1. For the nonzero numbers $a$, $b$, and $c$, define

$$J(a, b, c) = \frac{a}{b} + \frac{b}{c} + \frac{c}{a}. $$

Find $J(2, 12, 9)$.

(A) 4  (B) 5  (C) 6  (D) 7  (E) 8

2. What is the value of

$$(3x - 2)(4x + 1) - (3x - 2)4x + 1$$

when $x = 4$?

(A) 0  (B) 1  (C) 10  (D) 11  (E) 12

3. Let $d$ and $e$ denote the solutions of $2x^2 + 3x - 5 = 0$. What is the value of $(d - 1)(e - 1)$?

(A) $-\frac{5}{2}$  (B) 0  (C) 3  (D) 5  (E) 6

4. Suppose that $a$ and $b$ are nonzero real numbers, and that the equation $x^2 + ax + b = 0$ has solutions $a$ and $b$. Then the pair $(a, b)$ is

(A) $(-2, 1)$  (B) $(-1, 2)$  (C) $(1, -2)$  (D) $(2, -1)$  (E) $(4, 4)$

5. Suppose $A$, $B$, and $C$ are three numbers for which $1001C - 2002A = 4004$ and $1001B + 3003A = 5005$. The average of the three numbers $A$, $B$, and $C$ is

(A) 1  (B) 3  (C) 6  (D) 9  (E) Not uniquely determined

6. Simplify

$$\sqrt{\sqrt[3]{x} \cdot \sqrt[3]{x} \cdot \sqrt[3]{x}}.$$

(A) $\sqrt{x}$  (B) $\sqrt[3]{x^2}$  (C) $\sqrt[3]{x^2}$  (D) $\sqrt{x}$  (E) $\sqrt[3]{x^{30}}$

7. Compute the sum of all the roots of $(2x + 3)(x - 4) + (2x + 3)(x - 6) = 0$.

(A) $7/2$  (B) 4  (C) 5  (D) 7  (E) 13

8. The product of three consecutive positive integers is 8 times their sum. What is the sum of their squares?

(A) 50  (B) 77  (C) 110  (D) 149  (E) 194

9. For which of the following values of $k$ does the equation $\frac{x - 1}{x - 2} = \frac{x - k}{x - 6}$ have no solution for $x$?

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

10. Find the value(s) of $x$ such that $8xy - 12y + 2x - 3 = 0$ is true for all values of $y$.

(A) $\frac{2}{3}$  (B) $\frac{3}{2}$ or $-\frac{1}{4}$  (C) $-\frac{2}{3}$ or $-\frac{1}{4}$  (D) $\frac{3}{2}$  (E) $-\frac{3}{2}$ or $-\frac{1}{4}$

11. The sum of three numbers is 20. The first is 4 times the sum of the other two. The second is seven times the third. What is the product of all three?

(A) 28  (B) 40  (C) 100  (D) 400  (E) 800

12. Both roots of the quadratic equation $x^2 - 63x + k = 0$ are prime numbers. The number of possible values of $k$ is

(A) 0  (B) 1  (C) 2  (D) 4  (E) more than four
13. Two different positive numbers $a$ and $b$ each differ from their reciprocals by 1. What is $a + b$?
   
   (A) 1   (B) 2   (C) $\sqrt{5}$   (D) $\sqrt{6}$   (E) 3

14. If $a + 1 = b + 2 = c + 3 = d + 4 = a + b + c + d + 5$, then $a + b + c + d$ is
   
   (A) $-5$   (B) $-10/3$   (C) $-7/3$   (D) $5/3$   (E) 5

15. What is the sum of the reciprocals of the roots of the equation $\frac{2003}{2004}x + 1 + \frac{1}{x} = 0$?
   
   (A) $-\frac{2004}{2003}$   (B) $-1$   (C) $\frac{2003}{2004}$   (D) 1   (E) $\frac{2004}{2003}$

16. If $a$, $b$, and $c$ are positive real numbers such that $a(b + c) = 152$, $b(c + a) = 162$, and $c(a + b) = 170$, then $abc$ is
   
   (A) 672   (B) 688   (C) 704   (D) 720   (E) 750

17. Let $a$, $b$, and $c$ be real numbers such that $a - 7b + 8c = 4$ and $8a + 4b - c = 7$. Then $a^2 - b^2 + c^2$ is
   
   (A) 0   (B) 1   (C) 4   (D) 7   (E) 8