Practice Exam 3

Monday, March 27, 2017 12:58 PM

MC - No Calculator

B 1. $A = \int_1^3 (3x^2+2x)\,dx$

$= x^3 + x^2 \Big|_1^3$

$= 27 + 9 - (1+1)$

$= \boxed{34}$

D 2. $f(x) = \begin{cases} -x & \text{for } x<0 \\ 0 & \text{for } x=0 \\ x & \text{for } x>0 \end{cases}$

$\int_{-4}^{2} f(x)\,dx = \int_{-4}^{0} -x\,dx + \int_0^2 x\,dx$

$= -\frac{x^2}{2}\Big|_{-4}^{0} + \frac{x^2}{2}\Big|_0^2$

$= 0 - (-8) + 2 - 0$

$= \boxed{10}$

B 3. $\int_0^h C(s)\,ds$

$\frac{\text{gal}}{\cancel{\text{mile}}} \cdot \frac{\cancel{\text{mile}}}{\text{hr}}$

$\boxed{\frac{\text{gal}}{\text{hr}}}$

D 4. $\frac{dr}{dt} = 2\,\frac{\text{in}}{\text{sec}}$ $\frac{dV}{dt} = ?$, $r = 10\text{in}$

$\frac{d}{dt}\left(V = \frac{4}{3}\pi r^3\right)$

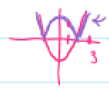
$\frac{dV}{dt} = 4\pi r^2 \frac{dr}{dt}$

$\frac{dV}{dt} = 4\pi (10)^2 \cdot 2$

$= \boxed{800\pi \ \frac{\text{in}^3}{\text{sec}}}$

A 5. $v(t) = t^2 - 4 \ \frac{\text{ft}}{\text{sec}}$

$\text{dist} = \int_1^3 |t^2-4|\,dt$



$\text{dist} = \int_1^2 (4-t^2)\,dt + \int_2^3 (t^2-4)\,dt$

$= \left(4t - \frac{t^3}{3}\right)\Big|_1^2 + \left(\frac{t^3}{3} - 4t\right)\Big|_2^3$

$= \underbrace{8 - \frac{8}{3} - 4 + \frac{1}{3}}_{4 - \frac{7}{3} = \frac{5}{3}} + \underbrace{9 - 12 - \frac{8}{3} + 8}_{5 - \frac{8}{3} = \frac{7}{3}}$

$= \frac{5}{3} + \frac{7}{3} = \frac{12}{3} = \boxed{4}$

D 6. $\int_1^4 f'(x)\,dx$

$= f(4) - f(1)$

$= 2 - (-5)$

$= \boxed{7}$

1st fund Thm of Calculus!

A 7. $\lim_{x\to 3} \frac{g(3)-g(x)}{3-x} = -.628$

$\therefore g'(3) = -.628$

$g(x)$ is decreasing

C 8. $\int_1^3 \frac{x}{x^2+1}\,dx$ $u = x^2+1$, $\frac{du}{dx} = 2x$

$dx = \frac{du}{2x}$

$x=1,\ u=2$

$x=3,\ u=10$

$= \frac{1}{2}\int_2^{10} \frac{du}{u}$

$= \frac{1}{2}\ln|u|\Big|_2^{10} = \frac{1}{2}(\ln 10 - \ln 2)$

$= \frac{1}{2}\left(\ln \frac{10}{2}\right) = \boxed{\frac{1}{2}\ln 5}$

A 9. $\frac{d}{dx}\ln\left(\frac{1}{x^2-1}\right) =$

$= \frac{1}{\frac{1}{x^2-1}} \cdot -1(x^2-1)^{-2} \cdot 2x$

$= \frac{-2x\,\cancel{(x^2-1)}}{(x^2-1)^{\cancel{2}}}$

$= \frac{-2x}{x^2-1} = \boxed{\frac{2x}{1-x^2}}$

B 10. $f(x) = e^{2x}$

$\frac{f(5)-f(0)}{5-0} = \frac{e^{10}-1}{5}$

$f'(x) = 2e^{2x}$

$2e^{2x} = \frac{e^{10}-1}{5}$

$e^{2x} = \frac{e^{10}-1}{10}$

$2x = \ln\left(\frac{e^{10}-1}{10}\right) \rightarrow x = \frac{1}{2}\ln\left(\frac{e^{10}-1}{10}\right)$

