FIITJEE - JEE (Main)

PHYSICS, CHEMISTRY & MATHEMATICS

JEE Main 2019 Mock Tests-1 (Code:100312.1)

ANSWER KEY

PHYSICS (PART-I)

1. **B**	2. **A**	3. **C**	4. **C**
5. **C**	6. **A**	7. **C**	8. **C**
9. **B**	10. **A**	11. **D**	12. **B**
13. **A**	14. **D**	15. **B**	16. **D**
17. **B**	18. **D**	19. **B**	20. **D**
21. **D**	22. **D**	23. **A**	24. **C**
25. **B**	26. **D**	27. **C**	28. **C**
29. **C**	30. **B**		

CHEMISTRY (PART-II)

1. **B**	2. **D**	3. **C**	4. **C**
5. **C**	6. **C**	7. **B**	8. **C**
9. **A**	10. **A**	11. **C**	12. **A**
13. **A**	14. **A**	15. **D**	16. **C**
17. **B**	18. **B**	19. **C**	20. **A**
21. **A**	22. **B**	23. **B**	24. **A**
25. **A**	26. **A**	27. **D**	28. **D**
29. **D**	30. **B**		

MATHEMATICS (PART-III)

1. **C**	2. **B**	3. **A**	4. **A**
5. **B**	6. **A**	7. **C**	8. **D**
9. **A**	10. **B**	11. **A**	12. **B**
13. **B**	14. **A**	15. **C**	16. **C**
17. **D**	18. **D**	19. **A**	20. **C**
21. **B**	22. **C**	23. **C**	24. **D**
25. **C**	26. **C**	27. **C**	28. **A**
29. **D**	30. **A**		

HINTS AND SOLUTIONS

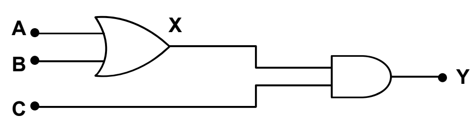
PHYSICS (PART-I)

1. Angle between P_1 and P_2 = 30° (given)
Angle between P_2 and P_3 = θ = 90° – 30° = 60°
$I_0 = 32\ Wm^2$
The intensity of light transmitted by P_2 is $I_1 = \frac{I_0}{2} = \frac{32}{2} = 16\ Wm^{-2}$
According to Malus law the intensity of light transmitted by P_2 is $I_2 = I_1 \cos^2 30° = 6\left(\frac{\sqrt{3}}{2}\right)^2 = 12\ Wm^{-2}$
Similarly intensity of light transmitted by P_2 is
$I_3 = I_2 \cos^2\theta = 12\cos^2 60° = 12\left(\frac{1}{2}\right)^2 = 3\ Wm^{-2}$.

2. The film appears bright when the path difference ($2\ \mu r \cos r$) is equal to odd multiple of $\frac{\lambda}{2}$.
I.E., $2\ \mu T \ COS\ R = (2N - 1)\ \lambda/2$ WHERE N = 1, 2, 3,…
$\therefore\ \lambda = \frac{4\mu t \cos r}{(2n-1)} = \frac{56000}{(2n-1)}$Å.

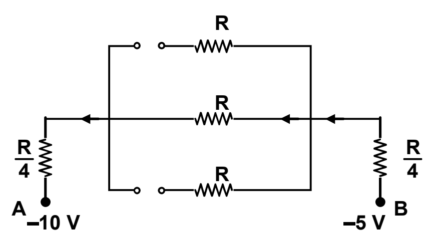
3.

A	B	C	X=(A+B)	Y= (x.C)
0	1	0	1	0
1	0	0	1	0
1	0	1	1	1
1	1	0	1	0

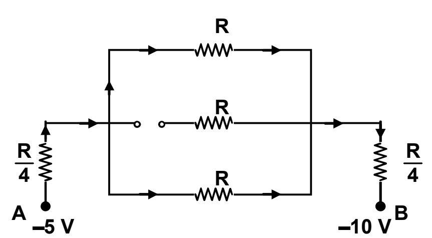


4. $V_{RB} = 500\ K\Omega \times 10\ MA = 5\ V$
$\therefore\ V_{BE} = 5.5 - 5 = 0.5\ V$

5. (i) $V_A = -10\ V$ and $V_B = -5\ V$
Diodes D_1 and D_3 are reverse biased D_2 is forward biased.



