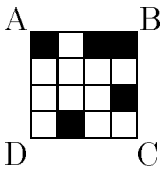
Snow College Jr. Mathematics Contest

April 1, 2008 **Junior division: grades 7–9** **Form: T**

Bubble in the single best choice for each question you choose to answer.

1. What is the minimum number of small squares that must be darkened so the large square has BD as a line of symmetry?



(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

2. On a test, Barb beat Carli. Mark beat Bill. Kathy scored lower than Bill. Mike scored lower than Kathy but better than Barb. What was the order from first to last?

(A) Carli, Mark, Kathy, Mike, Barb, Bill
(B) Mark, Bill, Kathy, Carli, Mike, Barb
(C) Mike, Barb, Mark, Bill, Carli, Kathy
(D) Bill, Barb, Mark, Kathy, Mike, Carli
(E) Mark, Bill, Kathy, Mike, Barb, Carli

3. $\sqrt{100} = \sqrt{36} + \sqrt{?}$

(A) 2
(B) 4
(C) 16
(D) 64
(E) none of these

4. If we were to write April 1, 2008 as a number (omitting punctuation) it would be 412008. What is the smallest prime number that is NOT a divisor of 412008?

(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

5. How many different letters in the phrase "APRIL FOOL" do *not* have any reflection symmetries?

(A) 1
(B) 2
(C) 3
(D) 4
(E) 5

6. Suppose that m people can do a task in d days. Assuming that they all work at the same rate, how many days will it take for $m + r$ people to do the task?

(A) $\frac{dm}{m+r}$
(B) $d - \frac{r}{m}$
(C) $\frac{d(m-r)}{m}$
(D) $\frac{dr}{m+r}$
(E) None of these

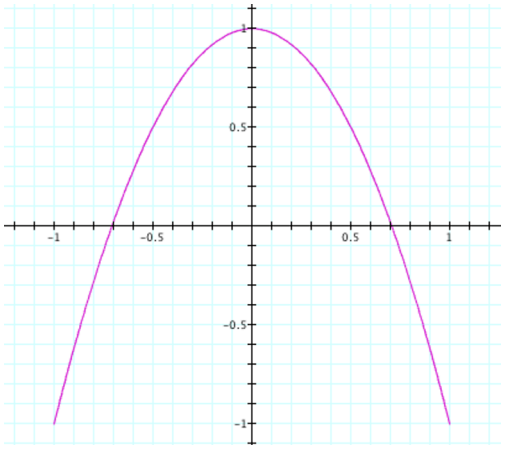
7. What is the midpoint of the line segment between $(-4, 3)$ and $(2, 1)$?

   (A) $(-1, 2)$
   (B) $(3, 2)$
   (C) $(2, 3)$
   (D) $(-0.5, 1.5)$
   (E) None of these

8. Geometry: if a ray begins inside of a simple polygon how many times might it intersect the polygon?

   (A) 0
   (B) 2
   (C) 6
   (D) 12
   (E) 19

9. Which set of parametric equations will produce the graph shown?



   (A) $\begin{cases} x(t) = t \\ y(t) = t^2 \end{cases} \quad 0 \le t \le 1$

   (B) $\begin{cases} x(t) = t \\ y(t) = t^2 \end{cases} \quad -\frac{\pi}{2} \le t \le \frac{\pi}{2}$

   (C) $\begin{cases} x(t) = t^2 \\ y(t) = t \end{cases} \quad -1 \le t \le 1$

   (D) $\begin{cases} x(t) = t^2 \\ y(t) = t^2 \end{cases} \quad -1 \le t \le 1$

   (E) $\begin{cases} x(t) = t \\ y(t) = -2t^2 + 1 \end{cases} \quad -1 \le t \le 1$

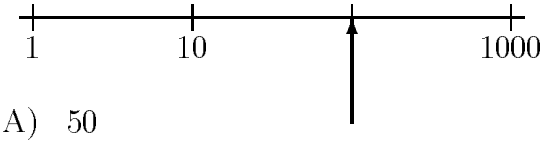
10. If Tuesday, April 1, 2008 is the 92nd day of the year and July 4, 2008 is the 186th day of the year, what day of the week will July 4 fall on this year?

