BRITISH COLUMBIA COLLEGES

Senior High School Mathematics Contest, 2004

Preliminary Round

Wednesday March 10, 2004

1. A student has three mathematics books, two English books, and four science books. The number of ways that the books can be arranged on a shelf, if all books of the same subject are kept together, is:

(a) 288 (b) 864 (c) 1260 (d) 1544 (e) 1728

2. The value of A + B that satisfies

$$\left(6^{30} + 6^{-30}\right)\left(6^{30} - 6^{-30}\right) = 3^A 8^B - 3^{-A} 8^{-B}$$

is:

- (a) 30 (b) 40 (c) 60 (d) 80 (e) 120
- 3. A mixing bowl is hemispherical in shape, with a radius of 12 cm. If it contains water to half its depth, then the angle through which it must be tilted before water will begin to pour out is:
 - (a) 15° (b) 30° (c) 45° (d) 60° (e) 75°
- 4. The hill behind Antonino's house is long and steep. He can walk down it at $4\frac{1}{2}$ km/hr, but he can walk up it at only $1\frac{1}{2}$ km/hr. If it takes him 6 hours to make the round trip, the distance, in kilometres, from his house to the top of the hill is:

(a) 18 (b)
$$\frac{27}{2}$$
 (c) 9 (d) $\frac{27}{4}$ (e) 6

- 5. Lana has a collection of nickels. When she collects them in groups of three, there is one left over; when she piles them in groups of five, there are two left over; and when she puts them in piles of seven, there are three left over. The sum of the digits of the smallest number of nickels that Lana can have is:
 - (a) 9 (b) 7 (c) 10 (d) 12 (e) 3
- 6. Suppose the line ℓ is parallel to the line $y = \frac{3}{4}x + 6$ and four units from it. A possible equation of the line ℓ is:
 - (a) $y = \frac{3}{4}x$ (b) $y = \frac{3}{4}x + 1$ (c) $y = \frac{3}{4}x + 2$ (d) $y = \frac{3}{4}x + 3$ (e) $y = \frac{3}{4}x + \frac{9}{2}$
- 7. You have a rectangular garden twenty metres long and ten metres wide. A one-metre wide path fills up the garden. If you walk along the centre of the path from beginning to end, the number of metres that you walk is:
 - (a) $199\frac{1}{2}$ (b) 200 (c) $200\frac{1}{2}$ (d) $209\frac{1}{2}$ (e)
- 8. A square grid is made up of a set of parallel lines, 5 cm apart, which are intersected at right angles by another set of parallel lines, also 5 cm apart. If a circular disc of diameter 3 cm is dropped on the square grid, the probability that the disc will not touch a grid line is:
 - (a) 0.04 (b) 0.10 (c) 0.24 (d) 0.30 (e) 0.16



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- 9. In the diagram, a circle is tangent to the hypotenuse of the isosceles right triangle ABC. Side AB is extended and is tangent to the circle at E. Side AC is extended and is tangent to the circle at F. If the area of triangle ABC is 9, then the area of the circle is:
 - (a) $9\pi (3 2\sqrt{2})$ (b) $9\sqrt{2}\pi$ (c) $9\pi (3 + 2\sqrt{2})$
 - (d) $18\sqrt{2}\pi$ (e) 36π
- 10. In the diagram at the right, segments join the vertices of a square with area 1 to midpoints of its sides. The area of the shaded quadrilateral is:
 - (a) $\frac{1}{2}$ (b) $\frac{2}{5}$ (c) $\frac{1}{3}$
 - (d) $\frac{1}{4}$ (e) $\frac{1}{5}$
- 11. The longer base of a trapezoid has length 15 and the line segment joining the midpoints of the two diagonals has length 3. The length of the shorter base of the trapezoid is:
 - (a) 6 (b) $\frac{15}{2}$ (c) 9 (d) 10 (e) 12
- 12. In the diagram at the right, $\angle A = \angle B = 120^{\circ}$, EA = AB = BC = 2, and CD = DE = 4. The area of the pentagon ABCDE is:
 - (a) $7\sqrt{3}$ (b) $9\sqrt{3}$ (c) $3 + 6\sqrt{3}$
 - (d) 12 (e) $6\sqrt{5}$
- 13. Each of 600 people have at most twenty \$5 bills, some may have none. Divide the 600 into groups of people with the same number of \$5 bills. The smallest possible maximum size of any of these groups is:
 - (a) 26 (b) 27 (c) 28 (d) 29 (e) 30
- 14. Consider the positive integers whose first digit is 1 and which have the property that if this digit is transferred to the end of the number, the resulting number is exactly 3 times as large as the original. For example, 139 would be transformed into 391, which is not exactly 3 times as large as 139. If N is the smallest such positive integer, then the remainder when N is divided by 9 is:
 - (a) 0 (b) 3 (c) 4 (d) 5 (e) 8
- 15. The pyramid ABCDE has a square base and all four triangular faces are equilateral. The measure of the angle ABD is:
 - (a) 30° (b) 45° (c) 60°
 - (d) 75° (e) 90°





