

2024 JEE 27<sup>th</sup> Shift-1 Questions

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**THE PERFECT HAT-TRICK WITH ALL-INDIA RANK 1**

JEE MAIN



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**27-Jan-2024 Shift-1**

Maths

1. Let  $a_1, a_2, \dots, a_{10}$  are 10 observations such that  $\sum_{i=1}^{10} a_i = 50$  and  $\sum_{i \neq j}^{10} a_i \cdot a_j = 1100$ , then their standard deviation will be

- (1)  $\sqrt{5}$   
(2)  $\sqrt{30}$   
(3)  $\sqrt{15}$   
(4)  $\sqrt{10}$

**Ans: (1)**

2. If  ${}^{n-1}C_r = (k^2 - 8) {}^n C_{r+1}$ , then the range of 'k' is

- (1)  $k \in (2\sqrt{2}, 3]$   
(2)  $k \in (2\sqrt{2}, 3)$   
(3)  $k \in [2, 3)$   
(4)  $k \in (2\sqrt{2}, 8)$

**Ans: (1)**

3. If four points  $(0,0), (1,0), (0,1), (2k, 3k)$  are concyclic, then  $k$  is

- (1)  $\frac{4}{13}$   
(2)  $\frac{5}{13}$   
(3)  $\frac{7}{13}$   
(4)  $\frac{9}{13}$

**Ans: (2)**

4. Find number of common terms in the two series

4, 9, 14, 19 .....upto 25 terms and

3, 9, 15, 21 .....upto 37 terms

- a) 4  
b) 7  
c) 5  
d) 3

**Ans: (a)**

5. If  $f(x) = x^3 + x^2 f'(1) + x f''(2) + f'''(3)$  then find  $f'(10)$

**Ans: (202)**

6. If  $(a, b)$  is the orthocenter of the Triangle having vertices  $(1, 2)$   $(2, 3)$  and  $(3, 1)$ .

$$I_1 = \int_a^b x \sin(4x^2 - x) dx, I_2 = \int_a^b \sin(4x^2 - x) dx \text{ then } \frac{36 I_1}{I_2} =$$

**Ans: (72)**

7. Find the value of  $\int_0^1 \frac{dx}{\sqrt{3+x} + \sqrt{1+x}} = A + B\sqrt{2} + C\sqrt{3}$

- a. 3
- b. 4
- c. 5
- d. 6

**Ans: (a)**

8. If sum of coefficients in  $(1 - 3x + 10x^2)^n$  and  $(1 + x^2)^n$  is  $A$  and  $B$  respectively then

- (1)  $A^3 = B$
- (2)  $A = B^3$
- (3)  $A = 2B$
- (4)  $A = B$

**Ans: (2)**

9.  $f(x) = \begin{bmatrix} \cos x & -\sin x & 0 \\ \sin x & \cos x & 0 \\ 0 & 0 & 1 \end{bmatrix}$

S - I  $\rightarrow f(-x) = \text{inverse of } f(x)$

S - II  $\rightarrow f(x)f(y) = f(x + y)$ .

- a) S1 is correct, S2 is incorrect
- b) S2 is correct, S1 is incorrect
- c) Both are correct
- d) Both are incorrect

**Ans: (c)**

10. Let  $8 = 3 + \frac{3+p}{4} + \frac{3+2p}{4^2} \dots \infty$  Find  $p$  is

- (A) 9
- (B)  $\frac{5}{4}$
- (C) 3
- (D) 1

**Ans: (A)**

11.  $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}$ ,  $\vec{b} = 3(\hat{i} - \hat{j} + \hat{k})$   $\vec{c}$  be the vector such that  $\vec{a} \times \vec{c} = \vec{b}$  and  $\vec{a} \cdot \vec{c} = 3$  then  $\vec{a} \cdot (\vec{c} \times \vec{b}) - \vec{b} \cdot \vec{c} = ?$

1. 24
2. -24
3. 18
4. 15

**Ans: (1)**

12.  $a = \lim_{x \rightarrow 0} \frac{(\sqrt{1+\sqrt{1+x^4}} - \sqrt{2})}{x^4}$ ,  $b = \lim_{x \rightarrow 0} \frac{\sin^2 x}{\sqrt{2} - \sqrt{1+\cos x}}$  Find  $ab^3 = ?$

