31. The number of sodium bromate moles involved in the balanced chemical equation is \_\_\_\_.

**SECTION-3(Maximum Marks: 12)**  
**Paragraph with Single Answer Type**

- This section contains TWO (02) paragraphs. Based on each paragraph, there are TWO (02) questions.
- Each question has FOUR options (A), (B), (C) and (D). ONLY ONE of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer
- Answer to each question will be evaluated according to the following marking scheme:

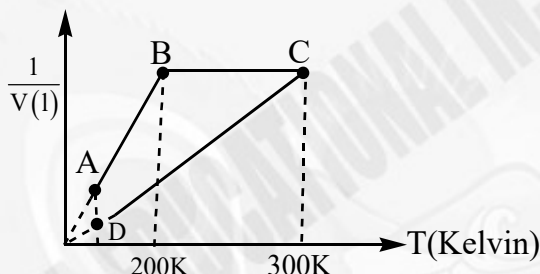
Full Marks: +3 If ONLY the correct option is chosen;

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

Negative Marks: -1 In all other cases.

**Paragraph-I:**

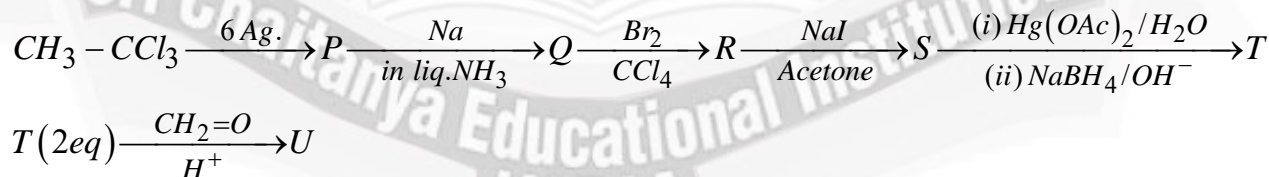
One mole of an ideal monoatomic gas is processed in process ABCD then answer the following questions (Given:  $R = 2 \text{ cal/mol} \cdot \text{K}$ )



32. Entropy change for gas in process BC
- A)  $3 \ln\left(\frac{3}{2}\right) \text{ cal./K}$       B)  $\frac{3}{2} \ln\left(\frac{3}{2}\right) \text{ cal./K}$
- C)  $4 \ln\left(\frac{3}{2}\right) \text{ cal./K}$       D)  $\frac{4}{2} \ln\left(\frac{3}{2}\right) \text{ cal./K}$
33. Heat change in complete process ABCD?
- A) 200 cal      B) 50 cal      C) 1200 cal      D) 100 cal

**Paragraph-II:**

In the following reaction sequence:



34. Possible stereoisomers of U is
- A) 2      B) 3      C) 4      D) 6
35. The compound which have not chiral centre is/are
- A) Q      B) R      C) T      D) U







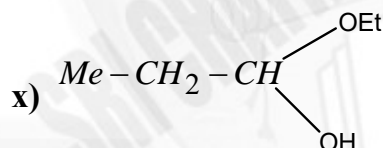
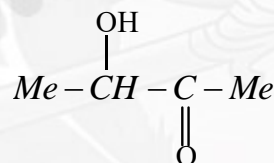
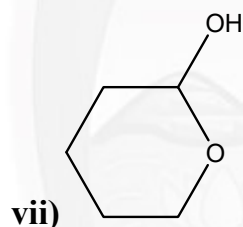
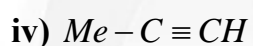
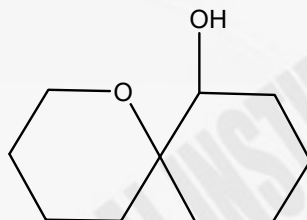
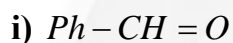
### SECTION-4(Maximum Marks: 12) Non-Negative Integer Answer Type

- This section contains THREE (03) questions.
- The answer to each question is a NON-NEGATIVE INTEGER.
- For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If ONLY the correct integer is entered;

Zero Marks : 0 In all other cases.