$\Rightarrow R_{AB} = R + \frac{R}{4} + \frac{R}{4} = \frac{3}{2}R$
(ii) When $V_4 = -5V$ and $V_B = -10\ V$
Diodes D_2 is reverse biased D_1 and D_3 are forward biased.



$\Rightarrow R_{AB} = \frac{R}{4} + \frac{R}{2} + \frac{R}{4} = R$

6. If β is fringe width, then $7.5\ \beta = 7.5$ mm (given)
$\lambda = 5000$ Å

7. $\tan\theta_1 = \frac{B_V}{B_H\cos\alpha}, \tan\theta_2 = \frac{B_V}{B_H\sin\alpha}$
$\Rightarrow \frac{\tan\theta_1}{\tan\theta_2} = \tan\alpha$

8. Plate A, C, E at same potential
$\Rightarrow C_{EFF} = \frac{\varepsilon_0 A}{d}$
$\therefore\ U = \frac{1}{2}\frac{\varepsilon_0 A}{d}V^2$

9. $\frac{kq'}{R} + \frac{kq}{r} = 0$
$q' = -\left(\frac{R}{r}\right)q = -\left(\frac{R}{3R}\right)\times 10 = -10\mu C$

10 $P_0(\pi r^2)$ + weight of liquid above sphere.

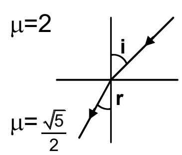
11. $\omega' = \sqrt{\frac{K}{m} - \frac{b^2}{4m^2}}$

12. V = 0, Since the x-axis is equidistant.

13. Speed of belt
$v = \omega r = 20 \times 0.2 = 4$ m/sec
$a_b = \mu g = 5$ m/sec^2
$\therefore\ s = \frac{V^2}{2a} = 1.6m$
Work done by friction = $\mu mg \times 1.6 = +16J$

14. Net force on current carrying loop kept in a uniform magnetic field is always zero.
For $\alpha = 0$, torque = 0

15.

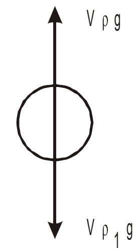


$2\sin i = \frac{\sqrt{5}}{2}\sin r$
$\Rightarrow \tan r = \frac{4}{3}$
$\therefore \hat{r} = \frac{-4\hat{i} - 3\hat{j}}{5}$

16. For $V_1 < 5$ volt the diode is forward biased output will be fixed at 5V and $V_1 > 5$ volt the diode is reverse biased, and output will follow V_1.

18. From the F.B.D. of the body

$a = \dfrac{V\rho_1 g - V\rho g}{V\rho_1} = \left(1 - \dfrac{kh}{\rho_1}\right)g \qquad \because \rho = kh$



$\therefore \quad v\dfrac{dv}{dh} = \left(1 - \dfrac{kh}{\rho_1}\right)g$

$\Rightarrow \quad \dfrac{v^2}{2} = \left(h - \dfrac{k}{2\rho_1}h^2\right)g$

$\therefore \quad v = 0 \text{ at } h = \dfrac{2\rho_1}{k}$

also $a = 0 \Rightarrow h = \dfrac{\rho_1}{k}$ is the mean position.