$0 < \frac{1}{2}\ln\left(\frac{e^{10}-1}{10}\right) < 5$, $\therefore$ one pt

B 11. $f'(5) = -3$, f concave down

$f'(x)$ decr

a)

x	f(x)
4	8
5	4
6	0

$\frac{4-8}{1} = -4$, $\frac{0-4}{1} = -4$

f'(x) const

b)

x	f(x)
4	8
5	6
6	2

$\frac{6-8}{1} = -2$, $\frac{2-6}{1} = -4$

f'(x) decr

c)

x	f(x)
4	8
5	6
6	5

$\frac{6-8}{1} = -2$, $\frac{5-6}{1} = -1$

f'(x) incr

d)

x	f(x)
4	8
5	3
6	2

$\frac{3-8}{1} = -5$, $\frac{2-3}{1} = -1$

f'(x) incr

B 12. $\lim_{t\to 0} \frac{\sqrt{1-2t} + t - 1}{t^2}$ "$\frac{0}{0}$"

$= \lim_{t\to 0} \frac{\frac{1}{\cancel{2}\sqrt{1-2t}} \cdot -\cancel{2} + 1}{2t}$

$= \lim_{t\to 0} \frac{\frac{-1}{\sqrt{1-2t}} + 1}{2t}$ "$\frac{0}{0}$"

$= \lim_{t\to 0} \frac{\frac{1}{\cancel{2}(1-2t)^{3/2}} \cdot -\cancel{2}t}{2}$

$= \lim_{t\to 0} \frac{-1}{2(1-2t)^{3/2}} = \boxed{\frac{-1}{2}}$

D 13. $\int_5^{12} f(x)\,dx$

$= 1(7) + 3(11) + 2(12) + 1(8)$

$= 7 + 33 + 24 + 8$

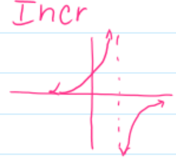
$= \boxed{72}$

B 14. VA $x=2$

$\therefore \lim_{x\to 2} f(x) = \pm\infty$

$f'(x) > 0,\ x \neq 2$

Incr



$\lim_{x\to 2^-} f(x) = \infty$

$\lim_{x\to 2^+} f(x) = -\infty$

D 15. $f(x)$ has min when $f'(x)<0 \to f'(x)>0$ at $x=3$

Note: a) $f'(5)=0$ identifies critical pt ONLY!

b) If $f'(x)<0 \to f'(x)>0$ at $x=5$, min occurs at $x=5$!

c) horiz tan line identifies critical pt. ONLY!

C 16. $g(x) = \int_0^x f(t)\,dt$

$g'(x) = f(x)$

$g''(x) = f'(x)$

$g(x)$ changes from conc up to conc down when $g''(x)>0 \to g''(x)<0$

OR

$g'(x)$ incr $\to g'(x)$ decr

This occurs at $x=5$

A 17. $f'(x)$: $-$ $+$ $+$ (at -2, 1)

