JEE Main 2019

Question Paper with Answer



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JEE Main 2019 Question Paper with Answers
11 Jan 2019 : Shift 1 : Paper 1

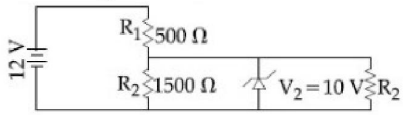
Physics

1. A rigid diatomic ideal gas undergoes an adiabatic process at room temperature. The relation between temperature and volume for this process is TV^x=constant, then x is:
1. 2/5
2. 5/3
3. 2/3
4. 3/5

2 . A gas mixture consists of 3 moles of oxygen and 5 moles of argon at temperature T. Considering only translational and rotational modes, the total internal energy
of the system is :
1. 15 RT
2. 20 RT
3. 12 RT
4. 4 RT

3. In a Young's double slit experiment, the path difference, at a certain point on the screen, between two interfering waves is ⅛ th of wavelength. The ratio of the intensity at this point to that at the centre of a bright fringe is close to :
1. 0.94
2. 0.85
3. 0.74
4. 0.80

4. In the given circuit the current through Zener Diode is close to:



1. 0.0 mA
2. 4.0 mA
3. 6.0 mA
4. 6.7 mA

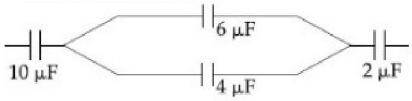
5. In an experiment, electrons are accelerated, from rest, by applying a voltage of 500 V. Calculate the radius of the path if a magnetic field 100 mT is then applied. [Charge of the electron=1.6 x 10^{-19} C
Mass of the electron=9.1 x 10^{-2} kg]
1. 7.5 x 10^{-3} m
2. 7.5 x 10^{-4} m

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3. 7.5 x 10^{-2} m
4. 7.5 m

6. A body of mass 1 kg falls freely from a height of 100 m, on a platform of mass 3 kg which is mounted on a spring having spring constant k=1.25 x 10^6 N/m. The body sticks to the platform and the spring's maximum compression is found to be x. Given that g=10 x 10^{-2} , the value of x will be close to:
1. 40 cm
2. 4 cm
3. 8 cm
4. 80 cm

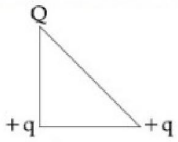
7. In the figure shown below, the charge on the left plate of the 10 μF capacitor is - 30μC .The charge on the right plate of the 6 μF capacitor is :



1. +12 μc
2. - 18 μc
3. – 12 μc
4. +18 μc

8. An amplitude modulated signal is given by $V(t) = 10\left[1 + 0.3\cos\left(2.2 \times 10^4 t\right)\right]\sin\left(5.5 \times 10^5 t\right)$. Here t is in seconds. The sideband frequencies (in kHz) are, [Given π = 22/7]
1. 178.5 and 171.5
2. 89.25 and 85.75
3. 1785 and 1715
4. 892.5 and 857.5

9. Three charges Q, +qand +q are placed at the vertices of a right-angle isosceles triangle as shown below. The net electrostatic energy of the configuration is zero, if the value of Q is :

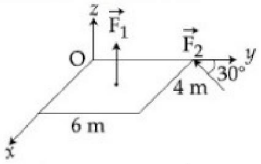


1. $\frac{-q}{1+\sqrt{2}}$
2. +q
3. -2q
4. $\frac{-\sqrt{2}q}{\sqrt{2}+1}$

10. An electromagnetic wave of intensity 50Wm^{-2} enters in a medium of refractive index 'n' without any loss. The ratio of the magnitudes of electric fields, and the ratio of the magnitudes of magnetic fields of the wave before and after entering into the medium are respectively, given by :
1. $(\sqrt{n}, \sqrt{n})$
2. $\left(\sqrt{n}, \frac{1}{\sqrt{n}}\right)$
3. $\left(\frac{1}{\sqrt{n}}, \frac{1}{\sqrt{n}}\right)$
4. $\left(\frac{1}{\sqrt{n}}, \sqrt{n}\right)$

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11. A slab is subjected to two forces $\vec{F}_1$ and $\vec{F}_2$ of same magnitude F as shown in the figure. Force $\vec{F}_2$ is in XY-plane while force F_1 acts along Z-axis at the point $(2\vec{i}+3\vec{j})$ .The moment of these forces about point O will be :



