PHYSICS, CHEMISTRY & MATHEMATICS

All India Test Series 2020

JEE (MAIN) Part Test -2

Physics : Optics (Ray & Wave), Modern Physics-Atomic Physics, X-ray, Nuclear Physics, Radioactivity, Semi-conductor Devices, Electromagnetic Waves, Principles of Communication and General Physics

Chemistry: Haloalkanes and Haloarenes, Organic Compounds Containing Oxygen, Amines, Polymers Biomolecules, Chemistry in Everyday Life

Maths : Indefinite and Definite Integration, Area, Differential Equation, Vectors 3-Dimensional, Geometry, Equations, Inequations, Quadratic Equations

Time : 3 Hrs **MM : 300**

Important Instructions :

1. Immediately fill in the particulars on this page of the Test booklet with Blue/Black Ball point pen. Use of pencil is strictly prohibited.
2. The answer sheet is kept inside this test Booklet. When you are directed to open the test booklet, take out the answer sheet and fill in the particulars carefully.
3. The test is of 3 hours duration
4. The test booklet consists of 75 Questions. Physics 1-25, Chemistry 26-50 and Maths 51-75.
5. Question no. 1 to 20, 26 to 45, 51 to 70 carries +4 for each correct answers & –1 to each wrong answer 0 for not attending.
6. Question no. 21 to 25, 46 to 50 & 71-75 do not carry any negative marks every correct option carries + 4 marks.
7. Use Blue/Black Ball point pen only for writing particulars/marking responses on side 1 and side 2 of the answer sheet.

PAPER : DC-TS'20-JEE(MAIN)-PT-2
Test Code : 2003 (0320)

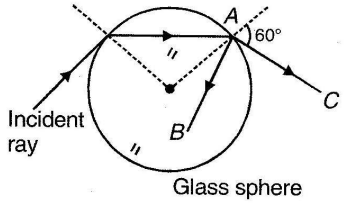
Name of Candidate (in Capital letters) : .....

Roll Number : .....

Candidate's Signature : .....

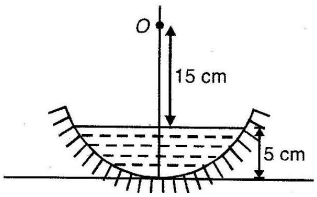
Physics

1. Consider the figure shown. Reflected ray AB and refracted ray AC are perpendicular. Refractive index of the material of the sphere is



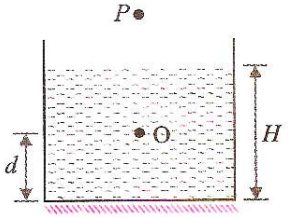
(a) $\sqrt{1.5}$ (b) $\sqrt{2}$ (c) $\sqrt{3}$ (d) $\sqrt{2.5}$

2. In the diagram, an object is placed at distance 20 cm from pole. In this condition object and image coincide. Radius of curvature of mirror is 25 cm. Refractive index of liquid is



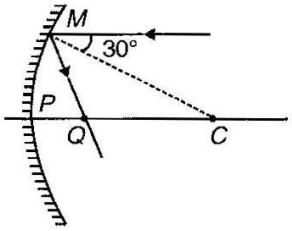
(a) $\frac{4}{3}$ (b) $\frac{3}{2}$ (c) $\frac{9}{8}$ (d) 1.2

3. A tank contains a transparent liquid of refractive index μ. The bottom of the tank is a plane mirror as shown. A person at P looks at an object O and its image in the mirror. The distance between the object and its image in the mirror as perceived by the person is



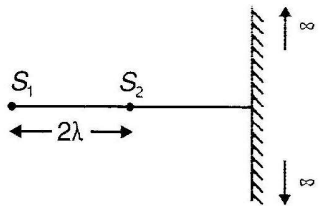
(a) $2\ \mu\ d$ (b) $\frac{2d}{\mu}$ (c) $\frac{2(H-d)}{\mu}$ (d) $\frac{(H+d)}{\mu}$