$f(x)$: $\searrow$ -2 $\nearrow$ 1 $\nearrow$

$f'(1)=0$

Horiz tan line

$f'(x)$ decr $(-\infty,-2)$

$f'(x)$ incr $(-2,1)\cup(1,\infty)$

B 18. $\frac{d}{dx}\int_x^0 \frac{du}{1+u^2}$

$= \frac{d}{dx}\left(-\int_0^x \frac{du}{1+u^2}\right)$

$= \boxed{-\frac{1}{1+x^2}}$

D 19. $g(x) = f(3x)$

$g'(x) = f'(3x)\cdot 3$

$g'(0.1) = 3f'(0.3)$

$g'(0.1) = 3(1.096)$

$= 3.288$

$1.096 \times 3 = 3.288$

C 20. $\frac{dy}{dx} = 4xy,\ (0,4)$

$\int \frac{dy}{y} = \int 4x\,dx$

$\ln|y| = 2x^2 + C_1$

$|y| = e^{2x^2 + C_1}$

$y = \pm e^{2x^2} e^{C_1}$

$y = Ce^{2x^2}$

$4 = Ce^0$

$\boxed{= 4e^{2x^2}}$

A 21. $y = x^3 - 6x^2$

$y' = 3x^2 - 12x$

$y'' = 6x - 12 = 0$

$x = 2$ $\quad y''<0 \to y''>0$

$y(2) = 8 - 24 = -16$

$y'(2) = 12 - 24 = -12$

$(2,-16)$ $m=-12$

$y + 16 = -12(x-2)$

$y + 16 = -12x + 24$

$\boxed{y = -12x + 8}$

B 22. $\int_0^k \cos(2x)\,dx = \frac{1}{2}$

$\frac{1}{2}\sin(2x)\Big|_0^k = \frac{1}{2}$

$\frac{1}{2}\left[\sin 2k - \sin 0\right] = \frac{1}{2}$

$\frac{1}{2}\sin(2k) = \frac{1}{2}$

$\sin(2k) = 1$

$2k = \frac{\pi}{2}$

$\boxed{k = \frac{\pi}{4}}$

C 23. I. $\int_a^b k f(x)\,dx = k\int_a^b f(x)\,dx,\ k\neq 0$

True

II. $\int_a^b x f(x)\,dx = x\int_a^b f(x)\,dx$

False! x is NOT a scalar

III. $\int_a^b f(x)\,dx = \int_a^c f(x)\,dx + \int_c^b f(x)\,dx$

True

I & III only

B 24. $f(x) = \sqrt{e^{2x}+1}$

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

$f'(0) = \frac{e^0}{\sqrt{e^0+1}}$

$= \frac{1}{\sqrt{2}} = \boxed{\frac{\sqrt{2}}{2}}$

C 25 $\frac{d}{dx}\left(x^2+3y^2=8+2xy\right)$

$$2x+6y\frac{dy}{dx}=2y+2x\frac{dy}{dx}$$

$$(6y-2x)\frac{dy}{dx}=2y-2x$$

$$\frac{d}{dx}\left(\frac{dy}{dx}=\frac{y-x}{3y-x}\right)$$

$$\frac{d^2y}{dx^2}=\frac{\left(\frac{dy}{dx}-1\right)(3y-x)-\left(3\frac{dy}{dx}-1\right)(y-x)}{(3y-x)^2}$$

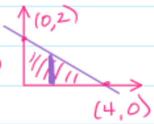
$$\left.\frac{dy}{dx}\right|_{(2,2)}=0$$

$$\left.\frac{d^2y}{dx^2}\right|_{(2,2)}=\frac{(0-1)(6-2)-\cancel{(0-1)(2-2)}^{\,0}}{(6-2)^2}$$

$$=\frac{-4}{16}=\boxed{-\frac{1}{4}}$$

A 26. $x+2y=4$

$y=-\frac{1}{2}x+2$



$d=-\frac{1}{2}x+2$, $r=-\frac{1}{4}x+1$

$$A=\frac{\pi}{2}r^2=\frac{\pi}{2}\left(-\frac{1}{4}x+1\right)^2$$

$$V=\frac{\pi}{2}\int_0^4\left(\frac{1}{16}x^2-\frac{1}{2}x+1\right)dx$$

$$V=\frac{\pi}{2}\left(\frac{1}{48}x^3-\frac{1}{4}x^2+x\right)\Big|_0^4$$

$$V=\frac{\pi}{2}\left(\frac{1}{48}(64)-\frac{1}{4}\cdot 16+4\right)$$

$$V=\frac{\pi}{2}\cdot\frac{4}{3}=\boxed{\frac{2\pi}{3}}$$

D 27. $x(t)=(t+1)(t-3)^3$

$$v(t)=(t-3)^3+3(t-3)^2(t+1)$$
$$=(t-3)^2(t-3+3t+3)$$
$$=(t-3)^2(4t)$$
$$a(t)=2(t-3)(4t)+4(t-3)^2$$
$$=4(t-3)(2t+t-3)$$
$$=4(t-3)(3t-3)=0$$

