I-NMC Sample Quesions Category Y

1. Find the derivative of the following function and calculate it for $x = 25$ to the nearest tenth.

$$y(x) = \sqrt{x + \sqrt{x + \sqrt{x}}}$$

Select the correct answer.

A. 0.1
B. 1.1
C. -0.9
D. 0.2
E. 0.3

2. The table lists the amount of U.S. cash per capita in circulation as of June 30 in the given year. Use a linear approximation to estimate the amount of cash per capita in circulation in the year 2000.

t	1960	1970	1980	1990
$C(t)$	\$ 176	\$ 270	\$ 574	\$ 1,068

Choose the nearest answer from the following:

A. \$1,491
B. \$1,524
C. \$1,587
D. \$1,562
E. \$1,572

3. Evaluate the integral

$$\int_{-2}^{5} \left|4x - x^2\right| dx.$$

Select the closest answer.

A. 109.00
B. 123.67
C. 102.33
D. 209.00
E. 23.67

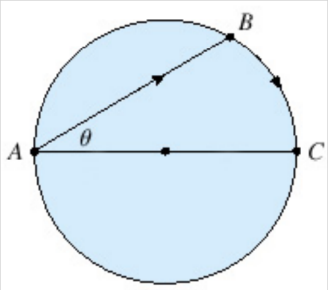
4. An animal population is increasing at a rate of $29 + 37t$ per year (where t is measured in years). By how much does the animal population increase between the fourth and tenth years?

Select the correct answer.

A. 1,728
B. 1,583
C. 1,380
D. 3,282
E. 1,528

5. A woman at a point A on the shore of a circular lake with radius 2 km wants to arrive at the point C diametrically opposite on the other side of the lake in the shortest possible time. She can walk at the rate of 6 km/h and row a boat at 2 km/h. How should she proceed? (Find θ). Round the result, if necessary, to the nearest hundredth.

   A man is at point A on the edge of a circular lake with a 2 km radius and wants to reach point C, diametrically opposite A, as quickly as possible. He can walk at 6 km/h or row a boat at 2 km/h. What strategy minimizes his travel time? Specifically, determine the angle θ (to two decimal places, if needed) that optimizes his path, whether it involves rowing partway and then walking the rest or another approach.



   A. 0.55 radians.
   B. She should walk around the lake from point A to point C.
   C. She should row from point A to point C.
   D. 0.34 radians.
   E. 0.98 radians.

6. Let

$$f(x) = \begin{cases} 7x - 2, & x \leq 1, \\ kx^2, & x > 1. \end{cases}$$

   Which of the following value of the constant k will make the function continuous everywhere?

   A. -2
   B. 0
   C. 1
   D. 5
   E. None of the other options

7. Consider the curve given by $x^{\frac{1}{3}} + y^{\frac{1}{3}} = 4$. Find the tangent line to the curve at $P(27, 1)$.

   A. $y = -\frac{x}{9} + 4$
   B. $y = -\frac{x}{3} + 10$
   C. $y = \frac{x}{9} - 2$
   D. $y = \frac{x}{3} - 8$
   E. $y = \frac{x}{9} + 10$

8. Find the area of the largest rectangle that can be inscribed into a semicircle of diameter 2 cm.

   A. 1 cm^2
   B. $\frac{\pi}{3}$ cm^2
   C. $\sqrt{3}$ cm^2

D. $\sqrt{2}$ cm^2
E. 2 cm^2

9. Suppose that you wish to reach a bus stop located on a paved street parallel to the one you are on right now. Both streets a separated by a grassy field that is 20 meters wide. The bus stop is located 10 meters down the street from the point directly in front of you across the field. If you can run 2 meters per second on grass, and 3 meters per second on paved ground, which point on the opposite street should you aim for to get to the bus stop as soon as possible?

   A. Directly in front
   B. Directly to the bus stop
   C. 2 meters down the street
   D. 3 meters down the street
   E. 5 meters down the street

10. Find the point(s) on the ellipse $4x^2 + y^2 = 4$ that are furthest from the point $(1, 0)$.

    A. $(-\frac{1}{3}, \frac{\sqrt{32}}{3})$
    B. $(\frac{1}{3}, -\frac{\sqrt{32}}{3})$
    C. $(\frac{1}{3}, \frac{\sqrt{32}}{3})$ and $(\frac{1}{3}, -\frac{\sqrt{32}}{3})$
    D. $(-\frac{1}{3}, \frac{\sqrt{32}}{3})$ and $(-\frac{1}{3}, -\frac{\sqrt{32}}{3})$

11. How many zeros are there at the end of 100!?.

    A. 23
    B. 24
    C. 36
    D. 37
    E. None of the above

12. A person shoots at a target independently 100 times. The chance of hitting the target at each trial is 0.999. It is known that the target was hit 4 times. What is the probability that the target was hit at the 50th trial?

    A. 0.99
    B. 0.50
    C. 0.25
    D. 0.04
    E. None of the above

13. The smallest positive integer x for which $2357949684x - 7$ is divisible by 11 is

    A. 3
    B. 6
    C. 9
    D. 12
    E. None of the above

14. Let a and b be natural numbers, neither ending with the digit 0. Suppose the product ab is a power of 10 (that is: 10, 100, 1000, 10000, ...). If $a > b$, the last digit of $a - b$ cannot be

A. 1
B. 3
C. 5
D. 7
E. 9

15. Evaluate

$$\sum_{n=1}^{\infty} \frac{1}{n(n+1)}.$$

A. 2
B. ∞
C. 1
D. 8
E. None of the above

16. Give the next term in the following sequence:

1, 1, 1, 1, 2, 1, 1, 3, 3, 1, 1, 4, 6, 4, 1, 1

A. 1
B. 2
C. 3
D. 4
E. 5

17. Find the value of $\lim_{x\to\infty} xe^x$.

A. 0
B. 1
C. ∞
D. $-\infty$
E. None of the above

18. Consider an nn-sided regular polygon. If a triangle is formed by selecting three of its vertices at random, what is the probability that the triangle shares exactly one side with the polygon?

A. $\frac{6(n-2)(n-3)}{n(n-1)}$
B. $\frac{6(n-3)}{(n-1)(n-2)}$
C. $\frac{6(n-4)}{(n-1)(n-2)}$
D. $\frac{6(n-2)}{(n-1)(n-3)}$
E. None of the above

19. In a study, how often a vowel is followed by another vowel or a consonant by another consonant can be modelled by Markov process with the following transition matrix:

	vowel	consonant
vowel	0.128	0.872
consonant	0.663	0.337

What is the percentage of letters that are expected to be vowels?

A. 48.39%
B. 43.19%
C. 51.83%
D. 56.81%
E. None of the above

20. Consider the following statement:

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Everybody trusts somebody.
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If the given statement is true, which of the following are not necessarily true?

I. Everybody trusts everybody.
II. Somebody trusts everybody.
III. Somebody trusts somebody.

A. I and III.
B. II and III.
C. I and II.
D. I, II and III.
E. None of A, B, C, or D