$\therefore \quad \text{amplitude} = \dfrac{\rho_1}{k}$

19. $V_A = V_C = V_0\sqrt{2}$ m/s

$V_B = 2V_0$ m/s

$\therefore\ KE = \dfrac{1}{2}2m(2V_0)^2 + \dfrac{1}{2}m\left(\sqrt{2}V_0\right)^2 + \dfrac{1}{2}3m\left(\sqrt{2}V_0\right)^2 \times + \left[\dfrac{1}{2}mV_0^2 + \dfrac{1}{2}mR^2 \times \dfrac{V_0^2}{R^2}\right] = 9m\,v_0^2$

20. $KE = \dfrac{3}{2}KT,\ V_{rms} = \sqrt{\dfrac{3RT}{M}}$

i.e. $\dfrac{KE_2}{KE_1} = \dfrac{T_2}{T_1} = 2$

$\therefore \quad KE_2 = 2KE_1 = 2 \times 6.21 \times 10^{-21}$

$= 12.42 \times 10^{-21}$ J

$\dfrac{V_{rms,2}}{V_{rms,1}} = \sqrt{\dfrac{T_2}{T_1}} = \sqrt{2}$

$\Rightarrow \quad V_{rms,2} = \sqrt{2} \times V_{rms,1} = 684$ m/s.

21. from the theory

23. $Q = C^2\left[m_{nuc}\left({}^{A}_{Z}X\right) - m_{nuc}\left({}^{A}_{Z-1}Y\right) - m_{e^+}\right]$ by definition.

Putting,

$m_{nuc}\left({}^{A}_{Z}X\right) = m\left({}^{A}_{Z}X\right) - Zm_e$

and similarly for ${}^{A}_{Z-1}Y$,

we get the final result.

24. $T = Kx = m\omega^2 r$

where $r = \ell_0 + x$

$\therefore \quad Kx = m\omega^2(\ell_0 + x) \ \Rightarrow \ x = \dfrac{m\omega^2\ell_0}{K - m\omega^2}$

$\therefore \quad r = \ell_0 + x = \dfrac{K\ell_0}{K - m\omega^2}$.

25. $6I = I^2R + I^2R$

$\Rightarrow\ 3 = IR$; $V = 3 \ \therefore\ I = 9A$

$\Rightarrow\ R = \dfrac{1}{3}\Omega$.

26. Impulse = Force × time; net momentum of the system is conserved as the net force on it is zero.

27. Total internal energy of system will remain conserve

$$nC_{V_1}T_1 + nC_{V_2}T_2 = \left[nC_{V_1} + nC_{V_2}\right]T$$

$$\left(\frac{3}{2}R\right)300 + \left(\frac{5R}{2}\right)600 = \left[\frac{3R}{2} + \frac{5R}{2}\right]T$$

$$T = \left(\frac{9+30}{8}\right)100 = \frac{3900}{8} = 487\text{K (approx)}$$

$$\Delta E = \left(\frac{3}{2}R\right)\left[487 - 300\right] = 187 \times \frac{3}{2} \times R = 280.5\ R$$

28. The gravitational potential at a point Q (OQ ≡ x) is given by :

$$V(x) = \begin{cases} -g_sR\left(\frac{3}{2} - \frac{1}{2}\frac{x^2}{R^2}\right), \text{ when } x < R \\ -g_sR\left(\frac{R}{x}\right), \text{when } x > R \end{cases}$$

The energy required to project the body, to a maximum altitude of 3R from its surface, is :

$$m\left(V_B\Big|_{x=\frac{R}{2}} - V_P\Big|_{x=4R}\right) = \frac{9}{8}mg_sR.$$

29. B (at P) = $2.\frac{\mu_0 i}{2\pi r}.\sin\theta$

30. $\sin\theta_C = \frac{2\mu}{3}$

At face AC, i is 60º

$i > \theta_C$

CHEMISTRY (PART-II)

1. **B**
Conceptual

2. **D**
Conceptual

3. **C**
Syn Addition

4. **C**
Due to greater +R effect

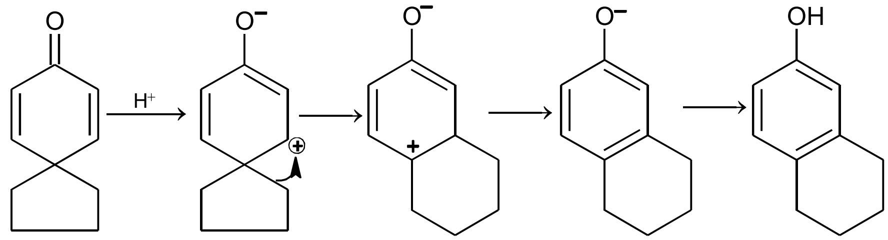
5. **C**
Grignard addition at ketone followed by neighbouring group participation