$t=3$, $t=1$

$a'(t)$ + 1 − 3 +

$v(t)$ ↗ 1 ↘ 3 ↗

$\boxed{v(t) \text{ incr } (-\infty,1)\cup(3,\infty)}$

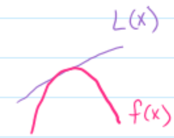
A 28. $\frac{1}{2}(6)\left[5+2(18)+2(16)+2(12)+7\right]$

$$\frac{1}{2}(\Delta x)\left[f(0)+2f(6)+2f(12)+2f(18)+f(24)\right]$$
$$=3(5+36+32+24+7)$$
$$=3(104)$$
$$=\boxed{312}$$

D 29. $\text{Avg} f=\frac{1}{7-3}\int_3^7 f(x)dx$

$$12=\frac{1}{4}\int_3^7 f(x)dx$$
$$\boxed{48}=\int_3^7 f(x)dx$$

C 30.



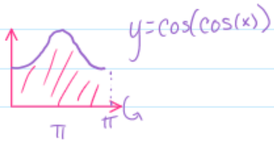
$L(x)>f(x)$

when $f(x)$ conc down

or $f''(x)<0$

MC - Calculator Active

C 31.



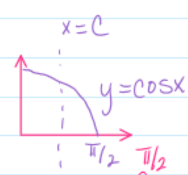
$$V=\pi\int_0^{\pi}(\cos(\cos x))^2dx$$

$\boxed{V=6.040}$

A 32. $h(x)=\frac{f(x)}{g(x)}$

$$h'(x)=\frac{f'(x)g(x)-g'(x)f(x)}{g^2(x)}$$
$$h'(3)=\frac{\left(-\frac{1}{3}\right)(3)-(1)(1)}{(3)^2}$$
$$h'(3)=\boxed{\frac{-2}{9}}$$

A 33.



$$\int_0^c \cos x\,dx=\int_c^{\pi/2}\cos x\,dx$$
$$\sin x\Big|_0^c=\sin x\Big|_c^{\pi/2}$$
$$\sin c-\sin 0=\sin \pi/2-\sin c$$
$$2\sin c=1$$
$$\sin c=1/2$$
$$\boxed{c=\pi/6}$$

D 34. $f(x) = 5 + 15x + 6x^2 - x^3$

$f'(x) = 15 + 12x - 3x^2 = 0$

$x^2 - 4x - 5 = 0$

$(x-5)(x+1) = 0 \rightarrow x = -1, 5$

$f'(x)$: $-$ | $+$ | $-$

$f(x)$: $\searrow$ -1 $\nearrow$ 5 $\searrow$

decr on $(-\infty, -1) \cup (5, \infty)$

A 35. $\int_0^1 \frac{\tan^2 x}{x^2+1}\,dx = f(1) - f(0)$

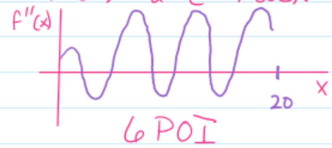
$f(0) = \frac{1}{2} - \int_0^1 \frac{\tan^2 x}{x^2+1}\,dx$

$f(0) = \boxed{.155}$

B 36. $f(x) = \frac{1}{4}x^2 - e^{-x} - \cos x - x$

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

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



6 POI

C 37. $f(x) = 5 + 5.8\sin\left(\frac{\pi x}{4}\right) - 15.7\cos\left(\frac{\pi x}{3}\right)$

$f'(x) = \frac{5.8\pi}{4}\cos\left(\frac{\pi x}{4}\right) + \frac{15.7\pi}{3}\sin\left(\frac{\pi x}{3}\right)$

$f'(x)$ is max at $x = 7.566$

C 38. $R(t) = 530e^{.18t}$

Let $v(t)$ = # people w/ inf.