1. $(3\hat{i}+2\hat{j}-3\hat{k})F$
2. $(3\hat{i}+2\hat{j}+3\hat{k})F$
3. $(3\hat{i}-2\hat{j}+3\hat{k})F$
4. $(3\hat{i}-2\hat{j}-3\hat{k})\mathbf{F}$

12. A hydrogen atom,initially in the ground state is excited by absorbing a photon of wavelength 980 Å. The radius of the atom in the excited state, in terms of Bohr radius a_o, will be: (hc = 12500 eV-Å)

1. $25a_o$
2. $16a_o$
3. $4a_o$
4. $6a_o$

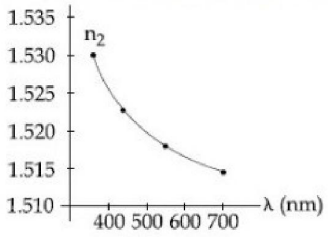
13. Ice at -20°C is added to 50 g of water at 40°C. When the temperature of the mixture reaches 0°C, it is found that 20 g of ice is still unmelted. The amount of ice added to the water was close to (Specific heat of water=4.2 J/g/°C
Specific heat of Ice=2.1 J/g/°C
Heat of fusion of water at 0°C=334 J/g)

1. 40 g
2. 50 g
3. 100 g
4. 60 g

14. A particle undergoing simple harmonic motion has time dependent displacement given by $x(t)=A\sin\frac{\pi t}{90}$. The ratio of kinetic to potential energy of this particle at t=210s will be:

1. 1/9
2. 1
3. 3
4. 2

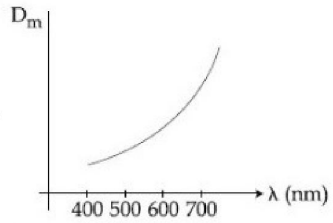
15. The variation of refractive index of a crown glass thin prism with wavelength of the incident light is shown. Which of the following graphs is the correct one, if D_m is the angle of minimum deviation ?



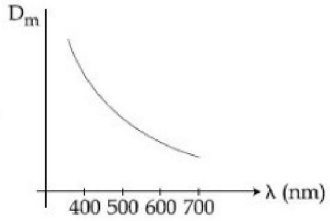
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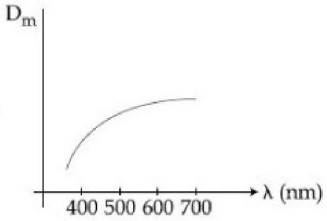
1.



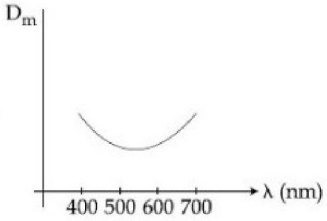
2.



3.



4.



16. A particle is moving along a circular path with a constant speed of 10 ms^{-1}. What is the magnitude of the change in velocity of the particle, when it moves through an angle of 60° around the centre of the Circle?

1. zero
2. 10 m/s
3. $10\sqrt{3}\mathrm{m/s}$
4. $10\sqrt{2}\mathrm{m/s}$

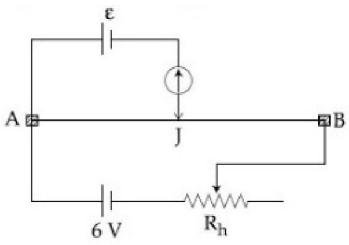
17. The force of interaction between two atoms is given by $\mathrm{F} = \alpha\beta \exp\left(-\frac{x^2}{\alpha \mathrm{kt}}\right)$; where x is the distance, k is the Boltzmann constant and T is temperature and α and β are two constants. The dimension of β is :

1. $\mathrm{M}^2\mathrm{LT}^{-4}$
2. $\mathrm{M}^0\mathrm{L}^2\mathrm{T}^{-4}$
3. MLT^{-2}
4. $M^2L^2T^{-2}$

18. The resistance of the meter bridge AB in given figure is 4 Ω . With a cell of emf ε =0.7 V and rheostat resistance $R_h = 2\Omega$ the null point is obtained at some point J. When the cell is replaced by another one of emf ε = ε2 , the same null point J is found for $R_h = 6\Omega$. The emf ε2 is,

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1. 0.6 V
2. 0.3 V
3. 0.5 V
4. 0.4 V

19 . A body is projected at t=0 with a velocity 10 ms^{-1} at an angle of 60° 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=10 ms^{-2}, the value of R is :