6. **C**
Greater be the steric hinderance lesser be the rate of S_N2

7. **B**
S_N2 reaction

8. **C**
(i) Witting reaction (ii) HBO

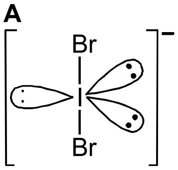
9. **A**



10. **A**
Crossed aldol condensation

11. **C**
Electronic configuration is ns^2np^3, as fifth ionisation energy is unusually as compared to fourth one

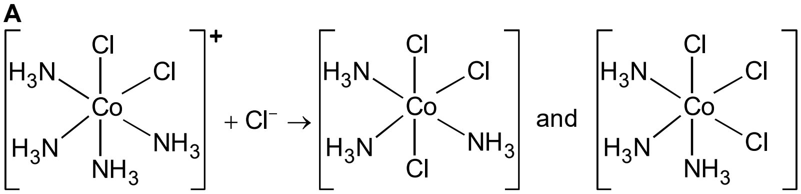
12. **A**



$IBr : X = 2 + \frac{1}{2}[7 - 2 + 1] = (2\sigma\text{-bonds} = 3 \text{ lone pairs})\ sp^3\text{-hybridisation shape} \rightarrow \text{Linear}$

13. **A**
(a) $\underset{\substack{BO=1.5 \\ \text{Paramagnetic}}}{C_2^+} \rightarrow \underset{\substack{BO=2 \\ \text{Diamagnetic}}}{C_2}$ (b) $\underset{\substack{BO=3 \\ \text{Diamagnetic}}}{NO^+} \rightarrow \underset{\substack{BO=2.5 \\ \text{Paramagnetic}}}{NO}$ (c) $\underset{\substack{BO=2 \\ \text{Paramagnetic}}}{O_2} \rightarrow \underset{\substack{BO=2.5 \\ \text{Paramagnetic}}}{O_2^+}$ (d) $\underset{\substack{BO=3 \\ \text{Diamagnetic}}}{N_2} \rightarrow \underset{\substack{BO=2.5 \\ \text{Paramagntic}}}{N_2^+}$

14. **A**



cis-form trans-form *cis*-form

15. **D**
Conceptual

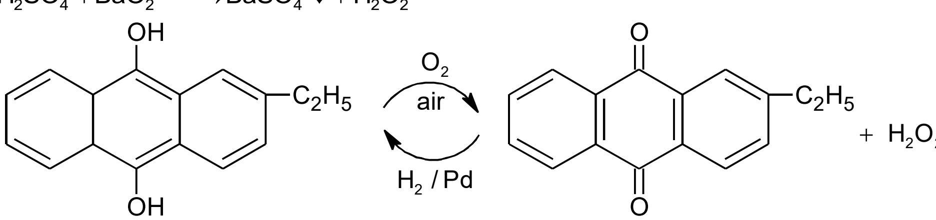
16. **C**

$$\text{Reducing character} \propto \frac{1}{\text{'E—H' bond dissociation enthalpy}}$$

17. **B**

$H_2SO_4 + PbO_2 \longrightarrow PbSO_4 \downarrow + \frac{1}{2}O_2 + H_2O$ (PbO_2 is not peroxy compound)

$H_2SO_4 + BaO_2 \longrightarrow BaSO_4 \downarrow + H_2O_2$



$(NH_4)_2SO_4 \rightleftharpoons 2NH_4^+ + SO_4^{2-}$

At anode : $2SO_4^{2-} \xrightarrow{\text{Electrolysis}} S_2O_8^{2-} + 2e^-$

Peroxo sulphate on hydrolysis, produces H_2O_2.