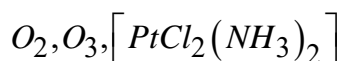
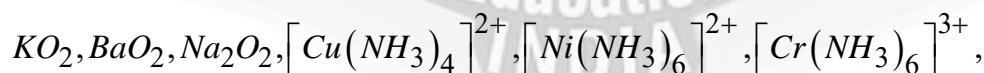
36. How many of the following will give silver mirror with tollen's reagent?



37. How many of the following contains  $CO_3^{2-}$  ion:

Azurite, Calamine, Zincite, Siderite, Magnetite, Magnesite, Dolomite, Bauxite, Copper pyrite

38. How many of the following are paramagnetic?



**MATHEMATICS****Max. Marks: 60****SECTION-1(Maximum Marks: 24)****One or More Type**

- This section contains SIX (06) questions.
- Each question has FOUR options (A), (B), (C) and (D). ONE OR MORE THAN ONE of these four option(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, 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 unanswered;  
 Negative Marks: -2 In all other cases.

39. Let  $f$  be a continuous function satisfying  $f(x) = f\left(\frac{x}{2}\right) \forall x \in \mathbb{R}$  and  $f(108) = \frac{3\pi}{2}$ . If

$g(x) = \min \left( f(x), \left| \frac{3\pi}{2} - |x| \right| \right)$  then which of the following options is/are CORRECT?

A)  $\lim_{x \rightarrow \infty} \frac{f(4 + \sin x) - f(1 + \sin x)}{x} = 0$

B)  $\lim_{x \rightarrow \infty} \frac{f(4 + \sin x) - f(1 + \sin x)}{x} = \frac{9\pi}{2}$

C) Number of points where  $g(x)$  is non-derivable is 3

D) Number of points where  $g(x)$  is non-derivable is 5

40. Let  $f: \mathbb{R} \rightarrow (0, \infty)$  is a continuous function such that

$f(x) + \frac{1}{f(x)} = e^x + e^{-x} \forall x \in \mathbb{R}$ , then which of the following is/are CORRECT?

A) Number of such functions  $f(x)$  is 2.

B) Number of such functions  $f(x)$  is 3.

C) area bounded by  $y = f(x)$ , x-axis, ordinate  $x = -1$  and ordinate  $x = 1$  can be

$\left( e - \frac{1}{e} \right) \text{Sq. units}$

D) area bounded by  $y = f(x)$ , x-axis, ordinate  $x = -1$  and ordinate  $x = 1$  can be

$(2e - 2) \text{Sq. units}$



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41. If  $\sum_{n=2009}^{\infty} \frac{1}{\binom{n}{2009}} = \frac{p}{q}$  then which among the following option(s) is/are correct?

(Note that  $\binom{n}{k}$  is defined as  $\frac{n!}{k!(n-k)!}$  and p and q are coprime integers)

- A)  $p + q < 4006$                       B) p-q is negative  
C)  $p + q > 4006$                       D) p is divisible by 3

42. Let  $f : D \rightarrow R$  be defined as  $f(x) = \frac{x^2 + 2x + a}{x^2 + 4x + 3a}$ , where D and R denote the complete domain of f for corresponding values of 'a' and the set of all real numbers respectively. If

'f' is surjective mapping, then the value of  $\frac{a^2 - 4a + 1}{a^2 - 2a + 3}$  can be

- A)  $\frac{1}{4}$                       B)  $\frac{1}{9}$                       C)  $-\frac{1}{9}$                       D) -1

43. Let S be the set of  $2 \times 2$  matrices given by  $S = \left\{ A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}, \text{ where } a, b, c, d \in I \right\}$ , such

that  $A^T = A^{-1}$ . Then which of the following is/are correct?

- A) Number of matrices in set S is equal to 6.  
B) Number of matrices in set S such that  $|A - I_2| \neq 0$  is equal to 3, where  $I_2$  is unit matrix of order 2  
C) Number of Symmetric matrices are more than Number of skew-symmetric matrices in set S.  
D) All matrices in set S are singular.







