



**Resonance**<sup>®</sup>  
Educating for better tomorrow

# JEE

## (Main)

**PAPER-1 (B.E./B. TECH.)**

# 2021

## **COMPUTER BASED TEST (CBT) Memory Based Questions & Solutions**

**Date: 27 July, 2021 (SHIFT-2) | TIME : (3.00 p.m. to 6.00 p.m)**

**Duration: 3 Hours | Max. Marks: 300**






**SUBJECT: MATHEMATICS**

### **Resonance Eduventures Ltd.**

Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005

Ph. No.: +91-744-2777777, 2777700 | FAX No. : +91-022-39167222

To Know more : sms RESO at 56677 | Website : [www.resonance.ac.in](http://www.resonance.ac.in) | E-mail : [contact@resonance.ac.in](mailto:contact@resonance.ac.in) | CIN : U80302RJ2007PLC024029

Toll Free : 1800 258 5555  7340010333  [facebook.com/ResonanceEdu](https://facebook.com/ResonanceEdu)  [twitter.com/ResonanceEdu](https://twitter.com/ResonanceEdu)  [www.youtube.com/resowatch](https://www.youtube.com/resowatch)  [blog.resonance.ac.in](https://blog.resonance.ac.in)

This solution was download from Resonance JEE (MAIN) 2021 Solution portal



**Resonance®**  
Educating for better tomorrow

**RESULT: JEE (Advanced),  
JEE (Main), NEET**

**HIGHEST No. of Classroom Selections**  
in JEE (Advanced) 2020 from any Institute of Kota

**5 AIRs in TOP-50 in JEE (Adv.) 2020 from Classroom**



**AIR-2  
(GEN-EWS)**  
**AIR-15**  
**DHANANJAY  
KEJRIWAL**  
With us Since Class 9<sup>th</sup>



**Zonal Topper  
IIT-Kharagpur**  
**AIR-25**  
**SAMARTH  
AGARWAL**  
With us Since Class 11<sup>th</sup>



**2nd Rank in  
IIT-Kharagpur Zone**  
**AIR-29**  
**SANKALP  
PARASHAR**  
With us Since Class 11<sup>th</sup>



**AIR-30**  
**AARYAN K.  
GUPTA**  
With us Since Class 9<sup>th</sup>



**AIR-41**  
**UTKARSH P.  
SINGH**  
With us Since Class 10<sup>th</sup>

Total Selections in JEE (Advanced) 2020

**4505**

Classroom: 3441 | Distance: 1064

Eligible for JEE (Advanced) Through JEE (Main) 2020

**14755**

Classroom: 11047 | Distance: 3708

NEET 2020

**2646**

Classroom: 1833 | Distance: 813

**ADMISSION OPEN for Session 2021-22**

**ONLINE + OFFLINE PROGRAMS**

**CLASS 11, 12 & 12+**

**Target: JEE (Main+Adv.) | JEE (Main) | NEET**

**Scholarship Upto 90%\***

Toll Free: 1800 258 5555 | Visit us: [www.resonance.ac.in](http://www.resonance.ac.in)



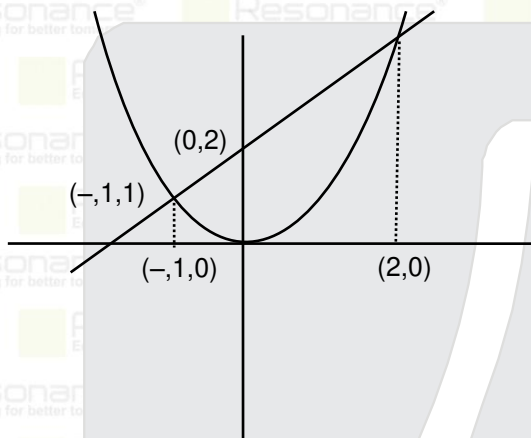
**PART : MATHEMATICS**

1 Area bounded by the curve  $y = x^2$  and the line  $y-x=2$  is

- (1)  $\frac{7}{2}$  (2)  $\frac{9}{2}$  (3)  $\frac{11}{2}$  (4)  $\frac{13}{2}$

Ans. (2)

Sol.