18. **B**
Conceptual

19. **C**
Conceptual

20. **A**
The six-membered cyclic ether is known as pyranose while the five membered cyclic ether is known as furanose. Linkage at C-1 carbon of α-glycosidic linkage in carbohydrate chemistry.

21. **A**
Conceptual

22. **B**
As the process is isothermal

23. **B**
Conceptual

24. **A**
As $Ag + I^- \longrightarrow AgNO_3$
Final concentration of I^- = 0.25 M (As 0.25 mol yellow ppt is formed)

$$I_2 + I^- \rightleftharpoons I_3^-$$

	I_2	I^-	I_3^-
t = 0	1	0.5	
t = teq	0.75	0.25	0.25

$$K = \frac{[I_3^-]}{[I_2][I^-]} = \frac{0.25}{0.75\times0.25} = \frac{1}{.75} = 1.33$$

25. **A**
$[H_2CO_3]$ = 1 M
$[H^+] = [HCO_3^-]$

$$K_{a_1} = \frac{[H^+][HCO_3^-]}{[H_2CO_3]} \quad [[H_2CO_3] \approx 1\,M \text{ as } K_{a_1} \text{ is small}]$$

$$K_{a_1} = [H^+]^2$$

$$[H^+] = \sqrt{K_{a_1}} = 2\times10^{-3}$$

26. **A**
Effective no of O^{2-} per unit cell = 4
Effective no of Zn^{2+} per unit cell = 1
Effective no of Al^{3+} per unit cell = 2
Formula of spinel = $ZnAl_2O_4$

27. **D**
Force of attraction between solute and solvent molecule decreases after dissolution

28. **D**

$$\frac{[\dot{Cl}]^2}{[Cl_2]} = K_{eq}$$

$$[\dot{Cl}] = [K_{eq}[Cl_2]]^{1/2}$$

$$\text{rate} = K_2[\dot{Cl}][CHCl_3]$$

$$= K_3K_{eq}[Cl_2]^{1/2}[CHCl_3]$$

29. **D**
Negative sol will form because KI is in excess.

30. **B**
No of nodal surface = $n - \ell - l = 5 - 0 - 1 = 4$

MATHEMATICS (PART-III)

1. We know that if $d_i = \frac{x_i - A}{h}$ then $\sigma_x = |h|\sigma_d$

In this case $-2x_i - 3 = \frac{x_i + \frac{3}{2}}{-\frac{1}{2}}$

So, $h = -\frac{1}{2}$

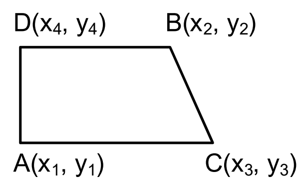
Then $\sigma_d = \frac{1}{|h|}\sigma_n = 2 \times 3.5 = 7$

2. Apply L' Hospital's Rule

$2xf(x) = (1 + x^2) f'(x) \Rightarrow \frac{f'(x)}{f(x)} = \frac{2x}{1+x^2}$

$\lim\limits_{x \to 1} \frac{\ln f(x) - \ln 2}{x-1}\left(\frac{0}{0}\right) = \lim\limits_{x \to 1} \frac{2x}{1+x^2} = 1$

3. On solving we have



$(x_1 - x_3)^2 + (x_2 - x_4)^2 + (y_2 - y_3)^2 + (y_1 - y_4)^2 \le 0$

$\Rightarrow x_1 = x_3,\ x_2 = x_4,\ y_2 = y_3$ and $y_1 = y_4$

$\Rightarrow \frac{x_1 + x_2}{2} = \frac{x_3 + x_4}{2}$ and $\frac{y_1 + y_2}{2} = \frac{y_4 + y_3}{2}$

Hence AB and CD bisect each other

Also we have $AB^2 = CD^2$

$\Rightarrow$ AB = CD

4. Constructing the truth table we get the answer.

		a	b	x	y	z	Opt A	Opt B	Opt C	Opt D
p	q	$p \to q$	~ q	a ^ b	a ^ q	~ p	$x \to z$	$x \to p$	$y \to z$	$y \to p$
T	T	T	F	F	T	F	T	T	F	T
T	F	F	T	F	F	F	T	T	T	T
F	T	T	F	F	T	T	T	T	T	F
F	F	T	T	T	F	T	T	F	F	T