4. A ray parallel to principal axis is incident at 30° from normal on concave mirror having radius of curvature R. The point on principal axis where rays are focused is Q such that PQ is



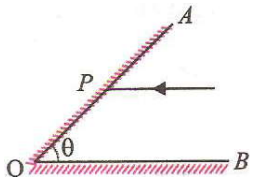
(a) $\frac{R}{2}$ (b) $\frac{R}{\sqrt{3}}$ (c) $\frac{\sqrt{2}R-R}{\sqrt{2}}$ (d) $R\left(1-\frac{1}{\sqrt{3}}\right)$

5. There are two sources kept at distance 2λ. A large screen is perpendicular to line joining the sources. Number of maximas on the screen in this case is ($\lambda =$ wavelength of light)



(a) 1 (b) 3 (c) 5 (d) 7

6. Two plane mirrors are inclined at angle θ as shown in figure. If a ay parallel to OB strikes the other mirror at P and finally emerges parallel to OA after two reflections, then θ is equal to



(a) 90° (b) 60° (c) 45° (d) 30°

7. Maximum kinetic energy of photoelectron is E and its wavelength of incident light is $\frac{\lambda}{2}$. If energy becomes double when wavelength becomes $\frac{\lambda}{3}$, then work function of metal is

(a) $\frac{3hc}{\lambda}$ (b) $\frac{hc}{3\lambda}$ (c) $\frac{hc}{\lambda}$ (d) $\frac{hc}{2\lambda}$

8. If frequency of k_α X-ray emitted from the element with atomic number 31 is f, then frequency of k_α X-ray emitted from the element with atomic number51 would be (Assuming screening constant for k_α X-rays is 1)

(a) $\frac{5}{3}f$ (b) $\frac{51}{31}f$ (c) $\frac{9}{25}f$ (d) $\frac{25}{9}f$

9. If 9.5 eV of energy is supplied to H atom the number of spectral lines emitted is equal to

(a) 0 (b) 1 (c) 2 (d) 3

10. If shortest wavelength of Lyman series of hydrogen atom is x, the wavelength of first member of Balmer series of hydrogen atom is

(a) $\frac{9x}{5}$ (b) $\frac{36}{5}x$ (c) $\frac{5x}{9}$ (d) $\frac{5x}{36}$

11. In certain electronic transition from quantum level *n* to ground state in atomic hydrogen in one or more steps no line belonging to Brackett series is observed. The wave numbers which may be observed in Balmer series is

(a) $\frac{8R}{9}, \frac{5R}{36}$ (b) $\frac{3R}{16}, \frac{8R}{9}$ (c) $\frac{5R}{36}, \frac{3R}{16}$ (d) $\frac{3R}{4}, \frac{3R}{16}$

12. There are two radioactive nuclei A and B. A is α emitter while B is beta emitter. Their disintegration constants are in ratio of 1 : x. What should be ratio of number of nuclei of A and B at any time *t* so that probabilities of getting number of α and β particles are same at that instant?

(a) x : 1 (b) 1 : x (c) e : 1 (d) 1 : e

13. A sample of radioactive material has mass *m*, decay constant λ and molar mass M. Avogadro constant is N_A. The initial activity of sample is

(a) λM (b) $\frac{\lambda m}{M}$ (c) $\frac{\lambda m N_A}{M}$ (d) $mN_A e^{-\lambda t}$

14. Two radioactive materials X_1 and X_2 have decay constant 11λ and λ respectively. It initially they have same number of nuclei, then ratio of number of nuclei of X_1 to X_2 will be $\frac{1}{e^2}$ after a time

(a) $\frac{1}{5\lambda}$ (b) $\frac{1}{11\lambda}$ (c) $\frac{1}{10\lambda}$ (d) $\frac{1}{9\lambda}$