- a. 16
- b. 32
- c. -16
- d. 48

**Ans: (b)**

13. For  $\frac{x^2}{25} + \frac{y^2}{16} = 1$ , find the length of chord whose mid point is  $P\left(1, \frac{2}{5}\right)$

- (1)  $\frac{\sqrt{1681}}{5}$
- (2)  $\frac{\sqrt{1481}}{5}$
- (3)  $\frac{\sqrt{1781}}{5}$
- (4)  $\frac{\sqrt{1691}}{5}$

**Ans: (4)**

14.  $f: N - \{1\} \rightarrow N$ ,  $f(n) =$  highest prime factor of 'n' then f is

1. One-one, onto
2. Many - one , on to
3. many-one, into
4. one-one, into

**Ans: (3)**

15. If  $|z - i| = |z - 1| = |z + i|$ ,  $z \in C$ , then the numbers of z satisfying the equation are

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

**Ans: (2)**

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16. If the minimum distance of centre of the circle  $x^2 + y^2 - 4x - 16y + 64 = 0$  from any point on the parabola  $y^2 = 4x$  is  $d$ , find  $d^2$

**Ans: (20)**

17. Consider the line  $L: 4x + 5y = 20$ . Let two other lines are  $L_1$  and  $L_2$  which trisect the line  $L$  and pass through origin, then tangent of angle between lines  $L_1$  and  $L_2$  is

- (1)  $\frac{20}{41}$
- (2)  $\frac{30}{41}$
- (3)  $\frac{40}{41}$
- (4)  $\frac{10}{41}$

**Ans: (2)**

18. If  $\alpha x + \beta y + 9 \ln |2x + 3y - 8\lambda| = x + C$  is the solution of  $(2x + 3y - 2)dx + (4x + 6y - 7)dy = 0$ , then  $\alpha + \beta + \gamma =$

- (1) 18
- (2) 19
- (3) 20
- (4) 21

**Ans: (1)**

19. If  $P(X)$  represent the probability of getting a '6' in the  $X^{\text{th}}$  roll of a die for the first time.

Also

$$a = P(X = 3)$$

$$b = P(X \geq 3)$$

$$c = P\left(\frac{X \geq 6}{x > 3}\right), \text{ then } \frac{b+c}{a} = ?$$

**Ans: (12)**

20. If the angle between two vectors  $\vec{a} = \alpha\hat{i} - 4\hat{j} - \hat{k}$  and  $\vec{b} = \alpha\hat{i} + \alpha\hat{j} + 4\hat{k}$  is acute then find least positive integral value of  $\alpha$ .

- (1) 4
- (2) 5
- (3) 6
- (4) 7

**Ans: (2)**

21. If  $S = \{1, 2, \dots, 10\}$  and  $M = P(S)$ ,

If  $ARB$  such that  $A \cap B \neq \phi$  where  $A \in M, B \in M$

Then

- (1)  $R$  is reflexive and symmetric
- (2) Only symmetric

- (3) Only reflexive  
(4) Symmetric and transitive

**Ans: (2)**

22. If  $f(x)$  is differentiable function satisfying  $f(x) - f(y) \geq \log \frac{x}{y} + x - y$ , then find

$$\sum_{N=1}^{20} f' \left( \frac{1}{N^2} \right)$$

**Ans: (2890)**

23. Let  $\frac{dx}{dt} + ax = 0$  and  $\frac{dy}{dt} + by = 0$  where  $y(0) = 1, x(0) = 2$ , and  $x(t) = y(t)$ , then t is

- (1)  $\frac{\ln 3}{a-b}$   
(2)  $\frac{\ln 2}{b-a}$   
(3)  $\frac{\ln 2}{a-b}$   
(4)  $\frac{\ln 3}{b-a}$

**Ans: (3)**

24.  $f(x) =$

$$\begin{cases} 2^{\frac{\sin(x-3)}{x-|x|}} & , x > 3 \\ -\frac{a(x^2-7x+12)}{b|x^2-7x+12|} & , x < 3 \\ b & , x = 3 \end{cases}$$