$\int_0^6 R(t)\,dt = V(6) - V(0)$

$V(6) = \int_0^6 R(t)\,dt + 725$

$V(6) = \boxed{6451 \text{ people}}$

D 39. $f(x)$ is odd $\rightarrow$ sym. origin

$\lim_{x\to-\infty} f(x) = -3$

then $\lim_{x\to\infty} f(x) = +3$

I $\rightarrow$ true

II $\rightarrow$ true - continuous

III $\rightarrow$ true end behavior

$\lim_{x\to-\infty} f(x) = -3$ & $\lim_{x\to\infty} f(x) = 3$

$\boxed{\text{I, II and III true}}$

C 40. $f(x) = x^3 - 7x^2 + 25x - 39$ $(c, 0)$ $g(x)$ $(0, c)$

$0 = c^3 - 7c^2 + 25c - 39$

$c = 3$

$f'(x) = 3x^2 - 14x + 25$

$f'(c) = 10 \implies$ Then $g'(0) = \boxed{\frac{1}{10}}$

A 41. $\int_k^6 \frac{dx}{x+2} = \ln k,\ k > 0$

$\ln|x+2|\Big|_k^6 = \ln k$

$\ln(8) - \ln(k+2) = \ln k$

$\ln\frac{8}{k+2} = \ln k$

$\frac{8}{k+2} = k$

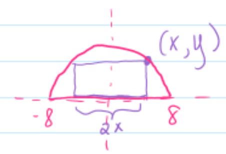
$k^2 + 2k = 8$

$k^2 + 2k - 8 = 0$

$(k+4)(k-2) = 0$

$\cancel{k = -4}$ $\boxed{k = 2}$

D 42.



$y = \sqrt{64 - x^2}$

$A = 2xy$

$A = 2x\sqrt{64 - x^2}$

$A' = 2\left(\sqrt{64-x^2}\right)^2 + \frac{2x}{2\sqrt{64-x^2}}$

$A = 128 - 2x^2 - 2x^2 = 0$

$128 = 4x^2$

$32 = x^2$

$x = \pm\sqrt{32}$ length must be +

$x = \sqrt{32}$

A': $+$ | $-$

A: $\nearrow$ $\sqrt{32}$ $\searrow$

$\therefore x = \sqrt{32}$ max

$y = \sqrt{64 - 32} = \sqrt{32}$

$A = 2(\sqrt{32})(\sqrt{32}) = \boxed{64}$

C 43. $f(x)=\begin{cases} e^{-x}+2 & \text{for } x<0 \\ ax+b & \text{for } x\geq 0 \end{cases}$

If f is differentiable, f is cont.

$\therefore \lim_{x\to 0^-} f(x) = \lim_{x\to 0^+} f(x)$

$e^0+2 = a(0)+b$

$3=b$

$f'(x)=\begin{cases} -e^{-x} & \text{for } x<0 \\ a & \text{for } x>0 \end{cases}$

$\lim_{x\to 0^-} f'(x) = \lim_{x\to 0^+} f(x)$

$-e^0 = a$

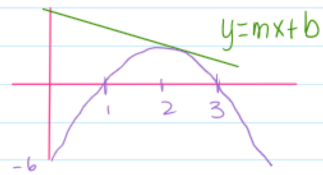
$-1=a$

$a+b = 3-1 = \boxed{2}$

B 44. $\int_2^{10} R(t)\,dt = \boxed{731 \text{ gal}}$

B 45. $y=mx+b$, $b\geq 2$

$f(x)=-2(x-2)^2+2$



$f'(x)=-4(x-2)=m$, $x\geq 2$

At $x=2$, $m=0$ and $b=2$

Other extreme in Quad I occurs at $(3,0)$

$f'(3)=-4$

$y=-4(x-3)$

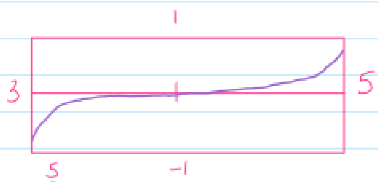
$y=-4x+12$, $b=12$

$\boxed{2\leq b\leq 12}$

Free Response – Calculator Active

1. $v(t)=(t-4)^4\sin(t-4)$

a) $\boxed{\begin{array}{l} v(3)=-.841 \\ s(3)=|v(3)|=.841 \\ a(3)=v'(3)=3.906 \end{array}}$

b) 

c) $v(t)$ is increasing on $(3,5)$ since the graph is continuously rising in interval.