1. 10.3 m
2. 2.8 m
3. 2.5 m
4. 5.1 m

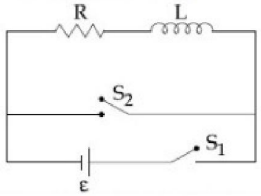
20. A liquid of density ρ is coming out of a hose pipe of radius a with horizontal speed v and hits a mesh. 50% of the liquid passes through the mesh unaffected. 25% looses all of its momentum and 25% comes back with the same speed. The resultant pressure on the mesh will be :

1. $\frac{3}{4}\rho v^2$
2. $\frac{1}{2}\rho v^2$
3. ρv^2
4. $\frac{1}{4}\rho v^2$

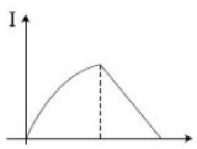
21. Equation of travelling wave on a stretched string of linear density 5 g/m is y=0.03 sin(450 t - 9x) where distance and time are measured in SI units. The tension in the string is :

1. 5N
2. 10 N
3. 12.5 N
4. 7.5 N

22.In the circuit shown,

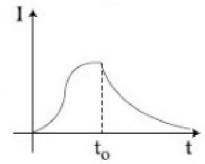


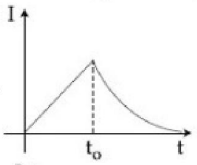
the switch S_1 is closed at time t=0 and the switch S_2 is kept open. At some later time(t_o), the switch S_1 is opened and S_2 is closed. The behaviour of the current I as a function of time 't' is given by :

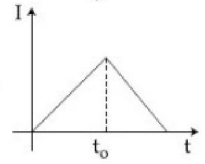
1. 

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2. 

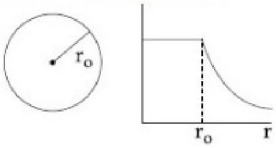
3. 

4. 

23. A satellite is revolving in a circular orbit at a height h from the earth surface, such that h << R where R is the radius of the earth. Assuming that the effect of earth's atmosphere can be neglected the minimum increase in the speed required so that the satellite could escape from the gravitational field of earth is :

1. $\sqrt{gR}(\sqrt{2}-1)$
2. $\sqrt{\frac{gR}{2}}$
3. $\sqrt{g\mathrm{R}}$
4. $\sqrt{2g\mathrm{R}}$

24. The given graph shows variation (with distance r from centre) of :



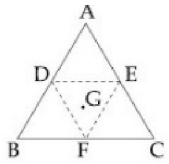
1. Potential of a uniformly charged sphere
2. Potential of a uniformly charged spherical shell
3. Electric field of a uniformly charged spherical shell
4. Electric field of a uniformly charged sphere

25. Two equal resistances when connected in series to a battery, consume electric power of 60W. If these resistances are now connected in parallel combination to the same battery, the electric power consumed will be:

1. 60 W
2. 30 W
3. 120 W
4. 240 W

26. An equilateral triangle ABC is cut from a thin solid sheet of wood. (See figure) D, E and F are the mid-points of its sides as shown and G is the centre of the triangle. The moment of inertia of the triangle about an axis passing through G and perpendicular to the plane of the triangle is I_o. If the smaller triangle DEF is removed from ABC, the moment of inertia of the remaining figure about the same axis is I. Then :

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1. $I = \frac{9}{16} I_0$
2. $\mathrm{I} = \frac{\mathrm{I}_0}{4}$
3. $\mathrm{I} = \frac{3}{4}\mathrm{I}_0$
4. $\mathrm{I} = \frac{15}{16}\mathrm{I}_0$

27. There are two long co-axial solenoids of same length l. The inner and outer coils have radii r_1 and r_2 and number of turns per unit length $_1$ and n_2 , respectively. The ratio of mutual inductance to the self inductance of the inner-coil is :

1. $\frac{n_2}{n_1} \cdot \frac{r_1}{r_2}$
2. $\frac{n_2}{n_1} \cdot \frac{r_2^2}{r_1^2}$
3. $\frac{n_2}{n_1}$
4. $\frac{n_1}{n_2}$

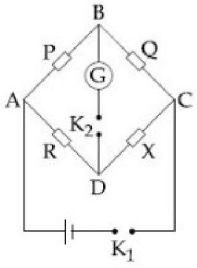
28. An object is at a distance of 20 m from a convex lens of focal length 0.3 m. The lens forms an image of the object. If the object moves away from the lens at a speed of 5 m/s, the speed and direction of the image will be:

1. 0.92 x 10^{-3} m/s away from the lens
2. 2.26 x 10^{-3} m/s away from the lens
3. 3.22 x 10^{-3} m/s towards the lens
4. 1.16 x 10^{-3} m/s towards the lens

29.If the de Broglie wavelength of an electron is equal to 10^{-3} times the wavelength of a photon of frequency 6 x 10^{14} Hz, then the speed of electron is equal to : (Speed of light=3x10^8 m/s Planck's constant=6.63 x 10^{-34} J.s
Mass of electron=9.1 x 10^{-31} kg)

1. 1.8 x 10^6 m/s
2. 1.45 x 10^6 m/s
3. 1.7 x 10^6 m/s
4. 1.1 x 10^6 m/s

30. In a Wheatstone bridhe (see fig.) Resistances P and Q are approximately equal. When R=400 Ω , the bridge is balanced. On interchanging P and Q, the value of R, for balance, is 405Ω. The value of X is close to:



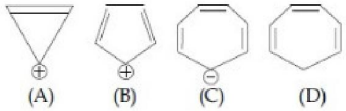
1. 401.5 ohm
2. 404.5 ohm

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3. 103.5 ohm
4. 402.5 ohm

Chemistry

1. Which compound (s) out of the following is/are not aromatic?



1. (B)
2. (C) and (D)
3. (A) and (C)
4. (B), (Cand (D)

2. The chloride that CANNOT get hydrolysed is :
1. $\mathrm{PBC_4}$
2. $\mathrm{SnCl_4}$
3. $\mathrm{SiCl_4}$
4. $\mathrm{CCl_4}$

Q.3 NaH is an example of:
1. molecular hydride
2. metallic hydride
3. saline hydride
4. electron-rich hydride

4. If a reaction follows the Arrhenius equation, the plot Ink vs $1/(\mathrm{RT})$ gives straight line with a gradient (-y) unit. The energy required to activate the reactant is:

1. y/Runit
2. - y unit
3. yR unit
4. y unit

5. For the chemical reaction X = Y, the standard reaction Gibbs energy depends on temperature T in K) as.
$\Delta_r G^{\circ}(\text{ in } k] mol^{-1}) = 120 - \frac{3}{8}T$
The major component of the reaction mixture at T is:
1. Y if T=280 K
2. Yif T=300 K
3. Xif T=350 K
4. Xif T=315 K

6. Match the metals (column I) with the coordination compound(s)/enzyme(s) (column II):

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(column I) Metals			(column II) Coordination compound(s)/enzyme(s)
(A)	Co	(i)	Wilkinson catalyst
(B)	Zn	(ii)	Chlorophyll
(C)	Rh	(iii)	Vitamin B_{12}
(D)	Mg	(iv)	Carbonic anhydrase

1. (A)-(iv); (B)-(iii); (-(i); (D)-(ii)
2. (A)-(i); (B)-(ii); (C)-(iii); (D)-(iv)
3. (A)-(ii); (B)-(1); (C)-(iv); (D)-(iii)
4. (A)-(iii); (B)-(iv); (C)-(i); (D)-(ii)

7. Match the ores (column A) with the metals (column B) :

(Column A) Ores		(Column B) Metals	
(I)	Siderite	(a)	Zinc
(II)	Kaolinite	(b)	Copper
(III)	Malachite	(c)	Iron
(IV)	Calamine	(d)	Aluminium

1. (I) - (b); (II) - (c); (III) - (d); (IV)-(a)
2. (I) - (c); (II) - (d); (III) - (b); (IV) - (a)
3. (1)-(a); (II) - (b); (III) - (c); (IV)-(d)
4. (1) - (c); (II) - (d); (III) - (a); (IV) - (b)

8 An example of solid sol is :
1. Paint
2. Hair cream
3. Gem stones
4. Butter

9. The concentration of dissolved oxygen (DO) in cold water can go upto :
1. 14 ppm
2. 8 ppm
3. 16 ppm
4. 10 ppm

10. The correct order of the atomic radii of C, Cs, Al, and S is:
1. S
1. $(A) \rightarrow (Q); (B) \rightarrow (R); (C) \rightarrow (P)$
2. $(A) \rightarrow (R); (B) \rightarrow (P); (C) - (S)$
3. $(A) \rightarrow (S); (B) \rightarrow (R); (C) \rightarrow (P)$
4. $(A) \rightarrow (Q); (B) \rightarrow (R); (C) \rightarrow (S)$

