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Name_____ ID_____ SEC_____

MATH 151   Final Exam Version B   Fall 2004

Sections 501-503, 515-517   P. Yasskin

On the front of the Scantron and on this sheet

   write your Name, your University ID and your Section.

Enter your Multiple Choice answers on the Scantron

   and CIRCLE them on this sheet.

<center>Multiple Choice: (4 points each. No part credit. No calculator.)</center>

1. Find x so that $(2,3) + x(2,-1) = (4,1)$

   a. $x = 1$ or 2

   b. $x = 1$ only

   c. $x = 2$ only

   d. $x = -1$ only

   e. No solutions

2. Find an equation of the line through the point $P = (1,-2,3)$ which is parallel to the vector $\overrightarrow{AB}$, where $A = (4,2,1)$ and $B = (1,-3,2)$.

   a. $(x,y,z) = (4 - 3t, 2 - 5t, 1 + t)$

   b. $(x,y,z) = (4 + t, 2 - 2t, 1 + 3t)$

   c. $(x,y,z) = (1 - 3t, -2 - 5t, 3 + t)$

   d. $(x,y,z) = (1 + 4t, -2 + 2t, 3 + t)$

   e. $(x,y,z) = (1 + t, -2 - 3t, 3 + 2t)$

3. Compute $\lim\limits_{x \to 4} \dfrac{\sqrt{x} - 2}{x - 4}$

   a. $\dfrac{1}{4}$

   b. $\dfrac{1}{2}$

   c. 0

   d. $-\dfrac{1}{2}$

   e. $-\dfrac{1}{4}$

4. The graph of $y = f(x)$ is shown at the right. Which of the following is FALSE?
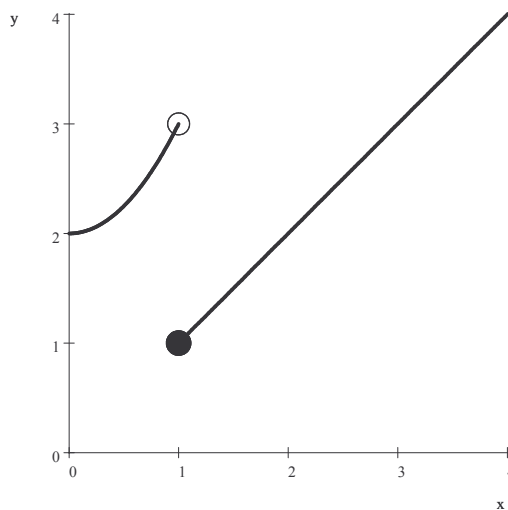
a. $\lim\limits_{x \to 1^-} f(x) = 3$

b. $\lim\limits_{x \to 1^+} f(x) = 1$

c. $f(1) = 1$

d. f is continuous from the left at $x = 1$

e. f is continuous from the right at $x = 1$

5. Which of the following is TRUE?

a. $\lim\limits_{x \to -11} |x + 11| = 11$

b. $\lim\limits_{x \to 11^-} \dfrac{|x - 11|}{x - 11} = -1$

c. $\lim\limits_{x \to -11^-} \dfrac{|x + 11|}{x + 11} = 11$

d. $\lim\limits_{x \to 11} \dfrac{|x - 11|}{x - 11} = 1$

e. $\lim\limits_{x \to -11^-} \dfrac{|x + 11|}{x + 11} = 0$

6. Compute $\lim\limits_{h \to 0} \dfrac{\tan\left(\frac{\pi}{4} + h\right) - 1}{h}$.

HINT: This limit is $f'(a)$ for what f and what a?