    (A) Monday
    (B) Tuesday
    (C) Wednesday
    (D) Thursday
    (E) Friday

11. Simplify. $\dfrac{5! \cdot 7!}{3! \cdot 6!}$

    (A) 4!
    (B) 80
    (C) 140
    (D) 35/18
    (E) 210

12. The diagram shows the logarithmic scale on a measuring device. What is the approximate reading at the arrow?



    (A) 50
    (B) 100
    (C) 200
    (D) 500
    (E) 750

13. Let $A = \{1, 2, 3, 4\}$, $B = \{3, 4, 5, 6\}$, $C = \{2, 3, 5, 7\}$. What is $A \cap (B \cup C)$?

    (A) $\{1, 2, 3, 4\}$
    (B) $\{3, 4, 5\}$
    (C) $\{2, 3, 4\}$
    (D) $\{2, 3, 4, 5, 7\}$
    (E) $\emptyset$

14. Which statement best characterizes the points $(-1,-1)$, $(1,2)$, and $(121,182)$?

(A) They are not coplanar.

(B) They are collinear.

(C) They form an acute triangle.

(D) They form a right triangle.

(E) They form an obtuse triangle.

15. Let $f(x,y) = x^2 - xy$. Then $f(x, x-y) =$

(A) x

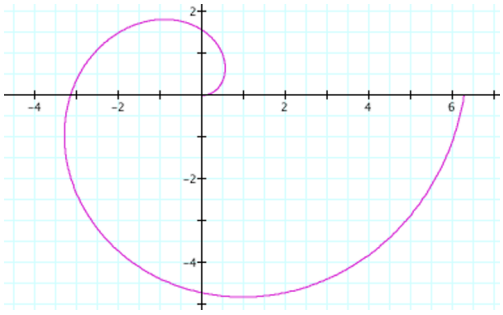
(B) x^2y

(C) $-y$

(D) xy

(E) $x^2(x-y)^2$

16. In a polar plot the coordinates (r,θ) are used instead of (x,y), where r is the distance from the origin to the point and θ is the angle measured counterclockwise from the positive x-axis to the ray from the origin through the point. Which polar equation best describes the graph?



(A) $r = \theta$

(B) $r = \sin\theta$

(C) $r = \cos\theta$

(D) $r = 1$

(E) $\theta = 2\pi$

17. What is $(2+3\mathrm{i}) \cdot (2-3\mathrm{i})$?

(A) $(2-6\mathrm{i})$

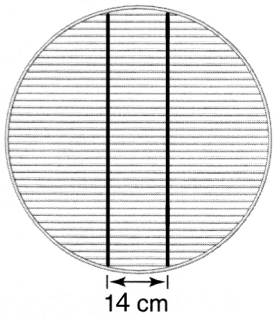
(B) $(2+6\mathrm{i})$

(C) $(4+9\mathrm{i})$

(D) -5

(E) 13

18. In the BBQ grill (diameter 50 cm) pictured, the two parallel support rods are equidistant from the center. What is the length of one of them?



(A) 46 cm

(B) 47 cm

(C) 48 cm

(D) 49 cm

(E) 50 cm

19. The vector dot product is defined as

$$\vec{a} \cdot \vec{b} = a_x b_x + a_y b_y + a_z b_z$$

What is $(3,4,-5) \cdot (1,2,-1)$?

(A) $(6,-2,2)$

(B) $(31,42,-51)$

(C) 6

(D) 16

(E) $(4,6,-6)$

20. It's Sophie's birthday! Sophie Germain, famous, self-taught, woman mathematician, was born April 1, 1776. A prime number p is called a *Sophie Germain prime* if $2p+1$ is also prime. Which of the following is not a Sophie Germain prime?

(A) 2

(B) 3

(C) 5

(D) 7

(E) 11