Sri Chaitanya IIT Academy.,India.

A.P T.S KARNATAKA TAMILNADU MAHARASTRA DELHI RANCHI

A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

SEC: Sr.Super60(Incoming)_STERLING BT WTA-30 Date: 27-04-2025
Time: 09:00AM to 12:00PM JEE-ADV_(2021-P1) Max. Marks: 180

KEY SHEET

PHYSICS

1	**3**	2	**3**	3	**1**	4	**1**	5	**20**	6	**10**
7	**1.6**	8	**240**	9	**44.2**	10	**57.55**	11	**1,3**	12	**2,3,4**
13	**1,2,4**	14	**1,4**	15	**1,4**	16	**1,3,4**	17	**14**	18	**3**
19	**0**										

CHEMISTRY

20	**4**	21	**3**	22	**3**	23	**3**	24	**1**	25	**12-12.05**
26	**9**	27	**16**	28	**1185**	29	**1**	30	**1,3,4**	31	**1,2,3**
32	**1,2,3**	33	**4**	34	**1,3,4**	35	**2,3,4**	36	**6**	37	**3**
38	**2**										

MATHEMATICS

39	**B**	40	**C**	41	**C**	42	**C**	43	**1.06-1.07**	44	**0.33**
45	**2**	46	**84**	47	**1**	48	**2011**	49	**ACD**	50	**BCD**
51	**AD**	52	**ABD**	53	**ABCD**	54	**AD**	55	**2**	56	**74**
57	**1**										

SOLUTIONS
PHYSICS

01. $\vec{F}=q\left(\vec{V}\times\vec{B}\right)=1.6\times10^{-13}N$

02. Kinetic Energy $KE=Vq\Rightarrow\frac{P^2}{2m}=Vq\Rightarrow\left(Bqr\right)^2=Vq2m\left[\because r=\frac{mV}{Bq}\right]$

$B^2q^2\left(\frac{d}{2}\right)^2=Vq2m\Rightarrow m=\frac{B^2d^2q}{8V}$

03. $\left[\frac{\mu_0I_1I_2}{2\pi}\ln\left(1+\frac{b}{a}\right)\hat{j}\right]$

Magnetic field $\left(\vec{B}\right)$ created by wire-I at a distance x from it, i.e.. $\left(\vec{B}\right)=\frac{\mu_0I_1}{2\pi x}(-k)$

Force acting on a small element dx of wire -2, i.e

$\overline{dF}=I_2\overline{d\times}\text{ X }\vec{B}\ or\ \overline{dF}=I_2\overline{d\times}X\left(\frac{\mu_0I_1}{2\pi x}(-k)\right)=\frac{\mu_0I_1I_2}{2\pi\times}dx\left[\hat{i}\times\left(-\hat{k}\right)\right]\left(as\overline{d}\times-d\times\hat{i}\right)=\left(\frac{\mu_0I_1I_2}{2\pi\times}d\times\right)\hat{j};$

$\vec{F}=\int\overline{dF}=\left[\frac{\mu_0I_1I_2}{2\pi}\int_a^{a+b}\frac{1}{\times}d\times\right]$

$\hat{j}=\left[\frac{\mu_0I_1I_2}{2\pi}In\left(1+\frac{b}{a}\right)\right]\hat{j}$

$\vec{F}$ point upward as indicated by $\hat{j}$

04. $\because$ electric force on the slab

$F=\frac{du}{d\times}=\frac{1}{2}\frac{\varepsilon_0bE^2}{d}(K-1)$

$Mg=\frac{\varepsilon_0bE^2}{2d}(K-1)$

05. Particle is projected in x-y plane which is $\perp$ er to the magnetic field. Since field is along z-axis.

Magnetic of velocity $V=\sqrt{2}V_0$

Radius of the circle $r=\frac{mV}{Bq}=\frac{\sqrt{2}mV_0}{Bq}$

06. Force on the charged particle

$\vec{F}=q\left[\vec{E}+\left(\vec{V}\times\vec{B}\right)\right]=q\left[E_0\hat{k}-B_0V_0\hat{j}\right]$

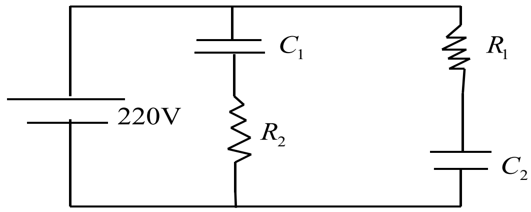
Here the magnetic force is along y-axis it causes the change in direction of velocity. Electric force is along z-axis it accelerate the charged particle. So velocity along -axis increases continuously

$\therefore$ Path of the particles helix with non uniform pitch.

