

Mathematics, 2017 EC, entrance exam, version 4

Grade 12 · Mathematics · 2017 E.C.

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Time allowed: 120 minutes

Questions: 59

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1. After rationalizing the denominator of $5/(3\sqrt{3} - 2\sqrt{2})$, the denominator is equal to _____. (1)

- A. 35
B. $5(3\sqrt{3}-2\sqrt{2})/19$
C. ✓ 19
D. $5(3\sqrt{3}+2\sqrt{2})/19$

Answer: C

Multiplying both the numerator and the denominator of the fraction by the conjugate of the denominator, $3\sqrt{3} + 2\sqrt{2}$, yields $(3\sqrt{3})^2 - (2\sqrt{2})^2 = 27 - 8 = 19$ in the denominator.

2. The solution set of the equation $5|2x-1| - 3|4x+5| = 2$ is equal to: (1)

- A. $\{6/11\}$
B. $\{-11, -9, -6/11\}$
C. $\{\}$
D. ✓ $\{-9, -6/11\}$

Answer: D

By analyzing the critical points of the absolute values, $x = 1/2$ and $x = -5/4$, we solve the equation in three intervals. Only $x = -9$ (for $x < -5/4$) and $x = -6/11$ (for $-5/4 \leq x < 1/2$) are valid solutions, giving the solution set $\{-9, -6/11\}$.

3. In a survey of 600 students, 250 drink tea, 225 drink coffee, 75 drink both. How many drink neither? (1)

- A. 400
B. 550
C. ✓ 200
D. 125

Answer: C

Using the principle of inclusion-exclusion, the number of students who drink tea or coffee is $250 + 225 - 75 = 400$. The number of students who drink neither is the total number of surveyed students minus this union, which is $600 - 400 = 200$.

4. Given relation $R = \{(x,y): y > x-2, y > -x-2, y \leq 4\}$. Which is the domain and range of R respectively? (1)

- A. ✓ $(-6,6)$ and $(-2,4]$
B. $(-2,4]$ and $(-6,6)$
C. $[-6,6]$ and $(-2,4)$
D. $(-2,4)$ and $(-6,6)$

Answer: A

The region is bounded below by $y = x - 2$ and $y = -x - 2$ (intersecting at $(0, -2)$), and above by $y = 4$. Thus, the range of y is $(-2, 4]$, and the maximum horizontal span (domain of x) occurs at $y = 4$, which gives $-6 < x < 6$.

5. $\triangle ABC$ and $\triangle DEF$ are similar. Area of $\triangle ABC = 12 \text{ m}^2$. DE is twice AB. Area of $\triangle DEF$? (1)
- A. 6 m^2 B. ✓ **48 m^2**
C. 36 m^2 D. 24 m^2

Answer: B

Since $\triangle ABC$ and $\triangle DEF$ are similar, the ratio of their areas is equal to the square of the ratio of their corresponding sides. Since $DE = 2AB$, the area of $\triangle DEF$ is $2^2 \times 12 \text{ m}^2 = 48 \text{ m}^2$.

6. Vector AB has initial A(2,-1) and terminal B(-4,7). Which is a unit vector in same direction? (1)
- A. ✓ **$-(3/5)\mathbf{i} + (4/5)\mathbf{j}$** B. $(3/5)\mathbf{i} - (4/5)\mathbf{j}$
C. $-(3/50)\mathbf{i} - (4/50)\mathbf{j}$ D. $(3/50)\mathbf{i} + (4/50)\mathbf{j}$

Answer: A

The vector $\vec{AB}$ is given by $B - A = (-4 - 2)\vec{i} + (7 - (-1))\vec{j} = -6\vec{i} + 8\vec{j}$, which has magnitude $\sqrt{(-6)^2 + 8^2} = 10$. The unit vector in the same direction is $\vec{u} = \frac{-6\vec{i} + 8\vec{j}}{10} = -\frac{3}{5}\vec{i} + \frac{4}{5}\vec{j}$.

7. Range of $f(x) = (x+2)/(x-2)$? (1)
- A. $\mathbb{R} \setminus \{2\}$ B. $\mathbb{R} \setminus \{-2\}$
C. $\mathbb{R} \setminus \{-1\}$ D. ✓ **$\mathbb{R} \setminus \{1\}$**

Answer: D

To find the range, we express x in terms of y : $y = \frac{x+2}{x-2} \implies y(x-2) = x+2 \implies x(y-1) = 2y+2 \implies x = \frac{2y+2}{y-1}$. Since $y = 1$ makes the denominator zero, the range is $\mathbb{R} \setminus \{1\}$.