$$x^2 - x - 2 = 0$$

$$(x-2)(x+1) = 0$$

$$\text{Required area} = \frac{1}{2} (3) (5) - \int_{-1}^2 x^2 dx$$

$$= \frac{15}{2} - \frac{1}{3} (8+1)$$

$$= \frac{15}{2} - 3 = \frac{9}{2} \text{ sq. unit}$$

2. If  $A_{3 \times 3} = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$  and  $M = A + A^2 + A^3 + \dots + A^{20}$ , then the sum of all the elements of M is :

- (1) 1540 (2) 1580 (3) 2020 (4) 1640

Ans. (3)

$$\text{Sol. } A^2 = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix}$$

$$A^3 = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 3 & 6 \\ 0 & 1 & 3 \\ 0 & 0 & 1 \end{bmatrix}$$

$$T_n = 1 + 2 + \dots + n = \frac{n(n+1)}{2} = \frac{20 \times 21}{2} = 210$$

**Resonance Eduventures Ltd.**

Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005

Ph. No.: +91-744-2777777, 2777700 | FAX No. : +91-022-39167222

To Know more : sms RESO at 56677 | Website : www.resonance.ac.in | E-mail : [contact@resonance.ac.in](mailto:contact@resonance.ac.in) | CIN : U80302RJ2007PLC024029

Toll Free : 1800 258 5555 | [facebook.com/ResonanceEdu](https://www.facebook.com/ResonanceEdu) | [twitter.com/ResonanceEdu](https://twitter.com/ResonanceEdu) | [www.youtube.com/resowatch](https://www.youtube.com/resowatch) | [blog.resonance.ac.in](https://blog.resonance.ac.in)

$$S_n = \frac{1}{2} \left( \frac{n(n+1)(2n+1)}{6} + \frac{n(n+1)}{2} \right)$$

$$= \frac{n(n+1)}{4} \left( \frac{2n+1}{3} + 1 \right)$$

$$= \frac{n(n+1)(n+2)}{6} = \frac{20 \times 21 \times 22}{6} = 1540$$

$$M = \begin{bmatrix} 1+1 \dots 20 \text{ times} & 1+2+3+\dots 20 & s_n \\ 0 & 1+1+1 \dots 20 \text{ times} & 1+2+3+\dots 20 \\ 0 & 0 & 1+1+1 \dots 20 \text{ times} \end{bmatrix}$$

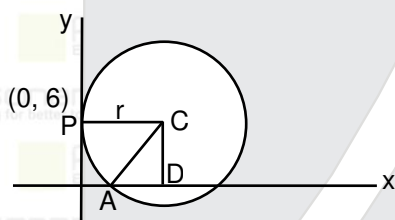
$$M = \begin{bmatrix} 20 & 210 & 1540 \\ 0 & 20 & 210 \\ 0 & 0 & 20 \end{bmatrix}$$

Sum of elements of M = 3(20) + 420 + 1540 = 2020

3. A circle touches y-axis at (0, 6) and has x-intercept equal to  $6\sqrt{5}$  then radius of the circle is :

Ans. 9

Sol.



$$AD = 3\sqrt{5}$$

$$CA^2 = CD^2 + AD^2$$

$$= 36 + 45$$

$$CA^2 = 81$$

$$CA = 9$$

$$\Rightarrow r = 9$$

4. Three vectors  $\vec{a}$ ,  $\vec{b}$ ,  $\vec{c}$  with magnitude  $\sqrt{2}$ , 1 and 2 respectively follows the relation  $\vec{a} = \vec{b} \times (\vec{b} \times \vec{c})$ .

The acute angle between the vectors  $\vec{b}$  &  $\vec{c}$  is  $\theta$ . Then the value of  $(1 + \tan \theta)$  is :

Ans. 2

Sol.  $\vec{a} = \vec{b} \times (\vec{b} \times \vec{c})$

$$\vec{a} = (\vec{b} \cdot \vec{c})\vec{b} - (\vec{b} \cdot \vec{b})\vec{c}$$

$$\vec{a} = (|\vec{b}| |\vec{c}| \cos \theta)\vec{b} - |\vec{b}|^2 \vec{c}$$

$$\vec{a} = (2 \cos \theta)\vec{b} - \vec{c}$$

## Resonance Eduventures Ltd.

Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005

Ph. No.: +91-744-2777777, 2777700 | FAX No. : +91-022-39167222

To Know more : sms RESO at 56677 | Website : [www.resonance.ac.in](http://www.resonance.ac.in) | E-mail : [contact@resonance.ac.in](mailto:contact@resonance.ac.in) | CIN : U80302RJ2007PLC024029