d) dist $=\int_3^5 |v(t)|\,dt = \int_3^4 -v(t)\,dt + \int_4^5 v(t)\,dt$

dist $=\boxed{.293}$

2. a) $\int_0^9 S(t)\,dt = \boxed{415.421 \text{ m}^3}$

b) $S(6)-R(6) = \boxed{-39.909 \text{ m}^3/\text{hr}}$

This is the rate of change of sand in the bin at $t=6$ hrs. Since the rate is negative, more sand is being removed than added at this pt.

c) $A(t)=$ Net amt of sand in bin

$A(t)=\int_0^t [S(x)-R(x)]\,dx$

$A'(t)=S(t)-R(t)=0$

$S(t)=R(t)$ at $t=3.837$

On $0<t<3.837$ $S(t)>R(t)$

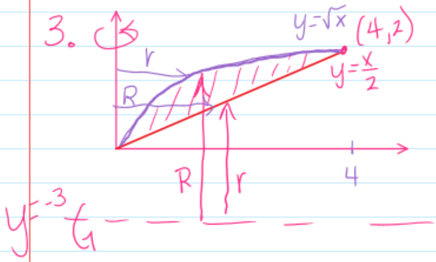
On $3.837<t<9$ $R(t)>S(t)$

Since sand was poured in at higher rate than it was removed until $t=3.837$ and is removed at higher rate than it is poured in after that, the amount of sand is a max at $t=3.837$ when $S(t)=R(t)$.

d) $\int_0^9 S(t)\,dt - \int_1^9 R(t)\,dt = \boxed{.00158 \text{ m}^3}$

effectively empty

3.



a) $A=\int_0^4 \sqrt{x}-\frac{x}{2}\,dx = \frac{2}{3}x^{\frac{3}{2}}-\frac{x^2}{4}\Big|_0^4 = \frac{2}{3}(4)^{3/2}-\frac{4^2}{4}-0$

$=\frac{16}{3}-\frac{12}{3}=\boxed{\frac{4}{3}}$

b) $R=2y$, $r=y^2$

$V=\pi\int_0^2 (2y)^2-(y^2)^2\,dy=\pi\int_0^2\left(4y^2-y^4\right)dy$

$V=\pi\left(\frac{4}{3}y^3-\frac{y^5}{5}\right)\Big|_0^2=\pi\left(\frac{32\cdot 5}{3\cdot 5}-\frac{32\cdot 3}{5\cdot 3}\right)$

$=\frac{32\pi}{15}(5-3)=\boxed{\frac{64\pi}{15}}$

c) $R=\sqrt{x}-(-3)=\sqrt{x}+3$
$r=\frac{x}{2}-(-3)=\frac{x}{2}+3$

$V=\pi\int_0^4 (\sqrt{x}+3)^2-\left(\frac{x}{2}+3\right)^2dx$

4. a) $f'(a)=g'(b)$

$f'(x)=2x$ $\quad g'(x)=2(x-3)$
$f'(a)=2a$ $\quad g'(b)=2b-6$

$2a=2b-6$
$\boxed{a=b-3}$

b) $m=\frac{(b-3)^2-(a^2-3)}{b-a}$ $\quad b=a+3$

$m=\frac{(a+\cancel{3-3})^2-a^2+3}{a+3-a}=\frac{a^2-a^2+3}{3}=1$

$\therefore f'(a)=2a=1$ $\boxed{a=\frac{1}{2}}$ and $g'(b)=2b-6=1$ $\boxed{b=\frac{7}{2}}$

c) $m=1$ $\quad f(a)=f\left(\frac{1}{2}\right)=\left(\frac{1}{2}\right)^2-3$
$=-\frac{11}{4}$

$$\boxed{\begin{aligned} y+\tfrac{11}{4}&=x-\tfrac{1}{2}\\ y&=x-\tfrac{13}{4}\end{aligned}}$$

d) $\boxed{A=\int_{1/2}^{2}\left(x^2-3-\left(x-\frac{13}{4}\right)\right)dx+\int_2^{7/2}\left((x-3)^2-\left(x-\frac{13}{4}\right)\right)dx}$