a. 4

b. 2

c. $\dfrac{4}{3}$

d. 1

e. $\dfrac{1}{2}$

7. Compute $\lim\limits_{x \to 1} \dfrac{e^x - e}{x - 1}$

   a. e

   b. $\dfrac{1}{e}$

   c. 0

   d. $2e$

   e. $\dfrac{1}{2e}$

8. If $f(x) = \dfrac{7x - 1}{9x + 2}$ then $f'(x) =$

   a. $\dfrac{-5}{(9x + 2)^2}$

   b. $\dfrac{-5}{(7x - 1)^2}$

   c. $\dfrac{5}{(7x - 1)^2}$

   d. $\dfrac{-23}{(9x + 2)^2}$

   e. $\dfrac{23}{(9x + 2)^2}$

9. If $f(x) = (\sin x)^{3x}$ then $f'(x) =$

   a. $(\sin x)^{3x}[3 \ln(\sin x) + 3x^2 \tan x]$

   b. $(\sin x)^{3x}[3 \ln x \cos x + 3x \tan x]$

   c. $(\sin x)^{3x}[3 \ln(\cos x) + 3x \cot x]$

   d. $(\sin x)^{3x}[3 \ln(\sin x) + 3x \cot x]$

   e. $(\sin x)^{3x}[3 \ln x \sin x + 3x \cot x]$

10. Find the critical numbers of the function $f(x) = x^{1/4}(x-3)^2$.

   a. $3, \dfrac{1}{3}$

   b. $3, \dfrac{1}{3}, 1$

   c. $3, \dfrac{1}{3}, 0$

   d. $3, 0$

   e. $3, 0, -3$

11. A ball is dropped (initial velocity $v(0) = 0$) from the top of a tall building. Due to air resistance, its acceleration is only $a(t) = 6 + 4e^{-t}$ m/sec^2. How far does it fall in $t = 1$ sec?

   a. $3 - 4e^{-1}$ m

   b. $3 + 4e^{-1}$ m

   c. $10 - 4e^{-1}$ m

   d. $10 + 4e^{-1}$ m

   e. $6 + 4e^{-1}$ m

12. Compute $\displaystyle\int_0^{\pi/2} \sin(2x)\, dx$

   a. $-\pi$

   b. -1

   c. 0

   d. 1

   e. π

13. Compute $\displaystyle\int_{e^9}^{e^{81}} \frac{1}{x\sqrt{\ln x}}\, dx$

   a. $2\sqrt{72}$

   b. $2\sqrt{6}$

   c. $\sqrt{72}$

   d. $\sqrt{6}$

   e. 12

Work Out: (10 points each. Part credit possible. Calculators allowed. Show all work.)

14. Find the equation of the tangent line to $y = \dfrac{\ln x}{x^2}$ at $x = e$.

15. If you start with 4000 bacteria which double every 20 hours, how many bacteria will there be after 30 hours?

16. In an ideal gas, the pressure P, volume V and the absolute temperature T are related by the equation $PV = kT$ where k is a constant. At present $P = 1$ atm, $V = 1000$ liter and $T = 275°$K.

   a. $(5$ points$)$ If the volume is held constant and the temperature increases at the rate $\dfrac{dT}{dt} = \dfrac{2°\text{K}}{\text{hr}}$, does the pressure increase or decrease and at what rate?

   b. $(5$ points$)$ If the temperature is held constant and the volume increases at the rate $\dfrac{dV}{dt} = \dfrac{10 \text{ liter}}{\text{hr}}$, does the pressure increase or decrease and at what rate?

17. The position of a particle is given by $x = t^3 - 9t^2 + 33t$. Find the minimum **velocity**. Explain why your critical point is an absolute minimum.

18. Use the Method of Riemann Sums with equal intervals and Right Endpoints to compute the integral $\int_2^4 3x(x-2)\,dx$.

Use the F.T.C. only to check your answer.

Hints: $\displaystyle\sum_{i=1}^n 1 = n$ $\displaystyle\sum_{i=1}^n i = \frac{n(n+1)}{2}$ $\displaystyle\sum_{i=1}^n i^2 = \frac{n(n+1)(2n+1)}{6}$ $\displaystyle\sum_{i=1}^n i^3 = \left(\frac{n(n+1)}{2}\right)^2$