Toll Free : 1800 258 5555 | [facebook.com/ResonanceEdu](https://www.facebook.com/ResonanceEdu) | [twitter.com/ResonanceEdu](https://twitter.com/ResonanceEdu) | [www.youtube.com/resowatch](https://www.youtube.com/resowatch) | [blog.resonance.ac.in](http://blog.resonance.ac.in)



$$\vec{a} \cdot \vec{b} = 2 \cos\theta - 2 \cos\theta$$

$$\Rightarrow \vec{a} \cdot \vec{b} = 0$$

$$\vec{a} \cdot \vec{a} = 2 \cos\theta (\vec{b} \cdot \vec{a}) - \vec{c} \cdot \vec{a}$$

$$\vec{c} \cdot \vec{a} = -2$$

$$\vec{a} \cdot \vec{c} = 2 \cos\theta (\vec{b} \cdot \vec{c}) - 4$$

$$-2 + 4 = 2 \cos\theta \times 2 \cos\theta$$

$$\cos^2\theta = \frac{1}{2}$$

$$\cos\theta = \frac{1}{\sqrt{2}}$$

$$\theta = 45^\circ$$

$$\text{So, } (1 + \tan\theta) = 2$$

5. Two square matrices A & B are such that  $A^2 + B^2$  is invertible and  $A^5 = B^5$ ,  $A^3B^2 = B^3A^2$ . Then the value of  $|A^3 - B^3|$  is :

Ans. 0

$$\text{Sol. } (A^3 - B^3)(A^2 + B^2) = A^5 - B^5 + A^3B^2 - B^3A^2 = 0$$

$$\text{Since } |A^2 + B^2| \neq 0 \Rightarrow |A^3 - B^3| = 0$$

6. Evaluate  $\lim_{x \rightarrow 0} \frac{x}{\sqrt[8]{1-\sin x} - \sqrt[8]{1+\sin x}}$

(1) 0

(2) -4

(3) 8

(4) 2

Ans. (2)

Sol. Rationalize denominator three times

$$\lim_{x \rightarrow 0} \frac{x \left\{ (1-\sin x)^{1/8} + (1+\sin x)^{1/8} \right\} \left\{ (1-\sin x)^{1/4} + (1+\sin x)^{1/4} \right\} \left\{ (1-\sin x)^{1/2} + (1+\sin x)^{1/2} \right\}}{(1-\sin x - 1 + \sin x)}$$

$$\lim_{x \rightarrow 0} \frac{8x}{-2\sin x}$$

$$= -4$$

7. If two given APs are  $\tan \frac{\pi}{9}$ ,  $x$ ,  $\tan \frac{7\pi}{18}$  and  $\tan \frac{\pi}{9}$ ,  $y$ ,  $\tan \frac{5\pi}{18}$ . Then the value of  $|x-2y|$  is :

Ans. 0

$$\text{Sol. } \left| \frac{1}{2} \left( \tan \frac{\pi}{9} + \tan \frac{7\pi}{18} \right) - \tan \frac{\pi}{9} - \tan \frac{5\pi}{18} \right|$$

$$\therefore 2x = \tan \frac{\pi}{9} + \tan \frac{7\pi}{18} \text{ and } 2y = \tan \frac{\pi}{9} + \tan \frac{5\pi}{18}$$

## Resonance Eduventures Ltd.

Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005

Ph. No.: +91-744-2777777, 2777700 | FAX No. : +91-022-39167222

To Know more : sms RESO at 56677 | Website : [www.resonance.ac.in](http://www.resonance.ac.in) | E-mail : [contact@resonance.ac.in](mailto:contact@resonance.ac.in) | CIN : U80302RJ2007PLC024029