8. Firm A offers starting salary 5000 Birr with raise of 600 per year. Total earned over first 20 years? (1)
- A. ✓ **214,000** B. 16,400
C. 264,000 D. 216,000

Answer: A

The earnings form an arithmetic series with $a_1 = 5000$, $d = 600$, and $n = 20$. The total sum is $S_{20} = \frac{20}{2}[2(5000) + 19(600)] = 10[10000 + 11400] = 214,000$ Birr.

9. Arithmetic sequence: first term 10, tenth term -26. Find a_{101} . (1)
- A. 420 B. 380
C. -410 D. ✓ **-390**

Answer: D

In an arithmetic sequence, $a_{10} = a_1 + 9d \implies -26 = 10 + 9d \implies d = -4$. The 101st term is $a_{101} = a_1 + 100d = 10 + 100(-4) = -390$.

10. Area enclosed by $f(x)=1-x^2$ and x-axis from $x=0$ to $x=2$. (1)
- A. 3 B. ✓ **2**
C. $2/3$ D. $4/3$

Answer: B

The area enclosed by $f(x) = 1 - x^2$ and the x-axis from 0 to 2 is the integral of the absolute value of $f(x)$, which is $\int_0^1 (1 - x^2)dx + \int_1^2 (x^2 - 1)dx = \frac{2}{3} + \frac{4}{3} = 2$.

11. Constant term in expansion of $(x - 2/x^2)^6$. (1)
- A. -160
B. -60
C. ✓ 60
D. 240

Answer: C

The general term in the expansion is $\binom{6}{r} x^{6-r} (-2x^{-2})^r = \binom{6}{r} (-2)^r x^{6-3r}$. For the constant term, we set $6 - 3r = 0 \implies r = 2$, yielding $\binom{6}{2} (-2)^2 = 15 \times 4 = 60$.

12. Square ABCD inscribed in circle radius 4 cm. Area of segment cut off by chords AB, BC, CD, AD? (1)
- A. $16(\pi+2)$
B. ✓ $16(\pi-2)$
C. $16(\pi+1)$
D. $16(\pi+1)$

Answer: B

The circle has radius $r = 4$ and area 16π . The inscribed square has a diagonal of $d = 8$, so its area is $\frac{1}{2}d^2 = 32$. The total area of the four segments cut off by the sides is the difference, $16\pi - 32 = 16(\pi - 2)$.

13. Which statement is NOT true? (1)
- A. $x+2$ is factor of $x^3-3x^2-4x+12$
B. ✓ $f(x)=x^4-6x^3+x^2+12x-6$ has real root between -1 and 0
C. Dividing $x^4+6x^3-10x+3$ by x^2-1 gives remainder $-4x+4$
D. Graph of degree n has at most $n-1$ turning points

Answer: B

For $f(x) = x^4 - 6x^3 + x^2 + 12x - 6$, the derivative is $f'(x) = 4x^3 - 18x^2 + 2x + 12$. On the interval $[-1, 0]$, $f''(x) = 12x^2 - 36x + 2 > 0$, meaning $f'(x)$ is strictly increasing from -12 to 12 and has one zero where $f(x)$ is minimized; because $\max\{f(-1), f(0)\} = -6 < 0$, there are no real roots on this interval.

14. $P(-2,5)$ and $Q(8,-1)$. Q is midpoint of PR . Find R . (1)
- A. $(-7,18)$
B. $(14,3)$
C. ✓ $(18,-7)$
D. $(3,2)$

Answer: C

If $Q(8, -1)$ is the midpoint of PR with $P(-2, 5)$, then $R = 2Q - P$. Thus, $R = (2(8) - (-2), 2(-1) - 5) = (18, -7)$.

15. Mr. Soresa divided 40,000 for three workers in ratio $1/2 : 3/10 : 1/5$. Find C's share. (1)
- A. 20,000
B. ✓ 8,000
C. 12,000
D. 13,333.33

Answer: B

The ratio of their shares is $\frac{1}{2} : \frac{3}{10} : \frac{1}{5}$, which simplifies to $5 : 3 : 2$ by multiplying by the common denominator 10. C's share is therefore $\frac{2}{10} \times 40,000 = 8,000$ Birr.