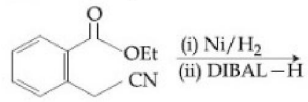
14. Peroxyacetyl nitrate (PAN), an eye irritant is produced by :
1. photochemical smog
2. classical smog
3. acid rain
4. organic waste

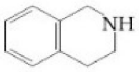
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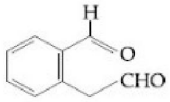
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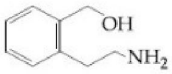
15. A 10 mg effervescent tablet containing sodium bicarbonate and oxalic acid releases 0.25 ml of CO_2 at T = 298.15K and p = 1 bar. If molar volume of CO_2 is 25.0 L under such condition, what is the percentage of sodium bicarbonate in each tablet ?
[Molar mass of $NaHCO_3$ = 84 g mol^{-1}]
1. 33.6
2. 8.4
3. 0.84
4. 16.8

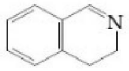
16.The major product of the following reaction is :



1. 

2. 

3. 

4. 

17. Anorganic compound is estimated through Dumus method and was found to evolve 6 moles of CO_2, 4 moles of H_2O and 1 mole of nitrogen gas. The formula of the compound is :
1. $C_6H_8N_2$
2. C_6H_8N
3. $C_{12}2H_8N_2$
4. $C_{12}H_8N$

18 . The amphoteric hydroxide is :
1. $Sr(OH)_2$
2. $Mg(OH)_2$
3. $Be(OH)_2$
4. $Ca(OH)_2$

19. Two blocks of the same metal having same mass and at temperature T_1 and T_2 respectively, are brought in contact with each other and allowed to attain thermal equilibrium at constant pressure. The change in entropy, ΔS, for this process is :
1. $2C_p \ln\left[\frac{(T_1+T_2)^{\frac{1}{2}}}{T_1T_2}\right]$
2. $C_p \ln\left[\frac{(T_1+T_2)^2}{4T_1T_2}\right]$
3. $2C_p \ln\left[\frac{T_1+T_2}{2T_1T_2}\right]$
4. $2C_p \ln\left(\frac{T_1+T_2}{4T_1T_2}\right)$

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20. For the cell $Zn(s)\left|Zn^{2+}(aq)\right|M^{x+}(aq)|M(s)$, different half cells and their standard electrode potentials are given below:

$M^{x+}(aq)/M(s)$	$Au^{3+}(aq)/Au(s)$	$Ag^{+}(aq)/Ag(s)$	$Fe^{3+}(aq)/Fe^{2+}(aq)$	$Fe^{2+}(aq)/Fe(s)$
$E^{\circ}_{M^{x+}/M}(V)$	1.40	0.80	0.77	−0.44

If $E_{Zn^{2}+}/Zn = -0.76V$, which cathode will give a maximum value of E°cell per electron transferred?

1. Fe^{2+}/Fe
2. Fe^{3+}/Fe^{2+}
3. Au^{3+}/Au
4. Ag^{+}/Ag

21. Consider the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ The equilibrium constant of the above reaction is K_p, If pure ammonia is left to dissociate, the partial pressure of ammonia at equilibrium is given by (Assume that $P_{NH_3} << p_{total}$ at equilibrium)

1. $\frac{K_p^{1/2}P^2}{16}$
2. $\frac{K_p^{1/2}P^2}{4}$
3. $\frac{3^{3/2}K_p^{1/2}P^2}{4}$
4. $\frac{3^{3/2}K_p^{1/2}P^2}{16}$

22. The correct match between item (I) and item (II) is :

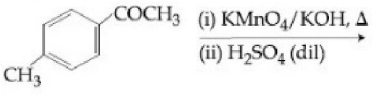
	Item - I	Item - II
(A)	Norethindrone	(P) Anti-biotic
(B)	Ofloxacin	(Q) Anti-fertility
(C)	Equanil	(R) Hypertension
		(S) Analgesics

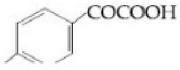
1. $(A) \rightarrow (Q); (B) \rightarrow (P); (C) \rightarrow (R)$
2. $(A) \rightarrow (R); (B) \rightarrow (P); (C) \rightarrow (S)$
3. $(A) \rightarrow (Q); (B) \rightarrow (R); (C) \rightarrow (S)$
4. $(A) \rightarrow (R); (B) \rightarrow (P); (C) \rightarrow (R)$

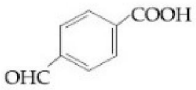
23. The freezing point of a diluted milk sample is found to be -0.2°C, while it should have been -0.5°C for pure milk. How much water has been added to pure milk to make the diluted sample?