Toll Free : 1800 258 5555 | [facebook.com/ResonanceEdu](https://www.facebook.com/ResonanceEdu) | [twitter.com/ResonanceEdu](https://twitter.com/ResonanceEdu) | [www.youtube.com/resowatch](https://www.youtube.com/resowatch) | [blog.resonance.ac.in](http://blog.resonance.ac.in)



$$I.F = e^{-\int \frac{1}{x} dx} = \frac{1}{x}$$

$$y\left(\frac{1}{x}\right) = \int \frac{x^2}{x^2+1} \left(\frac{1}{x}\right) dx$$

$$\Rightarrow \frac{y}{x} = \frac{1}{2} \ln(1+x^2) + \text{Inc}$$

$$\Rightarrow y = \frac{x}{2} (\ln(1+x^2) + \text{Inc})$$

Now  $y(1) = 0$

$$\Rightarrow 0 = \frac{1}{2} (\ln 2 + \text{Inc})$$

$$\ln 2c = 0$$

$$\Rightarrow c = \frac{1}{2}$$

Now  $y(2) = \frac{2}{2} (\ln 5 + \ln \frac{1}{2})$

$$y(2) = \ln \frac{5}{2}$$

10. If two sides of a parallelogram are  $4x + 5y = 0$  and  $7x + 2y = 0$ . If one of the diagonals is  $11x + 7y = 9$  then the other diagonal passes through the point :

(1)  $\left(\frac{1}{3}, -\frac{4}{3}\right)$

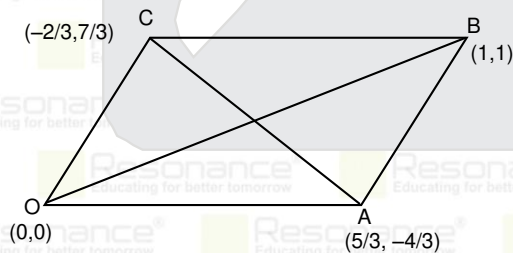
(2) (1,1)

(3) (2,3)

(4)  $\left(\frac{2}{3}, \frac{4}{3}\right)$

Ans. (2)

Sol. AC :  $11x + 7y = 9$



$$OA : 4x + 5y = 0$$

$$OC : 7x + 2y = 0$$

$$\Rightarrow A\left(\frac{5}{3}, -\frac{4}{3}\right) \text{ and } C\left(-\frac{2}{3}, \frac{7}{3}\right) \Rightarrow M = \left(\frac{1}{2}, \frac{1}{2}\right)$$

equation of OB  $\Rightarrow y = x$

## Resonance Eduventures Ltd.

Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005

Ph. No.: +91-744-2777777, 2777700 | FAX No. : +91-022-39167222

To Know more : sms RESO at 56677 | Website : [www.resonance.ac.in](http://www.resonance.ac.in) | E-mail : [contact@resonance.ac.in](mailto:contact@resonance.ac.in) | CIN : U80302RJ2007PLC024029

Toll Free : 1800 258 5555 | [facebook.com/ResonanceEdu](https://www.facebook.com/ResonanceEdu) | [twitter.com/ResonanceEdu](https://twitter.com/ResonanceEdu) | [www.youtube.com/resowatch](https://www.youtube.com/resowatch) | [blog.resonance.ac.in](http://blog.resonance.ac.in)

11. The point P(a, b) undergoes following transformation to a new co-ordinate P'  $\left(-\frac{1}{\sqrt{2}}, \frac{7}{\sqrt{2}}\right)$

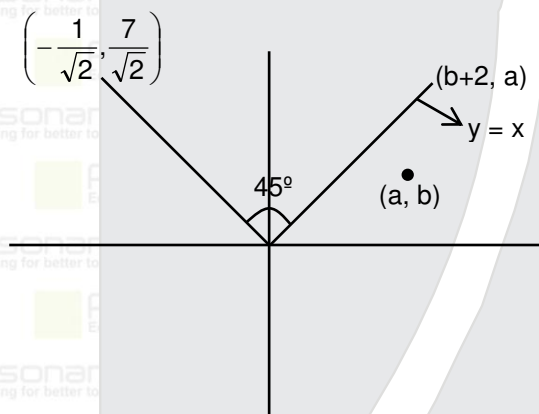
- (i) Reflection about  $y = x$
- (ii) Translation through 2 units in the positive direction of x-axis
- (iii) Rotation through an angle  $\frac{\pi}{4}$  in anti clockwise sense about the origin

Then the value of  $2a + b$  is :

- (1) 1
- (2) 3
- (3) 4
- (4) 9

Ans. (4)

Sol.