15. Radon 220 decays to Bismuth 212 by the following series of decay

$_{86}Rn^{220} \rightarrow {}_{84}Po^{216} + {}_{2}He^{4}$; $T_{1/2} = 55s$

$_{84}Po^{216} \rightarrow {}_{82}Pb^{212} + {}_{2}He^{4}$; $T_{1/2} = 0.016s$

$_{82}Pb^{212} \rightarrow {}_{83}Bi^{212} + {}_{-1}e^{0}$; $T_{1/2} = 10.6hrs$

If certain mass of radon is allowed to decay in certain container, after five minutes element with greatest and least mass will respectively be

(a) Radon, bismuth (b) Polonium, lead (c) Lead, bismuth (d) Bismuth, lead

Directions : Questions number 16 and 17 are based on the following paragraph.

A nucleus of mass $M+\Delta m$ is at rest and decays into two daughter nuclei of equal mass $\frac{M}{2}$ each. Speed of light is c.

Questions number 16 is these on the following paragraph.

16. The binding energy per nucleon for the parent nucleus is E_1 and that for the daughter nuclei is E_2. Then

(a) $E_1 > E_2$ (b) $E_2 > E_1$ (c) $E_1 = 2E_2$ (d) $E_2 = 2E_1$

Questions number 17 is these on the following paragraph.

17. The speed of daughter nuclei is :

(a) $c\sqrt{\frac{2\Delta m}{M}}$ (b) $c\sqrt{\frac{\Delta m}{M}}$ (c) $c\sqrt{\frac{\Delta m}{M+\Delta m}}$ (d) $c\frac{\Delta m}{M+\Delta m}$

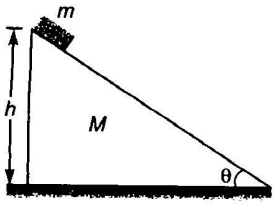
18. A loaded spring gun of mass M fires a bullet of mass *m* with a velocity *v* at an angle of elevation θ. The gun is initially at rest on a horizontal smooth surface. After firing, the centre of mass of the gun and bullet system

(a) move with velocity $\frac{v}{M}m$

(b) moves with velocity $\frac{vm}{M\cos\theta}$ in the horizontal direction

(c) does not move in horizontal direction

(d) moves with velocity $\frac{v(M-m)}{M+m}$ in the horizontal direction



19. A breaker contains water up to a height h_1 and kerosene of height h_2 above water so that the total height of (water + kerosene) is (h_1+h_2). Refractive index of water is μ_1 and that of kerosene is μ_2. The apparent shift in the position of the bottom of the beaker when viewed from above is :

(a) $\left(1-\frac{1}{\mu_1}\right)h_2+\left(1-\frac{1}{\mu_2}\right)h_1$ (b) $\left(1+\frac{1}{\mu_1}\right)h_1-\left(1+\frac{1}{\mu_2}\right)h_2$

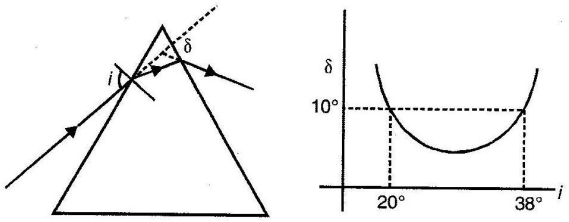
(c) $\left(1-\frac{1}{\mu_1}\right)h_1+\left(1-\frac{1}{\mu_2}\right)h_2$ (d) $\left(1+\frac{1}{\mu_1}\right)h_2-\left(1+\frac{1}{\mu_2}\right)h_1$

20. A diatomic molecule is made of two masses m_1 and m_2 which are separated by a distance r. If we calculate its rotational energy by applying Bohr's rule of angular momentum quantization, its energy will be given by (n is an integer)