$x = 3$

**Ans: (1)**

25. Let  $A = \begin{bmatrix} 2 & 0 & 1 \\ 1 & 0 & 0 \\ 3 & 2 & 0 \end{bmatrix}, B = [B_1 B_2 B_3]$  where  $B_1, B_2, B_3$  are column matrices such that  $AB_1 =$

$$\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, AB_2 = \begin{bmatrix} 2 \\ 0 \\ 1 \end{bmatrix}, AB_3 = \begin{bmatrix} 3 \\ 2 \\ 1 \end{bmatrix}$$

$\alpha =$  sum of diagonal elements of B

$\beta = |B|$ , then find  $|\alpha^3 + \beta^3|$

**Ans: (1.125)**

26. If  $\cos(2x) - a \sin x = 2a - 7$  has a solution for  $a \in [p, q]$  and  $r = \tan 9^\circ + \tan 63^\circ + \tan 81^\circ + \tan 27^\circ$ , then p.q.  $r = ?$

- (1)  $40\sqrt{5}$   
(2)  $32\sqrt{5}$   
(3)  $30\sqrt{5}$   
(4)  $48\sqrt{5}$

**Ans: (4)**

**27-Jan-2024 Shift-1**

Chemistry

- Which of the following has maximum magnetic moment?  
a)  $3d^3$   
b)  $3d^6$   
c)  $3d^7$   
Ans: (b)
- Mass of methane required to produce 22 g  $\text{CO}_2$  upon combustion is \_\_\_\_.  
Ans: 8
- Assertion : Boron has very high melting point (2453 K)  
Reason: Boron has strong crystalline lattice.  
Ans: A-T ; R-T ;  
Exp. → Right
- Sum of bond order of  $\text{CO}$  &  $\text{NO}^+$  is :  
Ans: 6
- How many of following have +4 oxidation number of central atom:  $\text{BaSO}_4$ ,  $\text{SOCl}_2$ ,  $\text{SF}_4$ ,  $\text{H}_2\text{SO}_3$ ,  $\text{H}_2\text{S}_2\text{O}_7$ ,  $\text{SO}_3$   
Ans: 3
- $\text{PbCrO}_4 + \text{NaOH}$  (hot excess)  $\square\square?$   
Product is:  
a) dianionic; CN = 4  
b) tetra-anionic; CN = 6  
c) dianionic; CN = 6  
d) tetra-anionic ; CN = 4  
Ans: d
- For negative deviation from Raoult's law :  
(1) BP increases ; VP increases  
(2) BP decreases ; VP increases  
(3) BP decreases: VP decreases  
(4) BP increases ; VP decreases  
Ans: d

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8.  $\text{NaCl} + \text{H}_2\text{SO}_4 + \text{K}_2\text{Cr}_2\text{O}_7 \rightarrow \square\square$  Products Above reaction gives red fumes (A) which on hydrolysis with aqueous NaOH gives yellow solution (B). Compounds (A) and (B) are :

Ans:  $\text{CrO}_2\text{Cl}_2, \text{Na}_2\text{CrO}_4$

9. Order of spin only magnetic moment for



(P)

(Q)

(R)

a)  $P > R > Q$

b)  $P > Q > R$

c)  $R > Q > P$

d)  $Q > P > R$

Ans: a

10. Electronic configuration of Nd(Z = 60) is :

Ans:  $[\text{Xe}] 4f^4 6s^2$

11. **Statement-1:**  $(\text{NH}_4)_2\text{CO}_3$  is basic.

**Statement-2:** Acidic nature of salt of WA & WB is dependent on  $K_a$  of WA &  $K_b$  of WB.

Ans: ( $S_1 \square T$  ;  $S_2 \square T$ )

12. Number of electrons present in all the compound filled subshell having  $n = 4$  and  $s = +1/2$ .

Ans: 16

13. Consider following data :  $2\text{HI}(\text{g}) \rightleftharpoons \text{H}_2(\text{g}) + \text{I}_2(\text{g})$

	Experiment-1	Experiment-2	Experiment-3
HI(mole/litre)	0.005	0.01	0.02
Rate ( $\text{mol L}^{-1} \text{s}^{-1}$ )	$7.5 \times 10^{-4}$	$3 \times 10^{-3}$	$1.2 \times 10^{-2}$

Find order of reaction.