44. Let  $f, g : [-2, 3] \rightarrow R$  be continuous function which are twice differentiable on the interval  $(-2, 3)$ . Let the values of  $f$  and  $g$  at the points  $-2, 0, 1$  and  $3$  be as given in the following table:

	$x = -2$	$x = 0$	$x = 1$	$x = 3$
$f(x)$	11	-4	6	16
$g(x)$	1	-2	0	2

In each of the intervals  $(-2, 0), (0, 1)$  and  $(1, 3)$  the function  $(f - 5g)''$  never vanishes. Then the correct statement(s) is (are)

- A)  $f'(x) - 5g'(x) = 0$  has exactly three solutions in  $(-2, 0) \cup (0, 1) \cup (1, 3)$   
 B)  $f'(x) - 5g'(x) = 0$  has exactly one solution in  $(0, 1)$   
 C)  $f'(x) - 5g'(x) = 0$  has atleast one solution in  $(1, 3)$   
 D)  $f'(x) - 5g'(x) = 0$  has atleast two solutions in  $(-2, 0)$

### SECTION-2(Maximum Marks: 12)

#### Paragraph with Numerical

- This section contains THREE (03) question stems.
- There are TWO (02) questions corresponding to each question stem.
- The answer to each question is a NUMERICAL VALUE.
- For each question, enter the correct numerical value corresponding to the answer in the designated place using the mouse and the on-screen virtual numeric keypad.
- If the numerical value has more than two decimal places, truncate/round-off the value to TWO decimal places.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks: +2 If ONLY the correct numerical value is entered at the designated place;

Zero Marks: 0 In all other cases.

#### Question Stem for Question Nos. 45 and 46

##### Question Stem

Consider the following three sets of complex roots of unity.

$$A = \{z : z^{18} = 1\}, B = \{\omega : \omega^{48} = 1\} \text{ and } C = \{z\omega : \forall z \in A \text{ and } \forall \omega \in B\}, \text{ then}$$

45. The number of distinct elements in the set  $C$  is  
 46. Let the set  $C$  has  $n$  distinct elements  $C_1, C_2, \dots, C_n$ , then the value of

$$|C_2 - C_1| + |C_3 - C_1| + \dots + |C_n - C_1| \text{ is } 2 \cot\left(\frac{5}{n}\right)^\circ \text{ where } n \text{ is natural number, then the value of } n \text{ is } \underline{\hspace{2cm}}$$



**Question Stem for Question Nos. 47 and 48****Question Stem**

If the expression for the  $n$ th term of the infinite sequence

$1, 2, 2, 3, 3, 3, 4, 4, 4, 4, 5, 5, 5, 5, 5, 6, \dots$  is  $\left[ \sqrt{\alpha n} + \frac{1}{\beta} \right]$ ,  $\alpha, \beta \in N$  (where  $[.]$  denotes the

greatest integer function) then answer will be followed

47. Let  $a = \alpha, b = \alpha + 1$  and  $c = \alpha + \beta + 1$  then number of numbers out of first 1000 natural numbers which are divisible by  $a$  or  $b$  or  $c$  is
48. Let  $a = \alpha, b = \alpha + 1, c = \alpha + \beta + 1$  and  $d = 3\beta + 1$ . The number of positive divisors of the number  $a^c \cdot b^c \cdot c^b \cdot d^b$  which are of the form  $4n + 1, n \in N$  is equal to

**Question Stem for Question Nos. 49 and 50****Question Stem**

Let  $t$  be a real number satisfying  $2t^3 - 9t^2 + 30 - \lambda = 0$  where  $t = x + \frac{1}{x}$  and  $x, \lambda \in R$  then

answer the following

49. If the given equation has three real and distinct solution for  $x$  then the positive value of  $\lambda$  is \_\_\_\_\_
50. If the given equation has exactly two real and distinct solutions of  $x$  then the absolute value of sum of all possible integral values of  $\lambda$  is \_\_\_\_\_ (Where  $\lambda \in [-25, 12]$ )

**SECTION-3(Maximum Marks: 12)****Paragraph with Single Answer Type**

- This section contains TWO (02) paragraphs. Based on each paragraph, there are TWO (02) questions.
- Each question has FOUR options (A), (B), (C) and (D). ONLY ONE of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +3 If ONLY the correct option is chosen;

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

Negative Marks : -1 In all other cases.