07. $i=2\times10^2A$

$P_{R_1}=i^2R_1=\left(2\times10^{-2}\right)^2\times4\times10^3=1.6W$

08. $Q_{C_1}=V_{R_1}\times C_1=80\times310^{-6}=240\mu C$

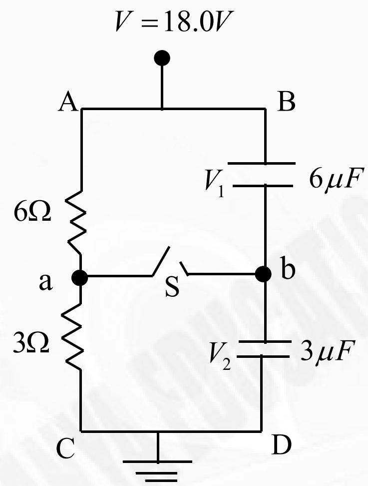


09. $\int d\tau = \frac{1}{2} Il^2 B$

10. $\frac{1}{2} Il^2 B = Kxl \sin 53^0$ find x

11. When 'S' is open across capacitors

$i = \frac{18}{9} = 2A$



$\frac{V_1}{V_2} = \frac{C_2}{C_1} = \frac{3}{6} = \frac{1}{2}$

$V_A = V_a = 6(2) = 12; V_1 = \frac{1}{3}(18) = 6$

$V_a - V_C = 3(2) = 6; V_2 = \frac{2}{3}(18) = 12$

$V_a = 6(\because V_C = 0); V_1 = V_B - V_a = 6$

$V_2 = V_b - V_D = 12$

$V_{ab} = V_a - V_b = 6 - 12 = -6$

$V_b = 12(V_D = 0)$

$Q_1 = C_1 V_1 = 6(6) = 36\mu C;$

$Q_2 = C_2 V_2 = 3(12) = 36\mu C$

When 'S' is closed

$V_1^1 = 12V \therefore Q_1^1 = C_1 V_1^1 = (6)12 = 72\mu C$

$V_1^1 = 6V \therefore Q_2^1 = C_2 V_2^1 = 3(6) = 18\mu C$

$\therefore$ Charge flown through 'S'

$= Q_1^1 - Q_1^2 = 72 - 18 = 54\mu C$

12. initially it acts as balanced wheat stone bridge

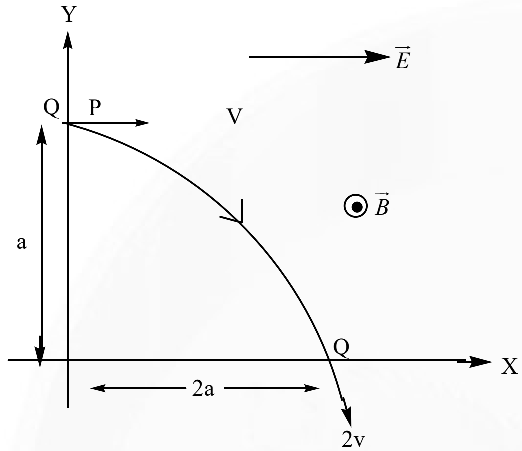
$\therefore$ current through G is zero

In steady state $i = \frac{2}{4+1+5} = 0.2A$

P.D. across $C_2 = V_G + V_{5\Omega} = I(G+R) = 0.2(1+5) = 1.2V$

13. From W-E theorems F.S= ΔKE

$E.q[2a] = \frac{1}{2}m4v^2 - \frac{1}{2}mv^2$



$E.q.2a = \frac{3mv^2}{2} \Rightarrow E = \frac{3mv^2}{4qa}$

Rate of work done by Electric field $= \frac{dw}{dt} = P$

$P = Fv = Eqv = \frac{3mv^2}{4qa}qv = \frac{3mv^2}{4a}$

At (Q), $P = \vec{F}.\vec{v} = \vec{E}q.\vec{v} = Eqv \neq 0,$ Hence © is wrong

At (Q), $P = \vec{F}.\vec{v} = \vec{E}q.\vec{v} = 0$ Work done by uniform magnetic field is zero

14. $R = \frac{mv\sin\theta}{Bq}; pitch = v\cos\theta T = v\cos\theta = \frac{2\pi m}{Bq}$