Ans: 2



14. If 3 moles of an ideal gas at 300 K expands isothermally from 30 dm<sup>3</sup> to 45 dm<sup>3</sup> against constant pressure of 80 K pascal then the amount of heat transfer is \_\_\_\_\_joule.

Ans: 1200

15. The mass of silver (Ag = 108 gm/mole) displaced by a quantity of electricity which displaces 5600 ml of O<sub>2</sub> at STP will be :

Ans: 108

16. Which of the following has +4 oxidation state?

(1) H<sub>2</sub>S<sub>2</sub>O<sub>7</sub>    (2) H<sub>2</sub>SO<sub>3</sub>

Ans: 2

17. Which halogen does not shows variable oxidation state?

- a) F<sub>2</sub>
- b) Cl<sub>2</sub>
- c) Br<sub>2</sub>
- d) I<sub>2</sub>

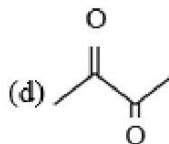
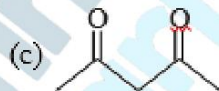
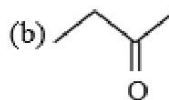
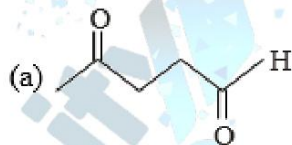
Ans: a

18. **Statement-1:** 4f & 5f series are written separately in periodic table in order to preserve principle of classification.

**Statement-2:** s-Block elements can be found on earth in pure form.

Ans: First statement is correct and second is not correct.

19. Which of the following compound is most acidic?



Ans: c

20. Which of the following is the strongest Bronsted base?



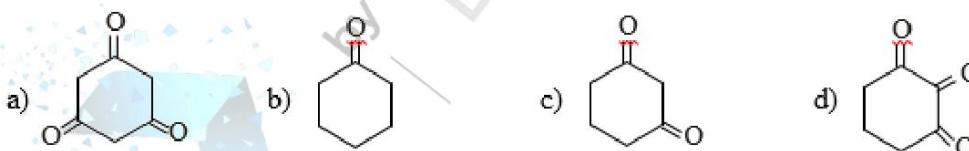
Ans: c

21. The correct statement regarding stereochemistry of  $S_N1$  and  $S_N2$  reaction is

- a)  $S_N1$  - Racemisation  
 $S_N2$  - Retention
- b)  $S_N1$  - Racemisation  
 $S_N2$  - Inversion
- c)  $S_N1$  - Retention  
 $S_N2$  - Inversion
- d)  $S_N1$  - Inversion  
 $S_N2$  - Retention

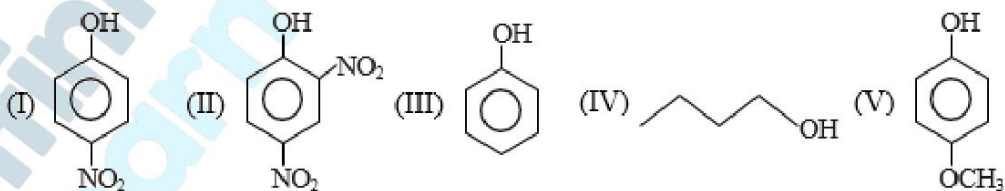
Ans: c

22. Which of the following has maximum enol content?



Ans: a

23. The correct order of acidic strength of the following compounds is

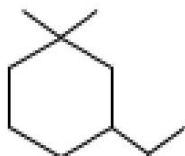


- a) II > I > III > V > IV
- b) II > I > V > III > IV
- c) I > II > III > V > IV

d) V > IV > III > I > II

Ans: a

24. The correct IUPAC name of following compound is



- a) 1,1-Dimethyl-3-ethyl cyclohexane
- b) 3-Ethyl-1,1-dimethyl cyclohexane
- c) 1-Ethyl-3,3-dimethyl cyclohexane
- d) 3,3-Dimethyl-1-ethyl cyclohexane