Using rotation theorem

$$\frac{-1}{\sqrt{2}} + \frac{7}{\sqrt{2}}i = \{(b+2) + ai\} \left\{ \cos \frac{\pi}{4} + i \sin \frac{\pi}{4} \right\}$$

$$\frac{-1}{\sqrt{2}} + \frac{7}{\sqrt{2}}i = \left( \frac{b+2}{\sqrt{2}} - \frac{a}{\sqrt{2}} \right) + i \left( \frac{b+2}{\sqrt{2}} + \frac{a}{\sqrt{2}} \right)$$

$$b - a + 2 = -1 \quad \dots\dots (i)$$

$$b + 2 + a = 7 \quad \dots\dots (ii)$$

Using equation (i) & (ii)

$$a = 4, b = 1$$

$$\Rightarrow 2a + b = 9$$

12. If  $\alpha^{1/5}$  and  $\beta^{1/5}$  are roots of the equation  $8x^2 + bx + c = 0$  where  $\alpha = \max(2^{6\sin 3x} + 8\cos 3x)$  and  $\beta = \min(2^{6\sin 3x} + 8\cos 3x)$ . Then the value of  $|b-c|$  is :

Ans. (42.0)

Sol.  $\alpha = \max(2^{6\sin 3x} + 8\cos 3x) = 2^{10}$

$$\beta = \min(2^{6\sin 3x} + 8\cos 3x) = 2^{-10}$$

$$\alpha^{1/5} = 2^2 \text{ and } \beta^{1/5} = 2^{-2}$$

## Resonance Eduventures Ltd.

Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005

Ph. No.: +91-744-2777777, 2777700 | FAX No. : +91-022-39167222

To Know more : sms RESO at 56677 | Website : www.resonance.ac.in | E-mail : [contact@resonance.ac.in](mailto:contact@resonance.ac.in) | CIN : U80302RJ2007PLC024029

Toll Free : 1800 258 5555 | [facebook.com/ResonanceEdu](https://www.facebook.com/ResonanceEdu) | [twitter.com/ResonanceEdu](https://twitter.com/ResonanceEdu) | [www.youtube.com/resovatch](https://www.youtube.com/resovatch) | [blog.resonance.ac.in](http://blog.resonance.ac.in)





$$\Rightarrow \left( e^x + \frac{1}{e^x} \right)^2 - 2 - \left( e^x + \frac{1}{e^x} \right) - 4 = 0$$

$$\Rightarrow \left( e^x + \frac{1}{e^x} \right)^2 - \left( e^x + \frac{1}{e^x} \right) - 6 = 0$$

Put  $e^x + \frac{1}{e^x} = t$

$$\Rightarrow t^2 - t - 6 = 0$$

$$t = 3, t = -2 \text{ (not possible)}$$

$$\Rightarrow e^x + \frac{1}{e^x} = 3$$

$$e^{2x} - 3e^x + 1 = 0$$

Put  $e^x = p$

$$\Rightarrow p^2 - 3p + 1 = 0$$

$$\Rightarrow \text{number of solutions} = 2$$

15. If  $f(x) = \begin{cases} \max(\sin t) & ; 0 \leq t \leq x, x \in [0, \pi] \\ 2 + \cos x & ; x > \pi \end{cases}$  then the number of points where of  $f(x)$  is not continuous or

non-differentiable.

(1) 0

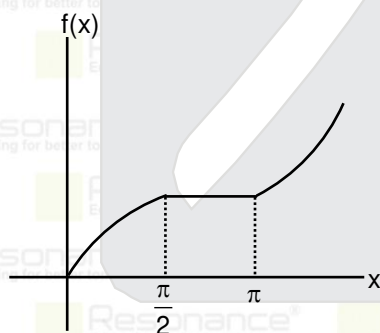
(2) 1

(3) 2

(4) infinite

Ans. (1)

Sol.