15. $Bqv = \frac{mv^2}{r} \Rightarrow Bq = \frac{mv}{r} = m\omega = m\left(\frac{2\pi}{T}\right)$

$[\because v = r\omega] \Rightarrow T = \frac{2\pi m}{Bq} \therefore a = \frac{T_1}{T_2} = 1$

$\Rightarrow pitch = P = (\theta\cos\theta)\left(\frac{2\pi m}{Bq}\right) \Rightarrow P \propto \cos\theta$

$C = \frac{P_1}{P_2} = \frac{\cos 30}{\cos 60} = \sqrt{3} = (3)^{1/2}$

As $Bqr_\perp = \frac{mv^2{}_\perp}{r}$

$\Rightarrow Bq = \frac{mv\sin\theta}{r}$

$\Rightarrow r = \frac{mv\sin\theta}{Bq}$

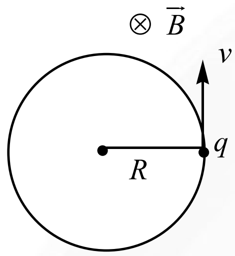
$\Rightarrow r \propto \sin\theta \Rightarrow \frac{r_1}{r_2} = b = \frac{\sin 30}{\sin 60} = \frac{1}{\sqrt{3}}$

$\therefore abc = 1 \,\&\, a = bc$

16. $R=\frac{mv}{qB};T=\frac{2\pi m}{q^B}$

Rate of sweeping the area is

$$\frac{dA}{dt}=\frac{\pi R^2}{T}=\frac{\pi\left(\frac{mv}{qB}\right)^2}{\frac{2\pi m}{q^B}}=\frac{1}{2}\frac{mv^2}{qB}$$



17. Here $\vec{V}$ parallel to $\vec{B}$

$\therefore \frac{4}{2}=\frac{y}{3}=\frac{z}{-6}$

$\Rightarrow y=6$ and $z=-12$

$\left|\vec{B}\right|=\sqrt{16+36+144}=\sqrt{196}=14T$

18. $E=\frac{B^2q^2R^2}{2m}\Rightarrow B^2=\frac{2mE}{q^2R^2}\Rightarrow B=\frac{\sqrt{2mE}}{qR}$

19. $T=\frac{2\pi m}{Bq}$ frequency $f=\frac{1}{T}=\frac{Bq}{2\pi m}$;

CHEMISTRY

20. $K_{eq} = \frac{k_f}{k_b} \Rightarrow \frac{[CH_3]^2}{[C_2H_6]}$

$\therefore [CH_3] = \frac{10^{-4}}{10} = 10^{-5} M$

$\frac{1.57\times10^{-3}}{K_b} = \frac{(10^{-5})^2}{1}$

21. CONCEPTUAL

22. $r_1 = k[0.01]^a [0.01]^b = 6.93\times10^{-6}$ ....(i)

$r_2 = k[0.02]^a [0.01]^b = 1.386\times10^{-5}$ ......(ii)

$r_3 = k[0.02]^a [0.02]^b = 1.386\times10^{-5}$ ......(iii)

From data $a = 1; b = 0;$

overall order =1; $k = 6.93\times10^{-4}\ \sec^{-1}$

$6.93\times10^{-4} = \frac{1}{50\times60} in \frac{A_0}{A_t};$

When $[A]_0 = 0.5 \quad \Rightarrow \quad A_t = 0.0625$

rate of reaction $= 6.93\times10^{-4}\times0.0625$

$= 4.33\times10^{-5} Ms^{-1}$

23. $A(g) + 2B(g) \rightarrow C(g)$

$t = 0$ 0.4 0.6

$t = t$ 0.3 0.4 0.1

$r_1 = KP_A^1 . P_B^2$

$r_1 = K\times0.4\times(0.6)^2$

$r_1 = K(0.3)(0.4)^2$

$\frac{r_1}{r_1} = 3$

24. $e^{-E_a/RT}$ is fraction of molecules having energy greater than activation energy (E_a), it is unit less. So A has same unit of K. for 1st order reaction unit of K is s^{-1}.