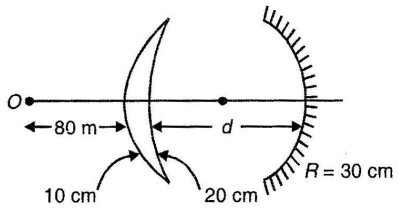
(a) $\frac{(m_1+m_2)^2\, n^2\, \hbar^2}{2m_1^2\, m_2^2\, r^2}$ (b) $\frac{n^2\, \hbar^2}{2(m_1+m_2)\, r^2}$ (c) $\frac{2n^2\, \hbar^2}{(m_1+m_2)\, r^2}$ (d) $\frac{(m_1+m_2)\, n^2\, \hbar^2}{2m_1 m_2\, r^2}$

Integer Type Questions

21. A ray is incident on prism at an angle *i* with normal. When it comes out of prism its angular deviation is δ. Graph between δ and *i* is given. Prism angle is _____ degree



22. If the final image after two refractions through the lens and one reflection from the mirror is formed at same point O, then d is $(\mu_g = 1.5)$_____ cm

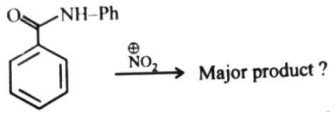


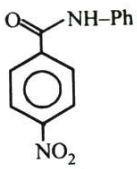
23. In a YDSE bichromatic light of wavelengths 400 nm and 560 nm are used. The distance between the slits is 0.1 mm and the distance between the plane of the slits and the screen is 1 m. The minimum distance between two successive regions of complete darkness is_____mm

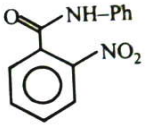
24. Which state of triply ionized (Be^{3+}) has same orbital radius as that of ground state of hydrogen? N = ?

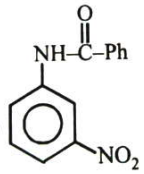
25. The half life of a radioactive substance is 20 minutes. The approximate time interval $(t_2 - t_1)$ between the time t_2 when $\frac{2}{3}$ of it has decayed and time t_1 when $\frac{1}{3}$ of it had decayed is _____min

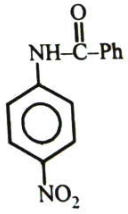
Chemistry

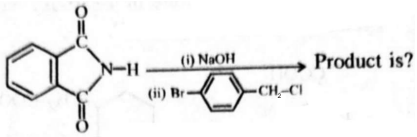
1. 

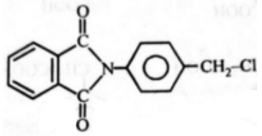
(a) 

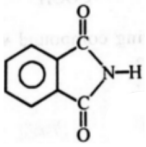
(b) 

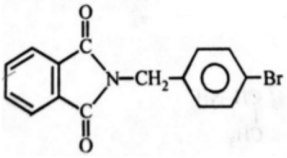
(c) 

(d) 

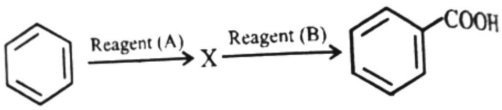
2. 

(a) 

(b) 

(c) 

(d) None of these

3. 

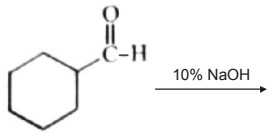
Reagent A and B respectively?

(a) $CH_3–CH_2–Cl/AlCl_3$, Hot $H^{\oplus}/KMnO_4$

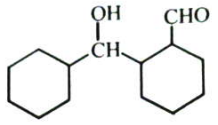
(b) $CH_3–\underset{\underset{O}{\|}}{C}–Cl / AlCl_3$, Zn–Hg/HCl

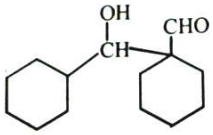
(c) Conc. HNO_3, H_2SO_4 / Sn/HCl

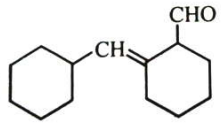
(d) $CH_3–CH_2–Cl/AlCl_3$, $NH_2–NH_2/KOH$

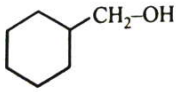
4. 