16. Solution set of $\log_2(x+2) + \log_2(x-1) = 2$. (1)
- A. $\{-3\}$
B. $\{-3, 2\}$
C. $\{\}$
D. ✓ $\{2\}$

Answer: D

Applying logarithmic properties, we get $\log_2((x+2)(x-1)) = 2 \implies (x+2)(x-1) = 4 \implies x^2 + x - 6 = 0$, which factors to $(x+3)(x-2) = 0$. Since the domain of the logarithms requires $x > 1$, only $x = 2$ is a valid solution.

17. If $\cos \theta = -3/5$ and $\tan \theta < 0$, which is true? (1)
- A. $\sin \theta = -4/5$ B. $\cot \theta = -4/3$
C. ✓ **$\csc \theta = 5/4$** D. $\tan \theta = 4/3$

Answer: C

Since $\cos \theta < 0$ and $\tan \theta < 0$, θ is in Quadrant II. Thus, $\sin \theta = \sqrt{1 - \cos^2 \theta} = \frac{4}{5}$, which gives $\csc \theta = \frac{1}{\sin \theta} = \frac{5}{4}$.

18. Volume of frustum of pyramid with base areas 81 cm^2 and 121 cm^2 , altitude 6 cm. (1)
- A. 602π B. ✓ **602**
C. 301 D. 903π

Answer: B

The volume of a frustum of a pyramid is $V = \frac{1}{3}h(A_1 + A_2 + \sqrt{A_1A_2}) = \frac{1}{3}(6)(81 + 121 + \sqrt{81 \times 121}) = 2(202 + 99) = 602 \text{ cm}^3$.

19. Simplify $(x^2-4)/(x^2+3x-10) \div (x^2+5x+6)/(x^2+8x+15)$. (1)
- A. $(x+2)/(x+5)$ B. $((x+2)/(x+5))^2$
C. $(x-2)/(x+3)$ D. ✓ **none**

Answer: D

Factoring the quadratics, we have $\frac{(x-2)(x+2)}{(x+5)(x-2)} \div \frac{(x+2)(x+3)}{(x+3)(x+5)} = \frac{x+2}{x+5} \div \frac{x+2}{x+5} = 1$ (for $x \notin \{-5, -3, -2, 2\}$). Since 1 is not in options A, B, or C, the correct choice is 'none'.

20. If $f(x) = (\pi^2+1)^4$, then $f'(x) = ?$ (1)
- A. ✓ **0** B. $8\pi(\pi^2+1)^3$
C. $4(\pi^2+1)^3$ D. $8(\pi^2+1)^3$

Answer: A

Since π is a mathematical constant, $f(x) = (\pi^2 + 1)^4$ is a constant function. The derivative of any constant function with respect to x is 0.

21. Which is a geometric sequence? (1)
- A. ✓ **1, 1.5, 2.25, 3.375, ...** B. 1, 1/8, 1/32, 1/64, ...
C. 27, 21, 15, 9, ... D. 1, 4, 8, 12, 15, ...

Answer: A

A sequence is geometric if the ratio of successive terms is constant. In option A, the ratio is consistently 1.5, whereas the other options represent arithmetic, non-constant ratio, or arbitrary sequences.

22. For matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & -5 \\ 3 & -5 & 6 \end{bmatrix}$, which is NOT true? (1)
- A. A is symmetric B. ✓ **$\det(A) = -71$**
C. A is invertible D. Cofactor of $a_{32} = 11$

Answer: B

Calculating the determinant of A along the first row gives $\det(A) = 1(24 - 25) - 2(12 + 15) + 3(-10 - 12) = -121$. Thus, statement B, which claims $\det(A) = -71$, is false.

23. Equation of tangent to circle $x^2+y^2-8x-10y-128=0$ at $(-8,10)$. (1)

- A. $5x-12y+136=0$ B. ✓ $12x-5y+146=0$
C. $12x+5y+146=0$ D. $5x+12y+136=0$

Answer: B

The circle is $(x-4)^2 + (y-5)^2 = 169$ with center $(4, 5)$. The slope of the radius to $(-8, 10)$ is $-\frac{5}{12}$, so the slope of the tangent is $\frac{12}{5}$. The tangent line is $y - 10 = \frac{12}{5}(x + 8) \implies 12x - 5y + 146 = 0$.