**Paragraph-I:**

Let  $A\left(\frac{1}{2}, 0\right), B\left(\frac{3}{2}, 0\right), C\left(\frac{5}{2}, 0\right)$  be the given points and  $P$  be a point satisfying maximum of  $\{PA + PB, PB + PC\} < 2$

51. The locus of  $P$  is symmetric about:

A) Origin      B) The line  $y = x$       C) y-axis      D) x-axis

52. The area of region (in Sq.units) of the point  $P$  is:

A)  $\sqrt{2}\left(\frac{\pi}{3} - \frac{\sqrt{3}}{4}\right)$       B)  $\sqrt{3}\left(\frac{\pi}{3} - \frac{\sqrt{3}}{4}\right)$       C)  $2\left(\frac{\pi}{3} - \frac{\sqrt{3}}{4}\right)$       D)  $3\left(\frac{\pi}{3} - \frac{\sqrt{3}}{4}\right)$



**Paragraph-II:**

$$\text{Let } f(x) = \lim_{n \rightarrow \infty} \left[ \frac{(nx+1)(nx+2)(nx+3)\dots(nx+n)}{n!} \right]^{\frac{1}{n}}, \text{ for all } x > 0$$

On the basis of above information, answer the following questions:

53.  $\lim_{x \rightarrow \infty} x \frac{f'(x)}{f(x)}$  is equal to

- A) 0                      B) e                      C) 1/e                      D) 1

54. Which of the following is incorrect?

- A) Range of  $f(x)$  is  $(1, \infty)$                       B)  $\lim_{x \rightarrow 0^+} f(x) = 1$   
 C)  $f(2) > f(1)$                       D)  $f'(3) = f(3)(\log_3 e)$

**SECTION-4(Maximum Marks: 12)**  
**Non-Negative Integer Answer Type**

- This section contains THREE (03) questions.
- The answer to each question is a NON-NEGATIVE INTEGER.
- For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme:  
 Full Marks : +4 If ONLY the correct integer is entered;  
 Zero Marks : 0 In all other cases.

55. If the standard deviation of 10 observations  $x_1, x_2, \dots, x_{10}$  is 4 and that of another set of 10 observations  $y_1, y_2, \dots, y_{10}$  is 3 and also  $X_i = (x_i - \bar{x})(y_i - \bar{y})$  and  $\bar{x}$  is mean of all  $x_i$ 's and  $\bar{y}$  is mean all  $y_i$ 's and  $\sum_{i=1}^{10} X_i = 80$ . Then standard deviation of observations  $x_1 - y_1, x_2 - y_2, \dots, x_{10} - y_{10}$  is
56. If  $\vec{a}$  and  $\vec{b}$  are vectors in space given by  $\vec{a} = \frac{\hat{i} - 2\hat{j}}{\sqrt{5}}$  and  $\vec{b} = \frac{2\hat{i} + \hat{j} + 3\hat{k}}{\sqrt{14}}$ , then the value of  $(2\vec{a} + \vec{b}) \cdot [(\vec{a} \times \vec{b}) \times (\vec{a} - 2\vec{b})]$  is
57. Consider a regular heptagon  $A_1A_2A_3A_4A_5A_6A_7$  inscribed in a unit circle. Let  $p_1 = (A_1A_2)(A_1A_3)(A_1A_4)(A_1A_5)(A_1A_6)(A_1A_7)$ ,  
 $p_2 = (A_2A_3)(A_2A_4)(A_2A_5)(A_2A_6)(A_2A_7)$ ,  
 $p_3 = (A_3A_4)(A_3A_5)(A_3A_6)(A_3A_7)$ ,  
 $p_4 = (A_4A_5)(A_4A_6)(A_4A_7)$ ,  
 $p_5 = (A_5A_6)(A_5A_7)$  and  $p_6 = A_6A_7$  where  $A_iA_j$  is length of the segment joining  $A_i$  and  $A_j$  then value of product  $(p_1p_2p_3p_4p_5p_6)^{\frac{2}{7}}$  is







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