Product A is (Major)

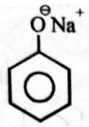
(a) 

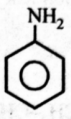
(b) 

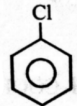
(c) 

(d) 

5. Compare the rate of E.S.R. :-

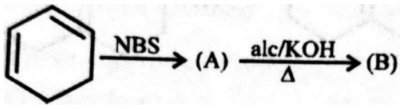
(a) 

(b) 

(c) 

(d) 

(a) B > A > D > C (b) A > B > D > C (c) C > A > B > D (d) D > C > B > A

6. 

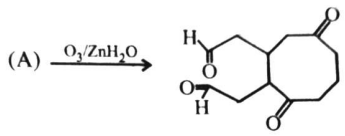
Incorrect statement about B.

(a) B give the reaction with cone. HNO3 and H2SO4

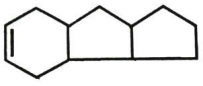
(b) On ozonolysis (reductive) of B give the 3 mole of glyoxal

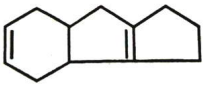
(c) B give the positive baeyer's reagent test.

(d) On the hydrogenation of B with H_2/Ni it will produce the cyclo hexane.

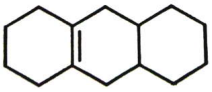
7. 

The structure of 'A' is

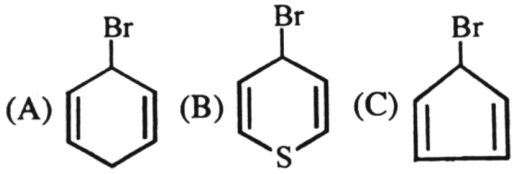
(a) 

(b) 

(c) 

(d) 

8. Compare the rate of SN^1 reaction?



(a) B > C > A (b) A > B > C (c) B > A > C (d) C > B > A

9. 2-Acetoxy benzoic acid is used as an:-

(a) Antimalarial (b) antidepressant (c) Antiseptic (d) Antipyretic

10. Which of the following best represents the structure of an amino acid in basic solution:-

(a) $R-\underset{\underset{NH_2}{|}}{CH}-COOH$ (b) $R-\underset{\underset{\overset{\oplus}{NH_3}}{|}}{CH}-COOH$

(c) $R-\underset{\underset{NH_2}{|}}{CH}-\overset{\ominus}{COO}$ (d) $R-\underset{\underset{\overset{\oplus}{NH_3}}{|}}{CH}-\overset{\ominus}{COO}$

11. Ribose and deoxyribose differ in structure around a single carbon, namely;-

(a) C–1 (b) C–2 (c) C–3 (d) C–4

12. The term invert sugar refers to an equimolar mixture of

(a) D-glucose and D-galactose (b) D-glucose and D-fructose

(c) D-glucose and D-mannose (d) D-glucose and D-ribose

13. Which of the following is not correctly matched?

(a) neoprene; $\left[-CH_2-\underset{\underset{Cl}{|}}{C}=CH-CH_2-\right]_n$

(b) nylon-66:

$\left[-NH-(CH_2)_6-NH-CO-(CH_2)_4-\overset{\overset{O}{\|}}{C}-O-\right]_n$

(c) terylene;

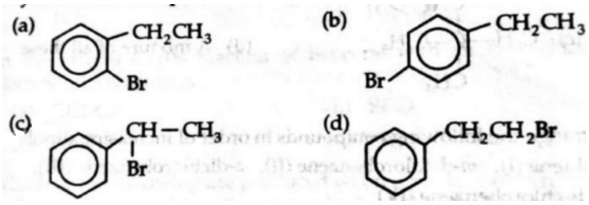
$\left[-OCH_2-CH_2-O-\overset{\overset{O}{\|}}{C}-\langle\bigcirc\rangle-\overset{\overset{O}{\|}}{C}\right]_n$

(d) PMMA : $\left[CH_2-\underset{\underset{COOCH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\right]_n$

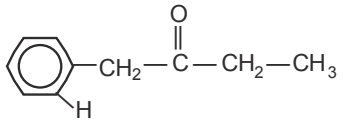
14. The substance which is not an artificial sweetener