25. $In \frac{K_2}{K_1} = \frac{E_a}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$

$In 2 = \frac{E_a}{2cal}\left[\frac{1}{290} - \frac{1}{300}\right]$

$E_a = \frac{2.303\times0.3\times2\times290\times300}{10} cal = 12K$ Cal

26. $E = \frac{nhC}{\lambda}$

$7.2\times10^{-3} J/s = \frac{n\times6.6\times10^{-34}\times3\times10^8}{330\times10^{-9}}$

No.of photon $= \frac{7.2\times10^{-3}\times330\times10^9}{6.6\times10^{-34}\times3\times10^8} = 120\times10^{14}$

Mole of CO formed $= 0.4\times20\times10^{-9} = 8\times10^{-9} mol/s$

27. Rate of formation of $C_2H_6 = 0.8\times 20\times 10^{-9} \;= 16\times 10^{-9} mol/s$

28. $\frac{N}{N_0} = \left(\frac{1}{x}\right)^n$; where n=no.of halves;

$\frac{N}{N_0} = \frac{1}{10} = \left(\frac{1}{x}\right)^n = n = 4$

Total time $= n\times t_{1/2}$ = 4740 = 4 $= 4\times t_{1/2}$;

$t_{1/2} = 1185$ years

29. $r = k^1(O_3)[O] = k^1(O_3)K_C\frac{[O_3]}{[O_2]} = k[O_3]^2[O_2]^{-1}$

30. CONCEPTUAL

31. $(A) K = Ae^{-E_a/RT}$ as $T\downarrow, K\downarrow$ rate of reaction $\downarrow$

(B) Rate of reaction $= k[A]^0$ =K = constant

(C) As surface area $\uparrow$ No. of molecules will be more to react per unit time, more surface site available for the reaction.

(D) Average rate defined for macro-scopic time and instantaneous rate defined for micro-scopic time.

32. For an elementary reaction $aA + bB \longrightarrow cC + dD$ rate law is always $r = K[A]^a[B]^b$ but not vice versa.

For a complex reaction $aA + bB \longrightarrow cC + dD$ rate law may or may not be $r = K[A]^a[B]^b$

33. (A) In a rate law reactant, product or catalyst may be appeared.

(B) We can not

(C) In an elementary reaction only positive integer stoichiometric coefficient appears.

(D) A zero order reaction is always complex

34. (A) $K = Ae^{-E_a/RT}$

As $T\uparrow, K\uparrow$ so if $T\to\infty$, then $K\to A$ or as $Ea\uparrow, K\uparrow$ so if $E_a\to 0$, then $K\to A$

(B) Catalyst does not change ΔH of reaction.

(C) A negative catalyst decrease rate of reaction by increasing activation energy.

35. $A + B \longrightarrow C$

(A) If it is an elementary reaction then it will be bimolecular reaction.

(B) It may be exothermic eq. $NH_3(g) + HCl(g) \longrightarrow NH_4Cl(s)$

(C) It may be heterogeneous

(D) It may be photochemical reaction

36. $2NH_3(g) \rightleftharpoons N_2(g) + 3H_2(g)$

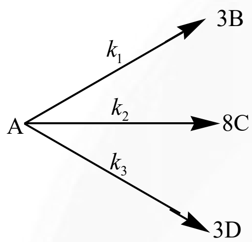
Rate $= K[NH_3]^0$

Rate $= 2$

Rate $= \frac{1}{3} \times \frac{\Delta[H_2]}{\Delta t} \Rightarrow \frac{\Delta[H_2]}{\Delta t} = 6$

37. $t_{1/2} = \frac{[A_0]}{2K_A} = \frac{[A_0]}{2 \times 5K} = \frac{200\,\text{min.}}{2 \times 5 \times 400} = \frac{60\,\text{sec.}}{20} = 3$

38.



$K_1 : K_2 : K_3 = 4 : 2 : 1$

Mole of A remain after 45 days

$$= \frac{N_0}{2^n} = \frac{N_0}{\frac{T}{2^{t_1/2}}} = \frac{1}{2^{45/15}} = \frac{1}{2^3} = \frac{1}{8}$$

Moles of A convert into product $= \frac{7}{8}$ mol

Moles of $[C] = \frac{K_2}{K_1 + K_2 + K_3} \times \frac{7}{8} \times \frac{8}{1} = 2$

MATHEMATICS

39. Let $I=\int e^{x}\left(\frac{x^{4}+2}{\left(1+x^{2}\right)^{5/2}}\right)dx$

$$=\int e^{x}\left(\frac{1}{\left(1+x^{2}\right)^{1/2}}+\frac{1-2x^{2}}{\left(1+x^{2}\right)^{5/2}}\right)dx$$

$$=\int e^{x}\left(\frac{1}{\left(1+x^{2}\right)^{1/2}}-\frac{x}{\left(1+x^{2}\right)^{3/2}}+\frac{x}{\left(1+x^{2}\right)^{3/2}}+\frac{1-2x^{2}}{\left(1+x^{2}\right)^{5/2}}\right)dx$$

$$=\frac{e^{x}}{\left(1+x^{2}\right)^{1/2}}+\frac{xe^{x}}{\left(1+x^{2}\right)^{3/2}}+C=\frac{e^{x}\left\{1+x^{2}+x\right\}}{\left(1+x^{2}\right)^{3/2}}+C$$

Hence, (d) is the correct answer.

