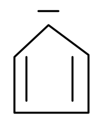
CHEMISTRY

Match the species in Column II which are weaker base than species given in Column I.

Column I		Column II	
(A)	HS^-	(P)	
(B)	$CH_3-CO-\overset{-}{C}H-CO-CH_3$	(Q)	F^-
(C)	OH^-	(R)	CN^-
(D)	NH_2^-	(S)	CH_3-COO^-
		(T)	CH_3S^-

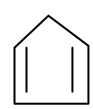
Answer:

A –Q, S
B –Q, R, S
C – Q, R, S, T
D – P, Q, R, S, T

Solution

A – (q, s); B – (q, r, s); C – (q, r, s, t); D – (p, q, r, s, t)

The acidity order is

HF > CH_3COOH >H_2S > HCN > $CH_3COH_2COCH_3$ > CH_3SH > H_2O >  > NH_3

MATHEMATICS

Match Column II with Column I.

Column I		Column II	
(A)	A certain function $f(x)$ satisfies $f(x) + 2f(6-x) = x$ for all real numbers x. The value of f (1) is	(P)	1
(B)	If $f(x)$ is continuous and differentiable over $[-2, 5]$ and $-4 \le f'(x) \le 3$ for all x in $(-2, 5)$ then the greatest possible value of $f(5) - f(-2)$ is	(Q)	2
(C)	Let $f(x) = x^n \lvert x \rvert$ for all real numbers x. Then, $f(x)$ is differentiable at the origin if n is equal to	(R)	3
(D)	The maximum value of $f(x)$ where $f(x) = \int_0^x \sin\{x(1-x)\}\,dx$, occurs at $x =$	(S)	4
		(T)	21

Answer:

A –R
B –T
C – P, Q, R, S, T
D – P

Solution

A) Put $x = 1$ and $x = 5$ and find $f(1)$

B) Using LMVT in [-2, 5]

$$-4 \le \frac{f(5) - f(-2)}{7} \le 3$$

$$-28 \le f(5) - f(-2) \le 21$$

C) For $n = -1$ we have

$$f(x)=\frac{|x|}{x}, x\neq 0$$

This is not differentiable at origin

For $n = 0$, $f(x) = |x|$, not differentiable at origin.

If n is a positive integer

$$\lim_{h\to 0}\frac{h^n|h|-0}{h}=\lim_{h\to 0}|h|.h^{h-1}=\lim_{h\to 0}h^a|h|, a\geq 1=0$$

Then limit exists and so $f'(0)$ exists. Hence $f(x)$ is differentiable at $x = 0$.

Thus, **$f(x) = x^n$ $|x|$ is differentiable at the origin if n is any positive integer**.

D) $f(x)=\int_0^x \sin\{x(1-x)\}dx$

$f'(x)=\sin x(1-x)\Rightarrow f'(x)=0\Rightarrow \sin x(1-x)=0$

$\Rightarrow x(1-x)=0,\pm\pi,\pm 2\pi$

Thus $x-x^2=n\pi\Rightarrow x^2-x+n\pi=0$

$\therefore x=\frac{1\pm\sqrt{1-4n\pi}}{2}$

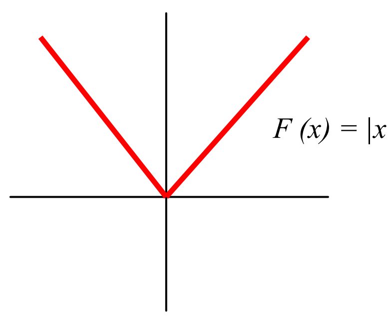
For real roots to exist $1\geq 4n\pi\Rightarrow n\leq\frac{1}{4\pi}$

Thus n = 0 or negative values.

$f'(x)=\cos\{x(1-x)\}.(1-2x)$

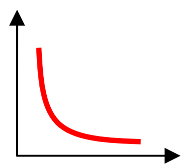
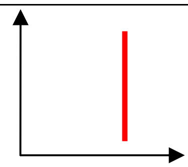
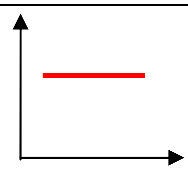
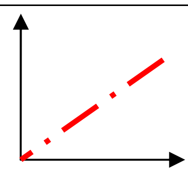
$f''(0)=1>0, f'(1)=-1<0$

But $f(x)$ is maximum at $x = 1$



PHYSICS

The graphs in Column I have one of p, V or T on the axes (non – repeating). Match these to the possible process in Column II.

Column I		Column II	
(A)		(P)	Isotherm
(B)		(Q)	Adiabatic
(C)		(R)	Isochoric
(D)		(S)	Isobaric
		(T)	None

Answer

A –P, Q
B –P, R, S
C –Q, R, S
D –R, S

Hint: Use definitions of various processes (such as isothermal) and $pV = nRT$.