(a) Sucralose (b) Alitame (c) Saccharin (d) Sucrose

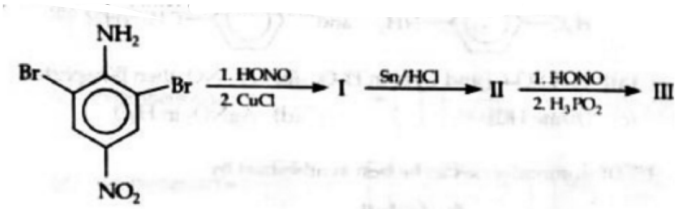
15. Which of the following organic compounds will not yield CO_2 when treated with Na_2CO_3 solution?
(a) Benzoic acid (b) Phenol (c) Sulphanilic acid (d) Orthonitrophenol

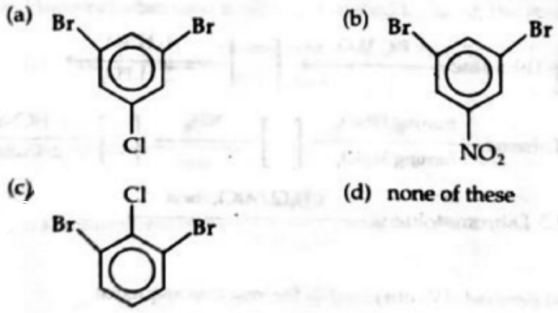
16. Which of the following will be obtained by the bromination of ethylbenzene in the presence of light?


17. When phenol is heated with CCl_4 at 340 K, and this is followed by hydrolysis, the main product obtained is
(a) o-hydroxybenzaldehyde (b) p-hydroxybenzaldehyde
(c) o-hydroxybenzoic acid (d) p-hydroxybenzoic acid

18. Which of the following hydrogens will be the most acidic?


(a) (b) (c) (d)

19. The final product (III) obtained in the reaction sequence


is


(d) none of these

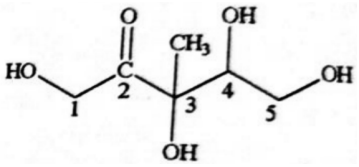
20. Arrange the following compounds in order of decreasing basic strength

CH_3NH_2	$(CH_3)_2NH$	$(CH_3)_3N$	NH_3
I	II	III	IV

(a) I > II > III > IV (b) II > I > III > IV (c) IV > III > II > I (d) II > III > I > IV

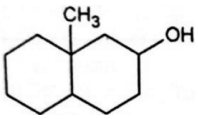
Integer Type Questions

21. Alcoholic group at position x reacts fastest with Lucas reagent. Then value of $\frac{2x}{5}$

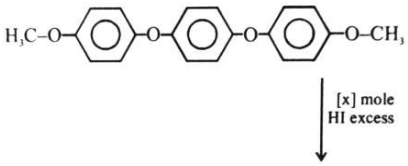


22. What is the number of optically active structural isomers of $C_4H_8O_3$. Which evolve CO_2 with aq. $NaHCO_3$.

23. What will be the number of stereo-isomers of the given compound.



24. A compound of mol wt. 180 is acetylated to give a compound of molecular wt. 390. What is the number of amino groups in the initial compound?

25. 

How many mole of HI will consumed in the given reaction?

Mathematics

1. The variable plane $(2\lambda+1)x+(3-\lambda)y+z=4$ always passes through the line, $\lambda \in R$

   (a) $\frac{x}{0}=\frac{y}{0}=\frac{z+4}{1}$ (b) $\frac{x}{1}=\frac{y}{2}=\frac{z}{-3}$ (c) $\frac{x}{1}=\frac{y}{2}=\frac{z-4}{-7}$ (d) none of these