Critical point  $\frac{\pi}{2}$  &  $\pi$

$$\text{At } x = \frac{\pi}{2}$$

$f(x)$  is continuous and differentiable at  $x = \frac{\pi}{2} \Rightarrow \text{LHD} = \text{RHD} = 0$

at  $x = \pi$

$f(x)$  is again continuous and differentiable at  $x = \pi \Rightarrow \text{LHD} = \text{RHD} = 0$

So, number of dis-continuous and non differentiable point = 0

## Resonance Eduventures Ltd.

Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005

Ph. No.: +91-744-2777777, 2777700 | FAX No. : +91-022-39167222

To Know more : sms RESO at 56677 | Website : [www.resonance.ac.in](http://www.resonance.ac.in) | E-mail : [contact@resonance.ac.in](mailto:contact@resonance.ac.in) | CIN : U80302RJ2007PLC024029

Toll Free : 1800 258 5555 | [7340010333](https://www.facebook.com/ResonanceEdu) | [facebook.com/ResonanceEdu](https://www.facebook.com/ResonanceEdu) | [twitter.com/ResonanceEdu](https://twitter.com/ResonanceEdu) | [www.youtube.com/resowatch](https://www.youtube.com/resowatch) | [blog.resonance.ac.in](http://blog.resonance.ac.in)

16. If  $f(x) = \frac{1 - \sin x + \cos x}{1 + \sin x + \cos x}$ ,  $x \neq \pi$  then the value of  $f(\pi)$  so that  $f(x)$  is continuous.

- (1) 1 (2) 0 (3) -1 (4) 2

Ans. (3)

Sol. Since  $f(x)$  is continuous at  $x = \pi$

$$\Rightarrow f(\pi) = \lim_{x \rightarrow \pi} \frac{1 - \sin x + \cos x}{1 + \sin x + \cos x}$$

$$= \lim_{x \rightarrow \pi} \frac{2\cos^2 \frac{x}{2} - 2\sin \frac{x}{2} \cos \frac{x}{2}}{2\cos^2 \frac{x}{2} + 2\sin \frac{x}{2} \cos \frac{x}{2}}$$

$$= \lim_{x \rightarrow \pi} \frac{\cos \frac{x}{2} - \sin \frac{x}{2}}{\cos \frac{x}{2} + \sin \frac{x}{2}} = \frac{0 - 1}{0 + 1} = -1$$

$$\text{So } f(\pi) = -1$$

17. Let  $\left( 3^{\frac{1}{6} \log_3(25^{x-1} + 7)} + 3^{\frac{1}{8} \log_3(5^{x-1} + 1)} \right)^{10}$  is expanded in the increasing power of  $3^{\frac{1}{8} \log_3(5^{x-1} + 1)}$ . If 9<sup>th</sup> terms of the

expansion is 180 then the value of  $x$  is :

- (1) -1 (2) 1 (3) 0 (4) 2

Ans. (2)

Sol. 9<sup>th</sup> terms of the expansion  $\left( (25^{x-1} + 7)^{\frac{1}{6}} + (5^{x-1} + 1)^{\frac{1}{8}} \right)^{10}$  is

$${}^{10}C_8 \left( (25^{x-1} + 7)^{\frac{2}{6}} \times (5^{x-1} + 1)^{\frac{8}{8}} \right) = 180$$

$$\Rightarrow \frac{10 \times 9}{2} \left( (25^{x-1} + 7)^{\frac{2}{3}} \times (5^{x-1} + 1) \right) = 180$$

After solving  $x$  :

$$x = 1$$

## Resonance Eduventures Ltd.

Reg. Office & Corp. Office : CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005

Ph. No.: +91-744-2777777, 2777700 | FAX No. : +91-022-39167222

To Know more : sms RESO at 56677 | Website : [www.resonance.ac.in](http://www.resonance.ac.in) | E-mail : [contact@resonance.ac.in](mailto:contact@resonance.ac.in) | CIN : U80302RJ2007PLC024029

Toll Free : 1800 258 5555 | [7340010333](https://www.facebook.com/ResonanceEdu) | [facebook.com/ResonanceEdu](https://www.facebook.com/ResonanceEdu) | [twitter.com/ResonanceEdu](https://twitter.com/ResonanceEdu) | [www.youtube.com/resowatch](https://www.youtube.com/resowatch) | [blog.resonance.ac.in](http://blog.resonance.ac.in)