24. Image of circle $x^2+y^2-4x+6y+12=0$ rotated by $\pi/2$ about origin. (1)

- A. ✓ $(x-3)^2+(y-2)^2=1$ B. $(x+3)^2+(y+2)^2=0$
C. $(x-3)^2+(y+2)^2=1$ D. $(x+3)^2+(y-2)^2=1$

Answer: A

The circle standard form is $(x-2)^2 + (y+3)^2 = 1$ with center $C(2, -3)$ and radius $r = 1$. Rotating the center $C(2, -3)$ by $\pi/2$ counter-clockwise about the origin maps $(x, y) \rightarrow (-y, x)$, giving $C'(3, 2)$, which results in the equation $(x-3)^2 + (y-2)^2 = 1$.

25. Which vector is orthogonal to $u = (-4,6)$? (1)

- A. $(-3,2)$ B. $(-1,-1)$
C. $(3,-2)$ D. ✓ $(-3,-2)$

Answer: D

Two vectors are orthogonal if their dot product is zero. Calculating the dot product of $u = (-4, 6)$ with $(-3, -2)$ gives $(-4)(-3) + (6)(-2) = 12 - 12 = 0$.

26. Which is NOT true about transformation? (1)

- A. Reflection is onto mapping
B. Translation moves rectangles to congruent rectangles
C. Rotation moves circles to congruent circles
D. ✓ **Reflection is non-rigid motion**

Answer: D

A reflection is an isometry, which is by definition a rigid motion because it preserves distances and angles. Therefore, stating that reflection is a non-rigid motion is false.

27. Balloon inflated at $900 \text{ cm}^3/\text{s}$. Rate of radius increase when radius=15 cm. (1)

- A. $\pi \text{ cm/s}$ B. 1 cm/s
C. ✓ $1/\pi \text{ cm/s}$ D. $1/4 \text{ cm/s}$

Answer: C

Using the volume of a sphere $V = (4/3)\pi r^3$, we differentiate with respect to time to get $dV/dt = 4\pi r^2(dr/dt)$. Substituting $dV/dt = 900$ and $r = 15$ gives $900 = 900\pi(dr/dt)$, which yields $dr/dt = 1/\pi \text{ cm/s}$.

28. Marginal revenue when $x=20$ for $R(x)=3x^2+36x+5$. (1)

- A. ✓ **156** B. 120
C. 1925 D. 1236

Answer: A

Marginal revenue is the derivative of the revenue function, $R'(x) = 6x + 36$. Evaluating this at $x = 20$ gives $R'(20) = 6(20) + 36 = 156$.

29. Vectors $a=2i-3j+2k$, $b=2i+3j+k$. Area of triangle OAB. (1)

- A. $229/2$ B. $\sqrt{85}$
C. $\sqrt{229}/2$ D. $2\sqrt{229}$

Answer: C

The area of triangle OAB is half the magnitude of the cross product of vectors a and b . Computing $a \times b$ gives $-9i + 2j + 12k$, with a magnitude of $\sqrt{81 + 4 + 144} = \sqrt{229}$, so the area is $\sqrt{229}/2$.

30. Vector with initial (2,5,0) and terminal (-3,7,4). (1)

- A. $-5i+2j-4k$ B. $\sqrt{-5i+2j+4k}$
C. $5i-2j-4k$ D. $-i+12j+4k$

Answer: B

The components of the vector are found by subtracting the initial point from the terminal point: $(-3 - 2)i + (7 - 5)j + (4 - 0)k = -5i + 2j + 4k$.

31. GCF of 65 and 117 expressed as $65m - 117$. Find m . (1)

- A. 1 B. $\sqrt{2}$
C. 3 D. 4

Answer: B

The greatest common factor (GCF) of 65 and 117 is 13. Solving the equation $65m - 117 = 13$ gives $65m = 130$, which yields $m = 2$.

32. Greatest ratio among 3:2, 8:5, 121:75, 5:3. (1)

- A. $\sqrt{5:3}$ B. 8:5
C. 121:75 D. 3:2

Answer: A

Comparing the decimal values of the ratios: $3:2 = 1.5$, $8:5 = 1.6$, $121:75 \approx 1.613$, and $5:3 \approx 1.667$. The largest ratio is therefore 5:3.