2. $\int \frac{px^{p+2q-1}-qx^{q-1}}{x^{2p+2q}+2x^{p+q}+1}dx$ is equal to

   (a) $-\frac{x^p}{x^{p+q}+1}+C$ (b) $-\frac{x^q}{x^{p+q}+1}-C$ (c) $\frac{x^q}{x^{p+q}+1}+C$ (d) $\frac{x^p}{x^{p+q}+1}+C$

3. If $S_n=\left[\frac{1}{1+\sqrt{n}}+\frac{1}{2+\sqrt{2n}}+...+\frac{1}{n+\sqrt{n^2}}\right]$, then $\lim\limits_{n\to\infty} S_n$ is equal to

   (a) log 2 (b) log 4 (c) log 8 (d) none of these

4. $\int e^x(\text{Tan}\,x - x - 2\,\text{Tan}\,x\sec^2 x)dx = e^x f(x)+c$ where $f(0)=0$ then the value of $f\left(\frac{\pi}{4}\right)$ equal to

   (a) $\frac{\pi}{4}$ (b) $1-\frac{\pi}{4}$ (c) $-\frac{\pi}{4}$ (d) $\frac{\pi}{2}$

5. The area of the figure bounded by the parabola $(y-2)^2=x-1$, tangent to it at the point with the ordinate $y=3$, and the x-axis is

   (a) 7 sq. units (b) 6 sq. units (c) 9 sq. units (d) none of these

6. $\int_0^x ty(t)\,dt = x^2 + y(x)$ then y as a function of x is

   (a) $y=2-ce^{-x^2}$ (b) $y=2+ce^{x^2}$ (c) $y=2-ce^{-\frac{x^2}{2}}$ (d) $y=2+ce^{\frac{x^2}{2}}$

7. The equation of plane passes through the point of intersection of lines $\frac{x-1}{3}=\frac{y+1}{2}=\frac{z-3}{1}$ and $\frac{x-1}{2}=\frac{y+1}{1}=\frac{z-3}{3}$ and greatest distance from [0, 0, 0] is

   (a) $x+y-3z=11$ (b) $x-y+3z-11=0$ (c) $x-y+3z+11=0$ (d) $x+y-3z+11=0$

8. If $\vec{a}=(\hat{i}+\hat{j}+\hat{k})$, $\vec{a}.\vec{b}=1$ and $\vec{a}\times\vec{b}=\hat{j}-\hat{k}$ then $\vec{b}$ is

   (a) $\hat{i}-\hat{j}+\hat{k}$ (b) $2\hat{j}-\hat{k}$ (c) $\hat{i}$ (d) $2\hat{i}$

9. The length of projection of line segment joining the point (1, –1, 0) and (–1, 0, 1) to plane $2x + y + 6z = 1$ is equal to

   (a) $\sqrt{\frac{255}{41}}$ (b) $\sqrt{\frac{237}{41}}$ (c) $\sqrt{\frac{137}{41}}$ (d) $\sqrt{\frac{155}{41}}$

10. Let $\vec{a},\vec{b},\vec{c}$ be unit vector such that $\vec{a}+\vec{b}+\vec{c}=\vec{x}$, $\vec{a}.\vec{x}=1, \vec{b}.\vec{x}=\frac{3}{2}$ and $|x| = 2$ then angle between $\vec{c}$ and $\vec{x}$ is

    (a) $\cos^{-1}\frac{1}{2}$ (b) $\cos^{-1}\frac{3}{4}$ (c) $\cos^{-1}\frac{3}{8}$ (d) $\cos^{-1}\frac{5}{8}$

11. The value of $\int_{\sqrt{\ln 2}}^{\sqrt{\ln 3}} \frac{x \sin(x^2)}{\sin(x^2) + \sin(\ln 6 - x^2)} dx$

(a) $\frac{1}{4}\ln 6$ (b) $\frac{1}{4}\ln\frac{3}{2}$ (c) $\frac{1}{2}\ln\frac{3}{2}$ (d) $\frac{1}{4}\ln\sqrt{\frac{3}{2}}$