40. Let $I=\int e^{(x\sin x+\cos x)}.\left(\frac{x^{4}\cos^{3}x-x\sin x+\cos x}{x^{2}\cos^{2}x}\right)dx$

$$=\int\left(x.e^{(x\sin x+\cos x)}.x\cos x\right)dx-\int e\left(^{x\sin x+\cos x}\right).\left(\frac{x\sin x-\cos x}{\left(x\cos x\right)^{2}}\right)dx$$

Applying integration by parts

$$=\left\{x.e^{(x\sin x+\cos x)}-\int e^{(x\sin x+\cos x)}dx\right\}$$

$$-\left\{e^{(x\sin x+\cos x)}.\frac{1}{x\cos x}-\int e^{(x\sin x+\cos x)}dx\right\}$$

$$=e^{(x\sin x+\cos x)}\left(x-\frac{1}{x\cos x}\right)+C$$

Hence, © is the correct answer.

41. Note that $\sec^{-1}\sqrt{1+x^{2}}=\tan^{-1}x:\cos^{-1}\left(\frac{1-x^{2}}{1+x^{2}}\right)=2\tan^{-1}x$

For $x>0$

$$\Rightarrow I=\int\frac{e\tan^{-1}x}{1+x^{2}}\left\{\left(\tan^{-1}x\right)^{2}+2\tan^{-1}x\right\}dx,$$

Put $\tan^{-1}x=t$

$$==\int e^{t}\left(t^{2}+2t\right)dt=e^{t}.t^{2}=e^{\tan-1x}\left(\tan^{-1}x\right)^{2}+C$$

Hence, © is the correct answer.

42. $=\int\frac{1-7\cos^{2}x}{\sin^{7}x\cos^{2}x}dx=\int\left(\frac{\sec^{2}x}{\sin^{7}x}-\frac{7}{\sin^{7}x}\right)dx$

$$=\int\frac{\sec^{2}x}{\sin^{7}}dx-\int\frac{7}{\sin^{7}x}dx=I_{1}+I_{2}$$

Now, $I_{1}=\int\frac{\sec^{2}x}{\sin^{7}x}dx=\frac{\tan x}{\sin^{7}x}+7\int\frac{\tan x.\cos x}{\sin^{8}x}dx$

$$=\frac{\tan x}{\sin^{7}x}+I_{2}$$

$$\therefore I_{1}+I_{2}=\frac{\tan x}{\sin^{2}x}+C\Rightarrow f\left(x\right)=\tan x$$

43. Let $P = \sin^3 x \cos^3 x$

$$\frac{dP}{dx} = 3\sin^2 x \cos^4 x - 3\sin^4 x \cos^2 x$$
$$= 3\sin^2 x\left(1-\sin^2 x\right)\cos^2 x - 3\sin^4 x\cos^2 x$$
$$= 3\sin^2 x\cos^2 x - 6\sin^4 x\cos^2 x$$
$$P = 3I_{2,2} - 6I_{4,2}$$
$$I_{4,2} = \frac{1}{6}\left(-P + 3I_{2,2}\right)$$

44. Let $P = \sin^5 x \cos^3 x$

$$\frac{dP}{dx} = 5\sin^4 x\cos^4 x\cos^4 x - 3\sin^6 x\cos^2 x$$
$$= 5\sin^4 x\left(1-\sin^2 x\right)\cos^2 x - 3\sin^6 x\cos^2 x$$
$$= 5\sin^4 x\cos^2 x - 8\sin^6 x\cos^2 x$$
$$\therefore \quad P = 5I_{4,2} - 8I_{6,2}$$
$$\therefore \quad I_{4,2} = \frac{1}{5}\left(P + 8I_{6,2}\right)$$

45. $\therefore \ f(x) = 0 \Rightarrow \underbrace{\left(x^2 - 4x + 8\right)}_{D>0}\underbrace{\left(x^2 - 4x + 17 = 0\right.}_{D<0}$

$\therefore$ Equation has two distinct and two imaginary roots.