5. To have the area to be less than the circumference, we need to have the diameter be either 2 or 3. The possible ways to roll a 2 or 3 is 3, therefore the answer being $\frac{3}{36} = \frac{1}{12}$

6. Let W = {CAT, TOY, YOU, ...}

Clearly, R is reflexive and symmetric but not transitive

Since CAT R TOY, TOY R YOU $\not\Rightarrow$ CAT R YOU

7. We must have $x^2 + x - 6 \ne 0$ and $\left[x + \frac{1}{2}\right] > 0$, $\left[x + \frac{1}{2}\right] \ne 1$

$\Rightarrow x \ne -3, 2$ and $\left[x + \frac{1}{2}\right] \ge 2$

$\Rightarrow x + \frac{1}{2} \ge 2$

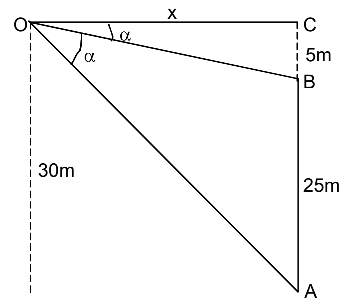
$\Rightarrow x \ge \frac{3}{2}$

$\Rightarrow x \in \left[\frac{3}{2}, 2\right) \cup (2, \infty)$

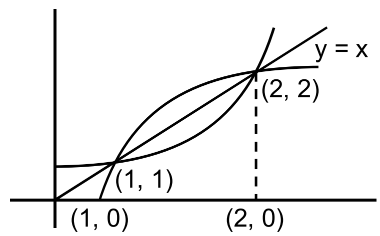
8. On solving, we get $(p - q)^2 + (p - 1)^2 + (q - 1)^2 = 0$
$\Rightarrow$ p, q = 1
Putting he values of p and q, $\Delta = 0$ as elements are in AP

9. Let the middle point of chord be (h, k)
$\therefore$ equation of chord is $T = S_1$
$\Rightarrow 3xh - 2yk + 2(x + h) - 3(y + k) = 3h^2 - 2k^2 + 4h - 6k$
Slope of this chord = $\frac{3h+2}{2k+3} = 2$ (given)
$\Rightarrow 3h - 4k = 4$
$\therefore$ Locus is $3x - 4y = 4$

10. We have $\tan\alpha = \frac{5}{x}$ and $\tan2\alpha = \frac{30}{x}$
$\Rightarrow \tan2\alpha = \frac{30}{5\cot\alpha}$
$\Rightarrow \tan2\alpha = 6\tan\alpha \Rightarrow 3 - 3\tan^2\alpha = 1$
$\Rightarrow \tan\alpha = \sqrt{\frac{2}{3}} \Rightarrow x = 5\cot\alpha = 5\sqrt{\frac{3}{2}}$ m



11. Area = $2\left|\int_1^2 x\,dx - \int_1^2 (x^2 - 2x + 2)\,dx\right| = \frac{1}{3}$ square



12. $\log_2\left(1 + \sqrt{6x - x^2 - 8}\right) \ge 0$
$\Rightarrow 1 + \sqrt{6x - x^2 - 8} \ge 1 \Rightarrow 6x - x^2 - 8 \ge 0$
$\Rightarrow x^2 - 6x + 8 \le 0$
$\Rightarrow (x - 2)(x - 4) \le 0$
$\Rightarrow 2 \le x \le 4.$
Now $f'(x) = x^2 + 2x + 2 > 0\ \forall\ x \in R$
$\Rightarrow$ f(x) is strictly increasing in [2, 4]
$f(x) = \frac{x^3}{3} + x^2 + 2x + c$
$\alpha = f(2) = \frac{8}{3} + 4 + 4 + c = \frac{32}{3} + c$
$\beta = f(4) = \frac{64}{3} + 16 + 8 + c = \frac{136}{3} + c$
$|\alpha - \beta|max = \frac{104}{3}$