Ans: b

25. Cyclohexene is classified in

- e) Benzenoid aromatic
- f) Alicyclic
- g) Benzenoid non aromatic
- h) Acyclic

Ans: b

26. Which of the following is polar solvent

- a) CCl<sub>4</sub>
- b) CHCl<sub>3</sub>
- c) CH<sub>2</sub>=CH<sub>2</sub>
- d) CO<sub>2</sub>

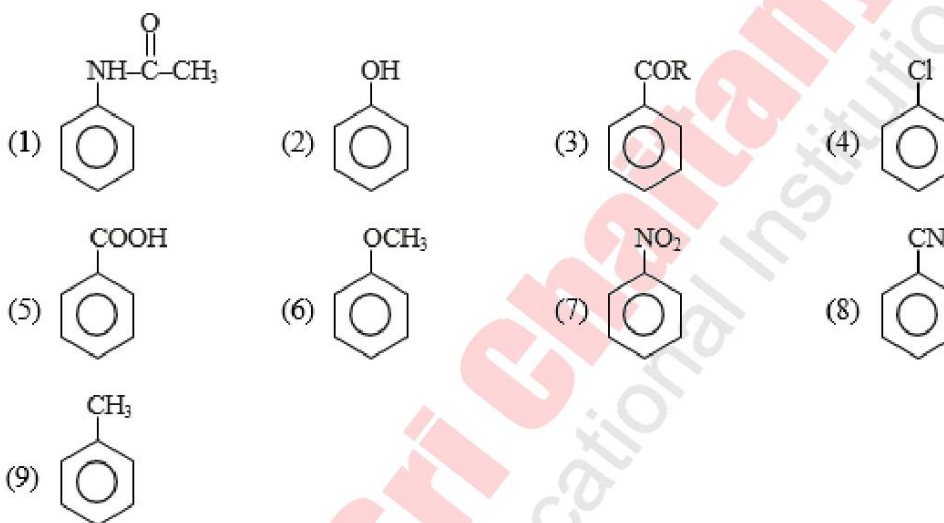
Ans: b

27. When nucleotide forms dimer the linkage present between is

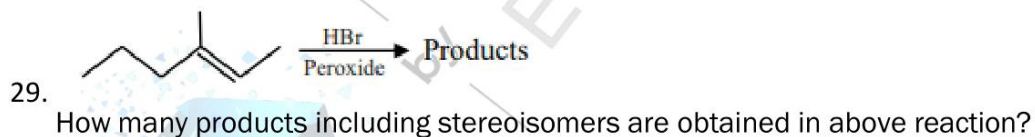
- a) Disulphide linkage
- b) Glycosidic linkage
- c) Phosphodiester linkage
- d) Peptide linkage