33. Benti earns 18,000, Derartu 20,000. Ratio of Derartu's earnings to total? (1)

- A. 9:10 B. $\sqrt{10:19}$
C. 9:19 D. 10:18

Answer: B

Derartu's earnings are 20,000 and the total earnings are $18,000 + 20,000 = 38,000$. The ratio of Derartu's earnings to the total is $20,000 : 38,000$, which simplifies to 10:19.

34. Maximize $Z=4x+y$ subject to $x+y \leq 50$, $3x+y \leq 90$, $x,y \geq 0$. (1)

- A. $\sqrt{120}$ B. 110
C. 200 D. 50

Answer: A

Evaluating the objective function $Z = 4x + y$ at the corner points of the feasible region, (0, 0) gives 0, (0, 50) gives 50, (20, 30) gives 110, and (30, 0) gives 120, which is the maximum value.

35. Linear programming constraints for screws A and B: 4 min automatic, 6 min hand for A; 6 min automatic, 3 min hand for B; each machine available 4 hours (240 min). (1)

- A. ✓ $4x+6y \leq 240, 6x+3y \leq 240, x \geq 0, y \geq 0$ B. $4x+6y \geq 240, 6x+3y \leq 240$
C. $4x+6y \geq 240, 6x+3y \geq 240$ D. $3x+6y \geq 240, \dots$

Answer: A

The available machine hours represent upper bounds on the time spent on each task. Therefore, the constraints are $4x + 6y \leq 240$ for the automatic machine, $6x + 3y \leq 240$ for hand work, and $x, y \geq 0$.

36. Corner points (0,0),(5,0),(3,4),(0,5). $Z=px+qy$, $p,q>0$. Max occurs at (3,4) and (0,5). Find relation. (1)

- A. ✓ $q=3p$ B. $p=3q$
C. $p=q$ D. $p > (1/3)q$

Answer: A

If the maximum value occurs at both (3, 4) and (0, 5), the objective function values at these points must be equal: $p(3) + q(4) = p(0) + q(5)$, which simplifies to $3p + 4q = 5q$, or $q = 3p$.

37. What percent of 15 is equal to 600? (1)

- A. 400 B. 90
C. 690 D. ✓ 4000

Answer: D

Let P be the percentage. We set up the equation $(P/100) * 15 = 600$, which gives $P = 60,000 / 15 = 4000\%$.

38. Shop sells 30 articles for 6600. Plans to sell each for 200. Approximate discount percent? (1)

- A. ✓ 9.091% B. 10%
C. 90.091% D. 8%

Answer: A

The current standard price per article is $6600 / 30 = 220$. Planning to sell each for 200 represents a discount of $(220 - 200)/220 = 1/11$, which is approximately 9.091%.

39. 12% tax on shoes amounts to 45 Birr. What is 8% tax? (1)

- A. ✓ 30 B. 37.5
C. 40 D. 35

Answer: A

If 12% tax equals 45 Birr, then 1% tax equals $45 / 12 = 3.75$ Birr. Therefore, an 8% tax corresponds to $8 * 3.75 = 30$ Birr.

40. Corner points (0,2),(3,0),(6,0),(6,8),(0,5). Minimize $Z=4x+6y$. Minimum occurs at: (1)

- A. (0,2) only
B. (3,0) only
C. ✓ any point on line segment joining (0,2) and (3,0)
D. midpoint of that segment only

Answer: C

Evaluating $Z = 4x + 6y$ at the corner points yields a minimum value of 12 at both (0, 2) and (3, 0). Since both are optimal corner points, any point on the line segment connecting them also achieves this minimum value.

41. Corner points (0,0),(0,40),(20,40),(60,20),(60,0). Objective $Z=5x+6y$. Compare max Z (Column A) with 421 (Column B). (1)

A. Column A greater
B. ✓ **Column B greater**
C. Equal
D. Cannot determine

Answer: B

The corner points give the objective values: $Z(0,0)=0$, $Z(0,40)=240$, $Z(20,40)=340$, $Z(60,20)=420$, and $Z(60,0)=300$. Thus, the maximum Z (Column A) is 420, which is less than Column B (421).

42. Box of 15 oranges, 12 good, 3 bad. Select 3 without replacement. Probability box approved (all three good). (1)

A. 12/15
B. 1/5
C. ✓ **44/91**
D. 88/225

Answer: C

The probability of choosing 3 good oranges out of 12 good ones and 15 total is calculated as $(12/15) * (11/14) * (10/13) = 44/91$.