13. $A = \begin{bmatrix} 5 & -2 \\ -7 & 3 \end{bmatrix}\begin{bmatrix} 2 & -1 \\ 0 & 4 \end{bmatrix}\begin{bmatrix} 1 & -1 \\ 2 & -1 \end{bmatrix} = \begin{bmatrix} -16 & 3 \\ 24 & -5 \end{bmatrix}$

14. $E_1 \Rightarrow$ Person is accident person
$E_2 \Rightarrow$ Person is not accident person
A = person will have an accident with in a year
$P(A) = P(E_1)\,P(A/E_1) + P(E_2)P(A/E_2) = 0.3 \times 0.6 + 0.7 \times 0.8 = 0.74$

15. Let $\frac{1}{H_{i+1}} - \frac{1}{H_i} = k$

$$\sum_{i=1}^{2n}(-1)^i\left(\frac{H_i + H_{i+1}}{H_i - H_{i+1}}\right) = \sum_{i=1}^{2n}\frac{(-1)^i}{k}\left(\frac{1}{H_{i+1}} + \frac{1}{H_i}\right) = 2n$$

16. $T_{r+1} = {}^{12}C_r\left(3^{\frac{1}{4}}\right)^{12-r} \cdot (4)^{r/3} = {}^{12}C_r \cdot 3^{(3-r/4)} \cdot (4)^{r/3}$

For rational term r = 0 or 12

$\therefore$ Sum = $T_1 + T_{13} = {}^{12}C_0 \cdot 3^3 + {}^{12}C_{12} \cdot 4^4 = 3^3 + 4^4 = 27 + 256 = 283$

17. $-1 \le x^2 - 10x + 26 \le 1 \Rightarrow x = 5$ only and at x = 5

$\frac{\pi}{2} = 0$ which not possible. Hence $a \in \phi$.

18. for $5 \le f(a) < 6$ x $[f(x)] = 5$

Hence cont. at x = a

19. $I = \int \sin(100x + x) \cdot (\sin x)^{99}\, dx$

$= \int(\sin(100x)\cos x + \cos 100x \cdot \sin x)(\sin x)^{99}\, dx$

$= \int \underbrace{\sin(100x)}_{I}\underbrace{\cos x \cdot (\sin x)^{99}}_{II} dx + \int \cos(100x) \cdot (\sin x)^{100}\, dx$

$= \frac{\sin(100x)(\sin x)^{100}}{100} - \frac{100}{100}\int \cos(100x)(\sin x)^{100}\, dx + \int \cos(100x)(\sin x)^{100}\, dx$

$= \frac{\sin(100x)(\sin x)^{100}}{100} + C$

20. D.R's of normal to plane x + y + z – 1 = 0 and x + ky + 3z – 1 = 0 is (1, 1, 1) and (1, k, 3) respectively

$\Rightarrow$ D.R. of normal to a plane perpendicular to given planes

$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 1 & 1 \\ 1 & k & 3 \end{vmatrix} = \hat{i}(3-k) - \hat{j}(2) + \hat{k}(k-1)$

$\Rightarrow \frac{1+2\lambda}{3-k} = \frac{2+\lambda}{-2} = \frac{1+3\lambda}{k-1} \Rightarrow -2 - 4\lambda = 6 + 3\lambda - 2k - \lambda k$ and $-2 - 6\lambda = -2 - \lambda + 2k + \lambda k$

$-4 - 10\lambda = 4 + 2\lambda \Rightarrow 12\lambda = -8 \Rightarrow \lambda = -\frac{2}{3}$

$\Rightarrow -2 + \frac{8}{3} = 6 - 2 - 2k + 2 - k = 3 \Rightarrow \frac{2}{3} - 4 = -\frac{4}{3}k \Rightarrow -\frac{10}{3} = -\frac{4}{3}k \Rightarrow k = \frac{5}{2}$

21. $x^n + \alpha x + \beta = (x - \alpha_1)^2(x - \alpha_2).....(x - \alpha_{n-1})$