1. 1 cup of water to 3 cups of pure milk
2. 1 cup of water to 2 cups of pure milk
3. 3 cups of water to 2 cups of pure milk
4. 2 cups of water to 3 cups of pure milk

24. The major product of the following reaction is

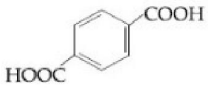


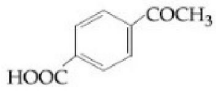
1. 

2. 

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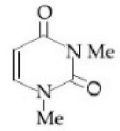
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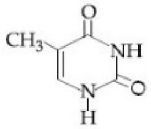
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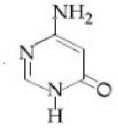
4. 

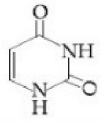
25. Heat treatment of muscular pain involves radiation of wavelength of about 900 nm. Which spectral line of H-atom is suitable for this purpose ? [
$R_H = 1 \times 10^5 \text{cm}^{-1}, \text{h} = 6.6 \times 10^{-34} \text{Js}, c = 3 \times 10^8 \text{ms}^{-1}$]
1. Paschen, $5 \rightarrow 3$
2. Paschen, $\infty \rightarrow 3$
3. Lyman, $\infty \rightarrow 1$
4. Balmer, $\infty \rightarrow 2$

26. Among the following compounds, which one is found in RNA?

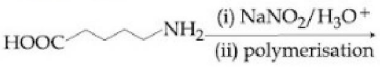
1. 

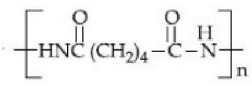
2. 

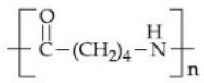
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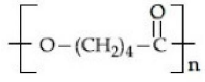
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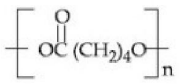
27. The polymer obtained from the following reactions is :



1. 

2. 

3. 

4. 

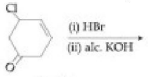
28. The correct statements among (a) to (d) regarding H_2 as a fuel are:
(a) It produces less pollutants than petrol.
(b) A cylinder of compressed dihydrogen weighs ~30 times more than a petrol tank producing the same

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amount of energy.
(c) Dihydrogen is stored in tanks of metal alloys like $NaNi_5$
(d) On combustion, values of energy released per gram of liquid dihydrogen and LPG are 50 and 142 kJ, respectively.
1. (b) and (d) only
2. (a) and (c) only
3. (b), (c) and (d) only
4. (a), (b) and (c) only

29. The major product of the following reaction



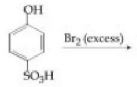
1. 

2. 

3. 

4. 

30. The major product of the following reaction is :



1. 

2. 

3. 

4. 

Mathematics

1. Two circles with equal radii are intersecting at the points (0,1) and (0, -1). The tangent at the point(0, 1) to one of the circles passes through the centre of the other circle. Then the distance between the centres of these circles is :
1. $\sqrt{2}$
2. $2\sqrt{2}$
3. 1
4. 2

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2. If y(x) is the solution of the differential equation $\frac{dy}{dx}+\left(\frac{2x+1}{x}\right)y=e^{-2x}, x>0$, where $y(1)=\frac{1}{2}e^{-2}$, then:

where , then:

1. $y\left(\log_e 2\right)=\frac{\log_e 2}{4}$
2. y(x) is decreasing i n (1, 0)
3. y(x) is decreasing in (½, 1)
4. $y\left(\log_e 2\right)=\log_e 4$

3. Let [x] denote the greatest integer less than or equal to x. Then $\lim_{x\to 0}\frac{\tan\left(\pi\sin^2 x\right)+(|x|-\sin(x[x]))^2}{x^2}$:

1. does not exist
2. equals
3. equals 0
4. equals

4. The area (in sq.units) of the region bounded by the curve $x^2=4y$ and the straight line x = 4y - 2 is:

1. 3/4
2. 7/8
3. 5/4
4. 9/8

5. If one real root of the quadratic equation $81x^2+kx+256=0$ is cube of the other root, then a value of k is :

1. - 300
2. 144
3. 100
4. - 81

6. Let $a_1, a_2, \ldots, a_{10}$, then $\frac{a_9}{a_5}$ equals:

1. $4(5^2)$
2. 5^3
3. 5^4
4. $2(5^2)$

7. The value of the integral $\int_{-2}^{2}\frac{\sin^2 x}{\left[\frac{x}{\pi}\right]+\frac{1}{2}}dx$

(where [x] denotes the greatest integer less than or equal to x) is:

1. 0
2. sin 4
3. 4-sin 4
4. 4

8. The sum of an infinite geometric series with positive terms is 3 and the sum of the cubes of its terms is 22/19. Then the common ratio of this series is :

1. 2/9
2. 4/9
3. 2/3
4. 1/3

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9. The straight line x + 2y = 1 meets the coordinate axes at A and B. A circle is drawn through A, B and the origin. Then the sum of perpendicular distances from A and B on the tangent to the circle at the origin is :

1. $2\sqrt{5}$
2. $4\sqrt{5}$
3. $\frac{\sqrt{5}}{4}$
4. $\frac{\sqrt{5}}{2}$

10. The sum of the real values of x for which the middle term in the binomial expansion of $\left(\frac{x^3}{3}+\frac{3}{x}\right)^8$ equals 5670 is :

1. 0
2. 6
3. 8
4. 4

11. The outcome of each of 30 items was observed ; 10 items gave an outcome - d each, 10 items gave outcome each and the remaining 10 items gave outcome + d each. If the variance of this outcome data is 4/3 then |d| equals :

1. 2/3
2. $\frac{\sqrt{5}}{2}$
3. $\sqrt{2}$
4. 2

12. If q is false and $p \wedge q \leftrightarrow r$ is true, then which one of the following statements is a tautology?

1. $(\mathrm{P} \wedge \mathrm{r}) \rightarrow (\mathrm{p} \vee \mathrm{r})$
2. $\mathrm{p} \vee \mathrm{r}$
3. $(\mathrm{P} \vee \mathrm{r}) \rightarrow (\mathrm{p} \wedge \mathrm{r})$
4. $p \wedge r$

13. Let $\mathrm{A}=\begin{pmatrix} 0 & 2\mathrm{q} & \mathrm{r} \\ \mathrm{p} & \mathrm{q} & -\mathrm{r} \\ \mathrm{p} & -\mathrm{q} & \mathrm{r} \end{pmatrix}$. If $\mathrm{AA}^{\mathrm{T}}=\mathrm{I}_3$, then |P| is:

1. $\frac{1}{\sqrt{5}}$
2. $\frac{1}{\sqrt{3}}$
3. $\frac{1}{\sqrt{6}}$
4. $\frac{1}{\sqrt{2}}$

14. Equation of a common tangent to the parabola $y^2 = 4x$ and the hyperbola xy=2 is :

1. x - 2y + 4 = 0
2. 4x + 2y + 1 = 0
3. x + y + 1 = 0
4. x + 2y + 4 = 0

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15. Let f: R → R be defined by $f(x) = \frac{x}{1+x^2}$, x ∈ R. Then the range of f is:

1. $\left[-\frac{1}{2}, \frac{1}{2}\right]$
2. $(-1, 1) - \{0\}$
3. $\mathbf{R} - [-1, 1]$
4. $\mathbf{R} - \left[-\frac{1}{2}, \frac{1}{2}\right]$

16. Two integers are selected at random from the set {1, 2, ..., 11). Given that the sum of selected numbers is even, the conditional probability that both the numbers are even is :

1. 3/5
2. 2/5
3. 7/10
4. 1/2

17. If $x \log_e(\log_e x) - x^2 + y^2 = 4 (y > 0)$, then dy/dx at x=e is equal to :

1. $\frac{(1+2e)}{\sqrt{4+e^2}}$
2. $\frac{(2e-1)}{2\sqrt{4+e^2}}$
3. $\frac{(1+2e)}{2\sqrt{4+e^2}}$
4. $\frac{e}{\sqrt{4+e^2}}$

18. The direction ratios of normal to the plane through the points (0, -1,0) and (0,0,1) and making an angle π /4 with the plane y - z + 5 = 0 are :

1. $2, \sqrt{2}, -\sqrt{2}$
2. $2\sqrt{3}$, 1 , - 1
3. $\sqrt{2}$, 1 , - 1
4. 2, -1, 1

19 Let $f_k(x) = \frac{1}{k}\left(\sin^k x + \cos^k x\right)$ for k=1, 2, 3, ... Then for all x ∈ R, the value of $f_4(x) - f_6(x)$ is equal to :