12. If a, b, c, be nonzero real numbers such that $\int_0^1 (1+\cos^8 x)(ax^2+bx+c)dx = \int_0^2 (1+\cos^8 x)(ax^2+bx+c)\,dx$ then the quadratic equation $ax^2 + bx + c = 0$ has

(a) no root in (0, 2) (b) at least one root in (1, 2)
(c) at least one root in (0, 1) (d) two imaginary roots

13. $\int f(x)\,dx = g(x) + c$, then $\int f^{-1}(x)\,dx$ is

(a) $x f^{-1}(x) + c$ (b) $f\{g^{-1}(x)\} + c$ (c) $x f^{-1}(x) - g\{f^{-1}(x)\} + c$ (d) $g^{-1}(x) + c$

14. Area of region bounded by $y = x - x^2$, $y = \ln x$ and y axis is

(a) $\frac{3}{2}$ (b) $\frac{5}{6}$ (c) $\frac{7}{6}$ (d) $\frac{3}{4}$

15. P, Q, R, S have position vectors p, q, r, s such that $p - q = 2(s - r)$, then

(a) PQ and RS bisect each other (b) PQ and RS trisect each other
(c) QS and PR bisect each other (d) QS and PR trisect each other

16. Solution of the equation $\frac{dy}{dx} + \frac{1}{x}\tan y = \frac{1}{x^2}\tan y \sin y$ is

(a) $2x = (2cx^2 - 1)\sin y$ (b) $2x = (1 + cx^2)\sin y$
(c) $2x + (1 + cx^2)\sin y = 0$ (d) none of these

17. The normal to a curve at P(x, y) meets the x-axis at G. If the distance of G from the origin is twice the abscissa of P, then the curve is a

(a) circle (b) Straight line (c) ellipse (d) parabola

18. If (x_0, y_0, z_0) is any solution of system of equation, $x_0 \neq 0$, $1 + x + y = 2z$, $1 + y + z = 2x$, $x + z = 2y + 2$ then value of $\frac{z_0^2 - y_0^2 + 1}{x_0}$ is

(a) -2 (b) 2 (c) 3 (d) -3

19. $\int_0^{\pi} \frac{x^2 \sin^4 x\,dx}{2x^2 + \pi^2 - 2\pi x}$ is equal to

(a) $\frac{\pi}{16}$ (b) $\frac{2\pi}{16}$ (c) $\frac{3\pi}{16}$ (d) $\frac{5\pi}{16}$

20. $\int \frac{(x^4 - 4)\,dx}{x^2\sqrt{4 + x^2 + x^4}}$ is

(a) $\frac{\sqrt{4 + x^2 + x^4}}{x}$ (b) $\sqrt{4 + x^2 + x^4} + c$ (c) $\frac{\sqrt{4 + x^2 + x^4}}{2} + c$ (d) $\frac{\sqrt{4 + x^2 + x^4}}{2x} + c$

Integer Type Questions

21. $\vec{u}$ and $\vec{v}$ are two unit non-colinear vectors such that $|\vec{u}\times\vec{v}|=\left|\frac{\vec{u}-\vec{v}}{2}\right|$ then $|\vec{u}+\vec{v}|$ is equal to

22. At present a firm is manufacturing 2000 items. It is estimated that the rate of charge of production P w.r.t. additional number of workers x is given by $\frac{dp}{dx}=100-12\sqrt{x}$. If firm employ 25 more workers, then new level of production of items is

23. The algebraic sum of perpendicular distances from the points (1, 2, 4), (–3, 5, 2) and (–1, 2, 3) to a variable plane is zero then plane passes through the point (a, b, c) then a + b + c is equal to

24. Let f(x) be a continuous in [0, π] such that $f(\pi)=3$ and $\int_0^{\pi/2}(f(2x)+f''(2x))\sin 2x\,dx=7$ then f(0) is

25. y(x) be real valued differential function on the interval (0, ∞) such that y(1) = 0 and $y'(x)=\ln x+2-\frac{y(x)}{x\ln x}$ then find the value of [y(e) – y′(e)].

    Where [.] denotes greatest integer function