Ans: c

28. How many groups show meta directing effect on benzene ring?



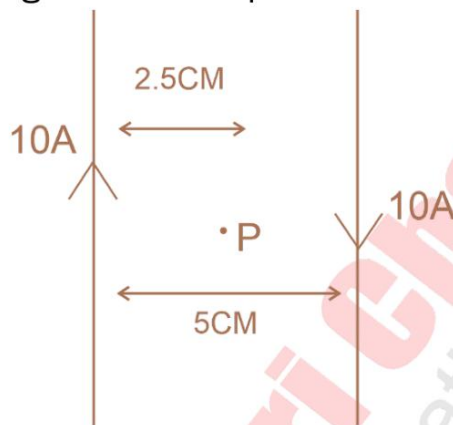
Ans: 4



Ans: 4

27-Jan-2024 Shift-1  
Physics

1. Find the magnetic field at point P



Ans:  $16 \times 10^{-5}$

2. If velocity at mean position is 10cm/s for SHM with  $A = 4$ cm . Find X when the velocity is 5cm/s

Ans:  $x = \pm 2\sqrt{3}$

3. If displacement of the particle  $S = 3t^2 + 4t + 5$  then velocity at  $t = 5$ sec

Ans: 34 m/s

4. Radius of the 3<sup>rd</sup> orbit is r then radius of the 4<sup>th</sup> orbit is

Ans:  $r_4 = r \times \frac{16}{9}$

5. If mass of 100kg moves with 6 m/s then velocity if 200kg is added

Ans:  $V = 5$  m/s

6. If  $E = E_0 \sin(\omega t - kx)$  then intensity of EM wave

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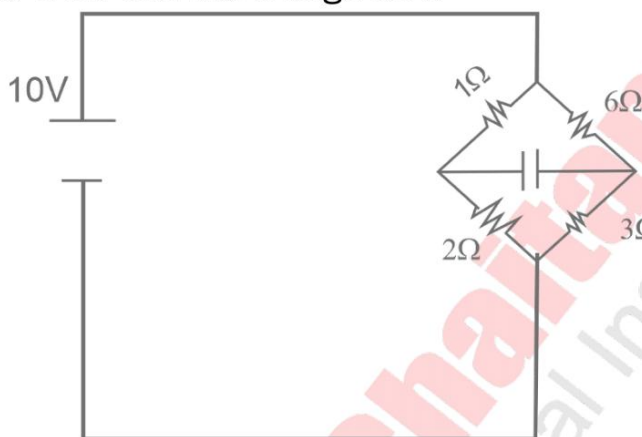


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Ans: Intensity =  $\frac{1}{2} \epsilon_0 E^2 \cdot C$

7. If  $C = 150 \mu\text{F}$  then find the charge on C

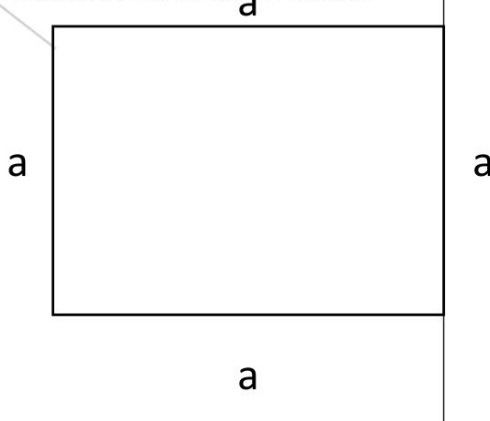


Ans:  $500 \mu\text{C}$

8. If two masses of 4g and 25g have seen KE then find the ratio of linear momentum

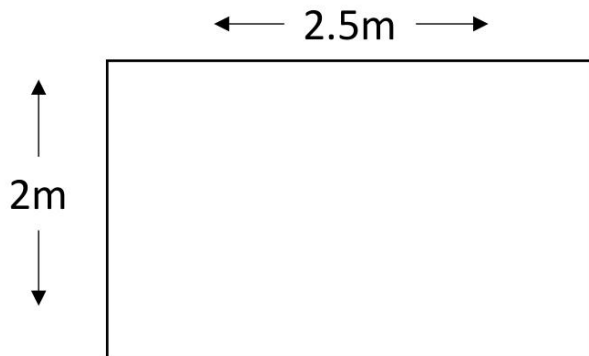
Ans:  $\frac{P_1}{P_2} = \frac{2}{5}$

9. Four rods each of mass  $m$  and length  $a$  are arranged as shown. Find the moment of inertia about the shown axis?



Ans:  $\frac{5ma^2}{3}$

10. Magnetic field  $B = (4t)$  Tesla into the page Find the average EMF induced in the loop



**Ans:** 2.16 volts

11. A proton with a constant velocity passes through a region of space without any change in its velocity. If  $E$  and  $B$  represents the electric and magnetic field, then the incorrect option is

**Ans:** c

- a.  $E=0, B=0$
  - b.  $E=0, B \neq 0$
  - c.  $E \neq 0, B=0$
  - d.  $E \neq 0,$
12. Statement 1: Linear momentum and moment of force has same dimensions
- a. Statement 2: Angular momentum and Planks constant have same dimensions