$\Rightarrow \frac{x^n + \alpha x + \beta}{(x - \alpha_1)^2} = (x - \alpha_2)(x - \alpha_3).....(x - \alpha_{n-1})$

$\Rightarrow (\alpha_1 - \alpha_2)(\alpha_1 - \alpha_3).....(\alpha_1 - \alpha_{n-1}) = \lim_{x \to \alpha_1}\left(\frac{x^n + \alpha x + \beta}{(a - \alpha_1)^2}\right) = \frac{n(n-1)}{2} \cdot \alpha_1^{n-2}$

22. Favourable cases

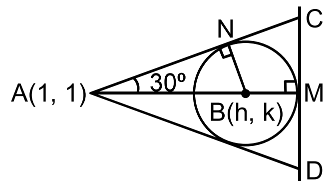
X	Y
GGGGG	BBB
BBBGG	GGG

$\Rightarrow$ Required probability = $\frac{{}^5C_5}{{}^8C_5} + \frac{{}^5C_3}{{}^8C_3} = \frac{11}{56}$

23. Put $n = \frac{1}{x}$

$$\lim_{x\to 0}\frac{1}{x}\left\{\frac{1}{x}\ln\left(\frac{1}{1+x}\right)+1\right\} = \lim_{x\to 0}\frac{1}{x}\left\{1-\frac{\ln(1+x)}{x}\right\} = \lim_{x\to 0}\left(\frac{x-\left(x-\frac{x^2}{2}+\frac{x^3}{3}-.....\right)}{x^2}\right) = \frac{1}{2}$$

24. Let co–ordinates of centre are B(h, k)



BN = BM

AB sin 30º = BM

$$\sqrt{(h-1)^2+(k-1)^2}\cdot\frac{1}{2} = \left|\frac{2h+4k-5}{\sqrt{20}}\right|$$

$11k^2 - h^2 + 16hk - 10h - 30k + 15 = 0.$

25. Length of focal chord making an angle α with x-axis is $4a\ \text{cosec}^2\ \alpha$

For $\alpha \in \left(0, \frac{\pi}{4}\right]$, it's minimum length = (4a) (2) = 8a

26. $$T_n = \frac{n}{n^2+k^2x^2} = \frac{1}{n\left(1+\left(\frac{k}{n}\right)^2 x^2\right)}$$

$$S = \frac{1}{n}\sum_{k=1}^{n}\frac{1}{1+\left(\frac{k}{n}\right)^2} = \int_0^1\frac{dt}{1+t^2x^2} = \frac{1}{x^2}\int_0^1\frac{dt}{t^2+\left(\frac{1}{x^2}\right)} = \left[\frac{1}{x}\tan^{-1}tx\right]_0^1 = \frac{\tan^{-1}x}{x}$$

27. $$(\vec{b}\times\vec{c})\cdot(\vec{a}\times\vec{d}) = (\vec{b}\cdot\vec{a})(\vec{c}\cdot\vec{d}) - (\vec{b}\cdot\vec{d})(\vec{c}\cdot\vec{a})$$

Using above formula.

28. $$\frac{dy}{dx} = 2ax = 2x\left(\frac{y}{x^2}\right);\ \frac{dy}{dx} = \frac{2y}{x}$$

Now, $m\frac{dy}{dx} = -1 \Rightarrow m = -\frac{x}{2y} \Rightarrow \frac{dy}{dx} = -\frac{x}{2y};\ y^2 = -\frac{x^2}{2}+c$

29. Complex number z is in 4^{th} quadrant

So, principal value of arg (z) will be $-\tan^{-1}\left|\tan\frac{4\pi}{5}\right|$.

30. $f(x) = \cos^{-1}x + \tan^{-1}x$

$$f'(x) = \frac{-1}{\sqrt{1-x^2}}+\frac{1}{1+x^2}$$

$$f''(x) = -x\left\{\frac{1}{(1-x^2)^{3/2}}+\frac{2}{(1+x^2)^2}\right\}$$

$\Rightarrow f'(x) \le 0$