43. Profit 20% on selling price of 960 Birr. Find cost. (1)

A. 600
B. ✓ **800**
C. 900
D. 840

Answer: B

Assuming standard phrasing where a 20% profit is calculated relative to the cost price, we have Selling Price = $1.2 * \text{Cost Price}$. For a selling price of 960 Birr, the Cost Price is $960 / 1.2 = 800$ Birr.

44. Infected 230,000, died 10,000, remaining 43% cured. Number still infected as percent of total? (1)

A. 57%
B. ✓ **54.5%**
C. 56.5%
D. 65%

Answer: B

The remaining infected individuals after deaths is 220,000. Since 43% are cured, 57% remain infected (125,400 people). As a percentage of the original total, this is $125,400 / 230,000 \approx 54.5\%$.

45. Meti sold shoe for 10,000 with 60% markup on selling price. Find cost price. (1)

A. ✓ **4,000**
B. 6,000
C. 16,000
D. 5,000

Answer: A

A 60% markup on the selling price means the markup amount is 60% of 10,000, which is 6,000. Therefore, the cost price is $10,000 - 6,000 = 4,000$.

46. $A = \begin{bmatrix} -2 & 3 & -1 \\ 0 & 1 & 2 \\ 0 & 0 & 3 \end{bmatrix}$, $|B|=1/3$. Find $\det(2A^TB)$. (1)

A. 16
B. -4
C. ✓ **-16**
D. 48

Answer: C

Since A is upper triangular, $\det(A) = (-2)(1)(3) = -6$. Since A and B are 3×3 matrices, $\det(2A^TB) = 2^3 * \det(A) * \det(B) = 8 * (-6) * (1/3) = -16$.

47. A, B non-zero square matrices same order, $(A+B)^2 = A^2+B^2$. Then which is true? (1)

- A. $AB=0$
B. $BA=0$
C. $AB=BA$
D. ✓ $AB=-BA$

Answer: D

Expanding the expression gives $(A+B)^2 = A^2 + AB + BA + B^2$. Since this equals $A^2 + B^2$, we must have $AB + BA = 0$, which simplifies to $AB = -BA$.

48. $P=(1,a,a)$, $Q=(a-1,1,1)$. Distance $PQ=3$. Find set containing a . (1)

- A. $\{-9,1\}$ B. ✓ $\{-1/3,3\}$
C. $\{-3,1/3\}$ D. $\{-1,9\}$

Answer: B

Using the distance formula, $PQ = \sqrt{((a-2)^2 + 2(1-a)^2)} = 3$. Squaring both sides and simplifying yields the quadratic equation $3a^2 - 8a - 3 = 0$, which factors to $(3a + 1)(a - 3) = 0$, giving $a = -1/3$ or 3 .

49. Probability of occurrence = $2/3$. Probability of non-occurrence? (1)

- A. $\frac{4}{3}$
C. $\frac{3}{4}$
- B. $\frac{2}{3}$
D. ✓ $\frac{1}{3}$

Answer: D

The probability of non-occurrence is the complement of the probability of occurrence, which is computed as $1 - 2/3 = 1/3$.

50. Red ball and 4 white balls. Draw two without replacement. Probability both white? (1)

- A. $\frac{1}{5}$ B. $\frac{4}{5}$
C. $\frac{16}{25}$ D. $\checkmark \frac{3}{5}$

Answer: D

With 1 red ball and 4 white balls, the total number of balls is 5. The probability of drawing two white balls without replacement is given by $P(W_1 \text{ and } W_2) = P(W_1) * P(W_2|W_1) = (4/5) * (3/4) = 3/5$.

51. Which is necessarily true for vectors A and B? (1)

- A. If $|A|=|B|$ then $A=B$
- B. $|kA| = k|A|$ for $k \in \mathbb{R}$
- C. ✓ If u is unit vector in direction of A , then $A \cdot u = |A|$
- D. If A parallel to B , then $A \cdot B = 0$

Answer: C

By definition, the unit vector in the direction of $\mathbf{A}$ is $\mathbf{u} = \mathbf{A} / |\mathbf{A}|$. Thus, the dot product $\mathbf{A} \cdot \mathbf{u} = \mathbf{A} \cdot (\mathbf{A} / |\mathbf{A}|) = (\mathbf{A} \cdot \mathbf{A}) / |\mathbf{A}| = |\mathbf{A}|^2 / |\mathbf{A}| = |\mathbf{A}|$.