5. $f(x)=k+12x+3x^2-2x^3$

a) $f'(x)=12+6x-6x^2=0$
$x^2-x-2=0$
$(x-2)(x+1)=0$
$x=2,-1$

		-1		2	
$f'(x)$	$-$		$+$		$-$
$f(x)$	$\searrow$		$\nearrow$		$\searrow$

$\boxed{\text{f(x) is incr on } (-1,2) \text{ since } f'(x)>0}$

b) Rel max occurs at $x=2$ since $f'(x)>0\to f'(x)<0$
$\therefore (2,4)$
so $f(2)=4=k+12(2)+3(2)^2-2(2)^3$
$4=k+24+12-16$
$4=k+20$
$\boxed{k=-16}$

c) $f''(x)=6-12x=0$
$x=\frac{1}{2}$

		$\frac{1}{2}$	
$f''(x)$	$+$		$-$
$f(x)$	$\cup$		$\cap$

$\boxed{\text{f(x) concave up on } (-\infty,\tfrac{1}{2}) \text{ since } f''(x)>0}$

d) Rel min occurs at $x=-1$ since $f'(x)<0\to f'(x)>0$

$f(-1)=-16+12(-1)+3(-1)^2-2(-1)^3$
$=-16-12+3+2$
$=-23$

$\boxed{\text{Rel min value}=-23}$

6. a) $g(4.5) = \int_0^{4.5} f(t)\,dt = \frac{1}{2}\left(\frac{9}{2}+3\right)(3) + \frac{1}{2}\left(\frac{3}{2}\right)(3)$

$= \frac{3}{2}\left(\frac{15}{2}\right) + \frac{9}{4} = \frac{45}{4} + \frac{9}{4} = \frac{54}{4} = \boxed{\frac{27}{2}}$

$$\boxed{\begin{array}{l} g'(4.5) = f(4.5) = 0 \\ g''(4.5) = f'(4.5) = -2 \end{array}}$$

$(-3, 0)$ $(0, 4.5)$ $(4.5, 7)$ $(7, 9)$

b) $Av\,f = \frac{1}{5-(-3)} \int_{-3}^{5} f(x)\,dx = \frac{1}{8}\left[\frac{1}{2}\left(6+\frac{9}{2}\right)(3) + \frac{27}{2} - \frac{1}{2}\left(\frac{5}{2}\right)(1) + \frac{1}{2}(2)(1)\right]$

$= \frac{1}{8}\left[\frac{3}{2}\left(\frac{21}{2}\right) + \frac{27}{2} - \frac{5}{4} + 1\right] = \frac{1}{8}\left(\frac{116}{4}\right) = \boxed{\frac{29}{8}}$

$63/4 + 54/4 - 5/4 + 4/4$

$4\overline{)116}$ 29 8 36

c) POI on g occur when $g''(x)$ changes sign or $g'(x)$ changes direction.
POI occurs at $x=5$ where $g''(x) < 0 \rightarrow g''(x) > 0$

Since $f'(x) < 0 \rightarrow f'(x) > 0$

d) $g'(x)$: $[-3$ $+$ 4.5 $-$ 7 $+$ $9]$
$g(x)$: $\nearrow$ 4.5 $\searrow$ 7 $\nearrow$

Rel max occurs at $x = 4.5$, $g'(x) > 0 \rightarrow g'(x) < 0$

Also, consider endpts.

$g(-3) = \int_0^{-3} f(t)\,dt < 0 \Rightarrow g(x)$ increases from $g(-3)$ to $g(4.5) \rightarrow$ No max at $g(-3)$.

$g(4.5) = \boxed{27/2}$

$g(9) = \int_0^9 f(t)\,dt = \frac{27}{2} - 5/4 + 1 = \frac{54}{4} - \frac{5}{4} + \frac{4}{4} = \boxed{\frac{53}{4}}$