1. -1/12
2. 1/12
3. 1/4
4. 5/12

20. Let $\left(-2 - \frac{1}{3}i\right)^3 = \frac{x+iy}{27}(i = \sqrt{-1})$, where x and y are real numbers, then y - x equals :

1. -85
2. -91
3. 85
4. 91

21 If tangents are drawn to the ellipse $x^2 + 2y^2 = 2$ at all points on the ellipse other than its four vertices then the mid points of the tangents intercepted between the coordinate axes lie on the curve :

1. $\frac{1}{2x^2} + \frac{1}{4y^2} = 1$
2. $\frac{1}{4x^2} + \frac{1}{2y^2} = 1$
3. $\frac{x^2}{2} + \frac{y^2}{4} = 1$

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4. $\frac{x^2}{4}+\frac{y^2}{2}=1$

22. The plane containing the line $\frac{x-3}{2}=\frac{y+2}{-1}=\frac{z-1}{3}$ and also containing its projection on the plane 2x+3y-z=5, contains which one of the following points ?
1. (0, -2, 2)
2. (2, 2, 0)
3. (-2, 2, 2)
4. (2, 0, -2)

23. If the system of linear equations
2x + 2y + 3z = a
3x - y + 5z = b
x - 3y + 2z = c
where a, b, c are non-zero real numbers, has more than one solution, then :
1. b+c-a=0
2. a+b+c=0
3. b-c+a=0
4. b-c-a=0

24. In a triangle, the sum of lengths of two sides is x and the product of the lengths of the same two sides is y. If $x^2-c^2=y$, where c is the length of the third side of the triangle, then the circumradius of the triangle is :
1. $\frac{c}{\sqrt{3}}$
2. $\frac{y}{\sqrt{3}}$
3. $\frac{3}{2}y$
4. $\frac{c}{3}$

25. Let $f(x)=\begin{cases}-1, & -2\le x<0\\ x^2-1, & 0\le x\le 2\end{cases}$ and $g(x)=|f(x)|+f(|x|)$. Then, in the interval (-2, 2), g is :
1. not differentiable at one point
2. differentiable at all points
3. not continuous
4. not differentiable at two points

26. If $\int\frac{\sqrt{1-x^2}}{x^4}dx=\mathrm{A}(x)\left(\sqrt{1-x^2}\right)^{\mathrm{m}}+\mathrm{C}$, for a suitable chosen integer m and a function A(x), where is a constant of integration, then $(\mathrm{A}(x))^{\mathrm{m}}$ equals :
1. $\frac{-1}{3x^3}$
2. $\frac{-1}{27x^9}$
3. $\frac{1}{27x^6}$
4. $\frac{1}{9x^4}$

27. Let $\vec{a}=\hat{i}+2\hat{j}+4\hat{k}, \vec{b}=\hat{i}+\lambda\hat{j}+4\hat{k}$ and $\vec{c}=2\hat{i}+4\hat{j}+\left(\lambda^2-1\right)\hat{k}$ be coplanar vectors. Then the non-zero vector $\vec{a}\times\vec{c}$ is :
1. $-10\hat{\mathrm{i}}+5\hat{\mathrm{j}}$

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2. $-14\hat{\mathrm{i}}-5\hat{\mathrm{j}}$
3. $-10\hat{\mathrm{i}}-5\hat{\mathrm{j}}$
4. $-14\hat{i}+5\hat{j}$

28 A square is inscribed in the circle $x^2+y^2-6x+8y-103=0$ with its sides parallel to the coordinate axes. Then the distance of the vertex of this square which is nearest to the origin is :
1. $\sqrt{41}$
2. 13
3. 6
4. $\sqrt{137}$

29. The maximum value of the function $f(x)=3x^3-18x^2+27x-40$ on the set S= $\left\{x\in\mathbf{R}:x^2+30\leq 11x\right\}$is :
1. – 122
2. 222
3. - 222
4. 122

30. The value of r for which ${}^{20}\mathrm{C}_{\mathrm{X}}^{20}\mathrm{C}_0+{}^{20}\mathrm{C}_{\mathrm{r}-1}^{20}\mathrm{C}_1+{}^{20}\mathrm{C}_{\mathrm{r}-2}^{20}\mathrm{C}_2+\ldots..+{}^{20}\mathrm{C}_0^{28}\mathrm{C}_{\mathrm{r}}$ is maximum, is :
1. 20
2. 11
3. 10
4. 15

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