46. $f(x) = \left(x^2 - 4x - 17\right)\left(x^2 - 4x + 8\right)$

$$= \left\{(x-2)^2 - 21\right\}\left\{(x-2)^2 + 4\right\}$$
$$\because \left(f(x)\right)_{\min} = (-21)(4) = -84$$

Which occurs at $x = 2$

47. Here, $2f'(x) = \lim_{h\to 0}\left(\frac{f(x+h) - f(x)}{h} + \frac{f(x\,x-h) - f(x)}{-h}\right)$

$$= \lim_{h\to 0}\left(\frac{f(x+h) - f(x-h)}{h}\right) \quad \text{....(i)}$$
$$\therefore 2f'(0) = \lim_{h\to 0}\left(\frac{f(h) - f(0)}{h} + \frac{f(-h) - f(0)}{-h}\right)$$
$$= \lim_{h\to 0}\frac{f(h) - f(-h)}{h} \text{....}(ii)$$

Now by given relation, we have

$$f(h) - f(-h) = \frac{f(x+h) - f(x-h)}{-h} \text{ and } f(0) = 1$$

From Eqs. (i) and (ii), we have $\dfrac{f'(x)}{f(x)} = 2010$

$$\Rightarrow \quad f(x) = e^{2010e}, f(0) = 1$$

$\therefore \{f(x)\}$ Is non-periodic

48. Here, $\int f\left(g(x)\right)\cos x dx = \int f\left(\log(\sin x)\right).\cos x dx$

$$= \int e^{2010\log(\sin x)}.\cos x dx$$
$$= \int (\sin x)^{2010}.\cos x dx$$

$$=\frac{(\sin x)^{2011}}{2011}+C$$

$$\therefore h(x)=\frac{(\sin x)^{2011}}{2011}$$

$$\Rightarrow h\left(\frac{\pi}{2}\right)=\frac{1}{2011}$$

49. Conceptual

50. $\int(\sin 3\theta+\sin\theta)\cos\theta e^{\sin\theta}d\theta=\left(-4\sin^3\theta-12\cos^2\theta-20\sin\theta+32\right)+F$

51. $\int\frac{1}{\left(x^{5/6}+5x^{7/6}\right).\sqrt{1+4x^{1/3}}}dx=-6\tan^{-1}\left(x^{-1/3}+4\right)^{1/2}+C=6\cot^{-1}\left(x^{-1/3}+4\right)^{1/2}+C$

52. $\int\cos ec^5 xdx=-\frac{\cos ec^3 x\cot x}{4}-\frac{3\cos ecx\cot x}{8}+\frac{3}{8}\log|\cos ecx-\cot x|+K$

53. $\int\frac{\cos x(1+4\cos 2x)}{\sin x+4\sin x\cos^2 x}dx=\log|\sin x|+\frac{1}{2}\log\left|\sin^2 x+5\cos^2 x\right|+c,$

54. $\int\sin^{-1}x\cos^{-1}xdx=\int\left[\frac{\pi}{2}\sin^{-1}x-\left(\sin^{-1}x\right)^2\right]dx$

$$=\frac{\pi}{2}\left(x\sin^{-1}x+\sqrt{1-x^2}\right)-\left(x\left(\sin^{-1}x\right)^2+2\sin^{-1}x\sqrt{1-x^2}-2x\right)+C$$

[Integrating by parts]

$$=\sin^{-1}x\left[\frac{\pi}{2}x-x\sin^{-1}x-2\sqrt{1-x^2}\right]+\frac{\pi}{2}\sqrt{1-x^2}+2x+C$$

$$\therefore\ f^{-1}(x)=\sin^{-1}x, f(x)=\sin x$$

55. Conceptual

56. $\int\frac{dx}{\left(x^2+1\right)^2}=\frac{1}{2}\tan^{-1}x+\frac{1}{2}\frac{x}{x^2+1}+C$

57. $\int e^{x^3+x^2-1}\left(3x^4+2x^3+2x\right)dx$

$$=\int\underbrace{x^2}_{I}\underbrace{e^{x^3+x^2-1}\left(3x^2+2x\right)}_{II}dx+\int e^{x^3+x^2-1}2xdx$$

$$=x^2e^{x^3+x^2-1}-\int 2xe^{x^3+x^2-1}dx+\int e^{x^3+x^2-1}2xdx$$

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

$$\Rightarrow f(1)=e \text{ and } f(-1)=\frac{1}{e}$$