52. Frequency table: $x: 3, 4, 5, 6, 7$; $f: 2, 4, 8, 4, 2$. Which is NOT true? (1)

- A. Mode = 5
B. Middle quartile = 5
C. Standard deviation = $\sqrt{1.2}$
D. ☒ **75th percentile = 6.5**

Answer: D

The cumulative frequencies are 2, 6, 14, 18, and 20. The 75th percentile corresponds to the 15th observation, which lies in the group of value 6, so the 75th percentile is 6, making option D incorrect.

53. Length 10m, breadth 2.4cm. Ratio length:breadth? (1)

- A. 5:1.2
B. 25:6
C. ✓ 1250:3
D. 625:6

Answer: C

Converting 10 meters to centimeters gives 1000 cm. The ratio of length to breadth is 1000 : 2.4, which simplifies to 10000 : 24, and dividing both by 8 yields 1250 : 3.

54. Farmer bought bull 44,000, cow 18,000. Sold bull at 5% loss, cow at 10% profit. Net result? (1)

- A. loss 200
B. profit 400
C. ✓ loss 400
D. profit 200

Answer: C

The farmer made a 5% loss on the bull (5% of 44,000 = 2,200) and a 10% profit on the cow (10% of 18,000 = 1,800). The net result is a loss of 2,200 - 1,800 = 400.

55. Solution set of system: $x+y-z=1$, $x+2y-3z=1$, $2x+3y-4z=2$. (1)

- A. $\{(1,1,0)\}$
B. ✓ $\{(1-k, 2k, k): k \in \mathbb{R}\}$
C. $\{\}$
D. $\{(2k, 1-k, k): k \in \mathbb{R}\}$

Answer: B

Performing Gaussian elimination on the system of equations reveals that the third row is a multiple of the second, leading to a free variable. Setting $z = k$, we find $y = 2k$ and $x = 1 - k$, which gives the solution set $\{(1-k, 2k, k): k \in \mathbb{R}\}$.

56. Which pair of lines are perpendicular? (1)

- A. $y=2x-1$ and $y=2x+1$
B. ✓ $y+2x=1$ and $2y-x=-1$
C. $y-2x=-2$ and $y-(1/2)x=1$
D. $y=3x+1$ and $y=(1/3)x+1$

Answer: B

Two lines are perpendicular if the product of their slopes is -1. The slope of the first line $y + 2x = 1$ is -2, and the slope of the second line $2y - x = -1$ is $1/2$; since $(-2) * (1/2) = -1$, they are perpendicular.

57. Weight data: 60,67,63,64,61,49,52,68,55,61. Which is NOT true about mean deviation? (1)

- A. Mean deviation about mean = 4.8
B. Mean deviation about median = 4.6
C. Mean deviation about mode = 4.6
D. ✓ Mean deviation about mean = 4.6

Answer: D

For the given dataset, the mean is 60 and the median/mode is 61. The mean deviation about the mean is 4.8, and the mean deviation about the median (and mode) is 4.6, so statement D is false.

58. Tent: cylinder height 5m, diameter 6m, conical top slant height 8m. Area of canvas? (1)

- A. ✓ 54π
B. 39π
C. 78π
D. 63π

Answer: A

The canvas area of the tent is the sum of the lateral area of the cylinder and the lateral area of the cone. Thus, $\text{Area} = 2 * \pi * r * h + \pi * r * l = 2 * \pi * 3 * 5 + \pi * 3 * 8 = 30\pi + 24\pi = 54\pi$.

59. In circle, chords AC and BD intersect at P. $\angle DAC=35^\circ$, $\angle APB=65^\circ$. Find $\angle ACB$.

(1)

A. 130°

B. 60°

C. 70°

D. ✓ 30°

Answer: D

In triangle APD, the angle APD is supplementary to APB, so angle APD = $180^\circ - 65^\circ = 115^\circ$. This makes angle PDA = $180^\circ - (115^\circ + 35^\circ) = 30^\circ$, and since angle ACB and angle BDA subtend the same arc AB, angle ACB = angle BDA = 30° .

END OF THE MARKING KEY

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