**Ans:** b

- a) Statement 1 is correct while statement 2 is false
  - b) Statement 1 is false while Statement 2 is correct
  - C) Both statements are correct
  - d) Both statements are false
13. If at the surface of the earth the acceleration due to gravity is given  $g$  then find the acceleration due to gravity at the surface

of the earth if the diameter of the earth is reduced to half ( mass of earth remains constant)

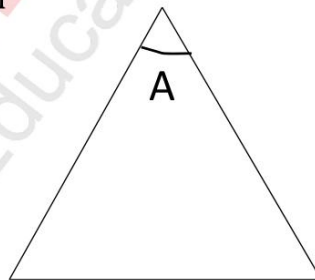
**Ans:** c

- a. g
- b. 2g
- c. 4g
- d. 16g

14. Resistance of length  $l$  is cut into five parts and those parts are put in parallel. Then find new resistance.

**Ans:**  $\frac{R}{25}$

15. If  $n = \cot\left(\frac{A}{2}\right)$  then find  $\delta_{\min}$



**Ans:**  $\delta_m = \pi - 2A$

16. Average K.E of a monoatomic molecule is  $0.414\text{eV}$ . Then the temperature is

**Ans:**  $3400^\circ\text{C}$

17.  $m_1 = 4\text{ kg}$ ,  $m_2 = 25\text{ kg}$ , K.E's are equal. Find the ratio of their Linear momentum?

**Ans:** 2:5

18. Consider the system shown. Find the moment of inertia about the diagonal shown.

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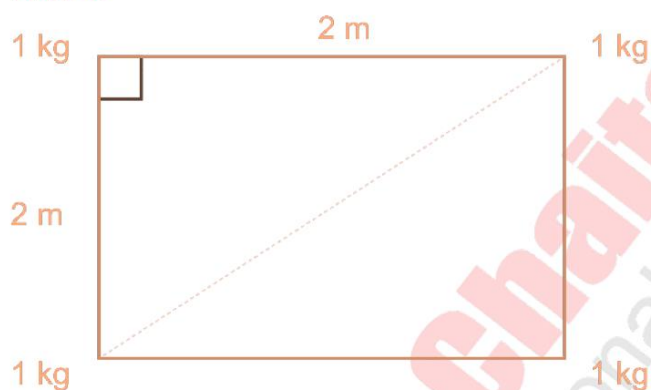
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- (a)  $1 \text{ kg} \cdot \text{m}^2$
- (b)  $2 \text{ kg} \cdot \text{m}^2$
- (c)  $4 \text{ kg} \cdot \text{m}^2$
- (d)  $6 \text{ kg} \cdot \text{m}^2$

Ans: c

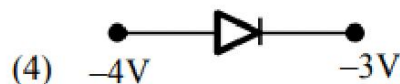
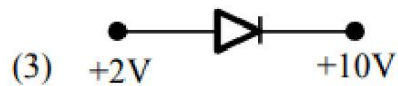
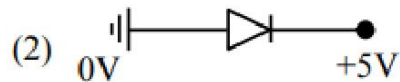
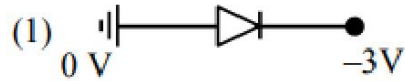


19. A rod of length  $l$  having resistance  $R$ , is cut into two equal parts. These parts are connected in parallel then new resistance shall be?

Ans: c

- (a)  $R$
- (b)  $\frac{R}{2}$
- (c)  $\frac{R}{4}$
- (d)  $2R$

20. Which among the following is forward biased:



a.

**Ans. 1**

21. Acceleration due to earth on the surface is  $g_0$ . If mass of earth remains same but radius is half, then find the acceleration on the surface for new system :

(1)  $\frac{g_0}{2}$

(2)  $g_0$

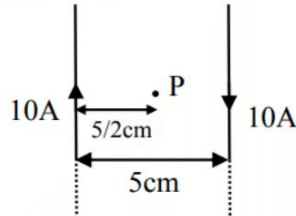
(3)  $2g_0$

(4)  $4g_0$

**Ans. (D)**

22. Two very long wire having current as shown. Find the magnetic field at point ' P ' (in micro tesla).

**Ans. 160**



23. If the electron revolving in the third Bohr's orbit of hydrogen species has radius  $R$ , then what will be its radius in fourth orbit in terms of  $R$ .

- (1)  $\frac{25R}{9}$   
 (2)  $\frac{16R}{9}$   
 (3)  $\frac{36R}{9}$   
 (4)  $\frac{9R}{16}$

Ans. (B)

24. A charge of magnitude  $10^{-6} \mu\text{C}$  is placed at origin in  $x - y$  co-ordinate system. Find the potential difference between the two point  $(\sqrt{3}, \sqrt{3})$  and  $(\sqrt{6}, 0)$ . (Axis are in meters)

- (1)  $3\sqrt{3} \times 10^3 \text{ V}$   
 (2)  $\frac{3}{\sqrt{3}} \times 10^3 \text{ V}$   
 (3)  $0 \text{ V}$   
 (4)  $2\sqrt{3} \times 10^3 \text{ V}$

Ans. (3)

25. An EM wave is given by

$$E = 200 \sin [1.5 \times 10^7 t - 0.05x] \text{ N/C}$$

Find the intensity of wave. [ $\epsilon_0 = 8.85 \times 10^{-12}$  SI units ]

Ans. 53.1

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26. A particle performs SHM with an amplitude 4 cm. Speed of particle at mean position is 10 cm/sec. Find position from mean where speed is 5 cm/sec

- (1) 2 cm
- (2)  $2\sqrt{3}$  cm
- (3) 0.5 cm
- (4)  $\sqrt{3}$  cm

Ans. (2)

27. Given :

$$m = 0.08 \text{ kg}$$

$$s_v = 0.17 \text{ kcal/kg} - ^\circ\text{C}$$

$$\Delta T = 5^\circ\text{C}$$

Find change in internal energy (in Joule) of gas.

Ans. 284

28. A gas undergoes isothermal expansion from  $30\text{dm}^3$  to  $45\text{dm}^3$ . Find heat absorbed by gas if external pressure is 10kPa ?

- (a) 100 J
- (b) 150 J
- (c) 120 J
- (d) 200 J

Ans. (C)

29. A banked road of radius 400 m is there with base separation between the rails is 1.5 m, if speed of a car for safe turning is 12 m/s, then find height of one rail w.r.t to second rail?

- (1)  $h = 0.054 \text{ m}$
- (2)  $h = 0.1 \text{ m}$

(3)  $h = 0.001 \text{ m}$

(4)  $h = 0.2 \text{ m}$

**Ans.** (1)

30. A particle is moving from origin with initial velocity  $55\hat{i}\text{m/s}$  and constant acceleration  $3\hat{i} + 2\hat{j}\text{m/s}^2$ .

When position of particle is  $84 \text{ m}$ , its velocity is  $\sqrt{\alpha}\text{m/s}$ . Find out  $\alpha$  :

**Ans.** 673

31.  $S_1 \rightarrow$  Viscosity coefficient of gas is less than liquid.  
 $S_2 \rightarrow$  Surface tension decreases if insoluble impurities are added.
- (1)  $S_1$  is true,  $S_2$  is true  
 (2)  $S_1$  is false,  $S_2$  is false  
 (3)  $S_1$  is true,  $S_2$  is false  
 (4)  $S_1$  is false,  $S_2$  is true

**Ans.** (1)

32. A point charge  $q$  is placed at a centre of a charged ring of total charge  $Q$ . Find tension in the ring.

**Ans.**  $\frac{KQq}{2\pi R^2}$

33. In meter bridge experiment there is a resistance in right slot of length  $10 \text{ cm}$  and radius of cross section is  $\sqrt{7} \times 10^{-4} \text{ m}$ . In left slot these is a resistance of  $4.5\Omega$ . If balance length from left is  $60 \text{ cm}$ . If unknown resistivity is  $x \times 10^{-7}$ . Find 'x'.

**Ans.** 66

34. Spherometer can't be used for measurement of :
- (1) Radius of curvature of convex mirror  
 (2) Radius of curvature of concave mirror



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- (3) Thickness of capacitor plates
- (4) Specific rotation of liquid

Ans. (4)

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