

Mathematics, 2015 EC, social science, entrance exam, round 1

Grade 12 · Mathematics · 2015 E.C.

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Time allowed: 120 minutes

Questions: 44

Total marks: 44

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1. Which one of the following defines a prime number? (1)
- A. It is a natural number where one of its factors is 3.
 - B. ✓ It is a natural number that has exactly two distinct factors.
 - C. It is an odd natural number that has only two factors.
 - D. It is a natural number that has an odd number of factors.

Answer: B

A prime number is defined as a natural number greater than 1 that has exactly two distinct positive divisors (factors): 1 and itself.

2. Which one of the following is a vector quantity? (1)
- A. Temperature of a room.
 - B. Floor area of a classroom.
 - C. Speed of a motorbike.
 - D. ✓ Force to push a car.

Answer: D

Force is a vector quantity because it has both magnitude and direction, whereas temperature, area, and speed are scalar quantities.

3. Which one of the following is true for the values of the trigonometric functions for the indicated angles? (1)
- A. $\sin\left(\frac{5\pi}{2}\right) = -1$
 - B. $\tan(-3\pi) = -1$
 - C. ✓ $\cos\left(-\frac{3\pi}{2}\right) = 0$
 - D. $\tan(7\pi) = -1$

Answer: C

Since cosine is an even function, $\cos\left(-\frac{3\pi}{2}\right) = \cos\left(\frac{3\pi}{2}\right) = 0$. The other options are incorrect: $\sin\left(\frac{5\pi}{2}\right) = 1$, and $\tan(-3\pi) = \tan(7\pi) = 0$.

4. Which one of the following is true about the function $f(x) = \cos x$? (1)
- A. Domain of f is $[-1, 1]$.
 - B. ✓ It is periodic with period 2π .
 - C. Range of f is $\{y|y \in \mathbb{R}\}$.
 - D. The difference between its maximum and minimum values is 2π .

Answer: B

The function $f(x) = \cos x$ is a fundamental trigonometric function with a domain of $\mathbb{R}$, a range of $[-1, 1]$, and a periodic nature of period 2π .

5. If the polynomial $f(x) = x^4 - 9x^2 + 22$ is divided by $x - 2$, which one of the following are the quotient and remainder respectively? (1)
- A. $x^3 - 2x^2 - 5x + 10$ and 2
 B. $x^3 - 2x^2 - 5x + 10$ and -2
 C. $x^3 + 2x^2 - 5x - 10$ and -2
 D. ✓ $x^3 + 2x^2 - 5x - 10$ and 2

Answer: D

Using synthetic division or polynomial long division to divide $x^4 - 9x^2 + 22$ by $x - 2$ yields a quotient of $x^3 + 2x^2 - 5x - 10$ and a remainder of 2.

6. Consider the graph of $f(x) = \log_5(x + 3)$ which is shown below. Which one of the following is NOT true about the function f ? (1)
- A. The domain of f is the set of all real numbers greater than -3 .
 B. The x-intercept of the graph of f is -2 .
 C. ✓ **The y-axis is a vertical asymptote of the graph of f .**
 D. The function increases as the value of x increases.

Answer: C

The vertical asymptote of the logarithmic function $f(x) = \log_5(x + 3)$ occurs where the argument equals zero, which is at the line $x = -3$, not the y-axis ($x = 0$).

7. In $\triangle ABC$ shown below, the medians $\overline{BD}$ and $\overline{AE}$ of $\triangle ABC$ are concurrent at point O . If $BD = 15$ cm, $OD = 5$ cm and $AO = BO$, then which one of the following is NOT true? (1)
- A. $BO = 10$ cm
 B. $OE = 5$ cm
 C. ✓ **$AO = 5$ cm**
 D. $AE = 15$ cm

Answer: C

The centroid O divides the median BD in a $2 : 1$ ratio, so $BO = 2 \cdot OD = 10$ cm. Since $AO = BO$, we must have $AO = 10$ cm, making option C incorrect and thus the correct choice for this 'NOT true' question.

8. Which one of the following interval(s) is the solution set of the quadratic inequality $10x^2 - 4x - 6 < 8x^2 + 4x - 12$? (1)
- A. ✓ $(1, 3)$
 B. $(3, \infty)$
 C. $(-\infty, 1)$
 D. $(-\infty, 1) \cup (3, \infty)$

Answer: A

Rearranging the inequality gives $2x^2 - 8x + 6 < 0$, which simplifies to $x^2 - 4x + 3 < 0$ or $(x - 1)(x - 3) < 0$. This inequality holds true for values of x strictly between the roots, which is the interval $(1, 3)$.

9. Which of the following is the solution set of the equation $\frac{3}{x+1} - \frac{1}{x-1} = \frac{2}{x}$? (1)
- A. ✓ $\left\{\frac{1}{2}\right\}$
 B. $\left\{-\frac{1}{2}\right\}$
 C. $\{1\}$
 D. $\{-1\}$

Answer: A

Combining the fractions on the left gives $\frac{2x-4}{x^2-1} = \frac{2}{x}$, which simplifies to $\frac{x-2}{x^2-1} = \frac{1}{x}$. Cross-multiplying yields $x^2 - 2x = x^2 - 1$, which simplifies to $-2x = -1$, giving the solution $x = \frac{1}{2}$.

10. Which one of the following expressions is equal to $\frac{x-3}{x+1} \div \frac{x+1}{x-1}$? (1)

A. $\frac{x-1}{x-3}$

B. ✓ $\frac{x^2 - 4x + 3}{x^2 + 2x + 1}$

C. $\frac{x^2 + 2x + 1}{x^2 - 4x + 3}$

D. $\frac{x-3}{x-1}$

Answer: B

To divide the rational expressions, we multiply the first expression by the reciprocal of the second: $\frac{x-3}{x+1} \cdot \frac{x-1}{x+1} = \frac{(x-3)(x-1)}{(x+1)^2} = \frac{x^2 - 4x + 3}{x^2 + 2x + 1}$.

11. A frustum of a cone is formed from a right circular cone of height 15cm. If the base radii of the frustum are 2cm and 3cm, where the height from the smaller base to the vertex is 4cm, what is the volume of the frustum of the cone? (1)

A. ✓ $\frac{209}{3}\pi\text{cm}^3$

B. $\frac{285}{3}\pi\text{cm}^3$

C. $\frac{119}{3}\pi\text{cm}^3$

D. $\frac{195}{3}\pi\text{cm}^3$

Answer: A

The height of the frustum is the height of the original cone minus the height from the smaller base to the vertex, which is $15 - 4 = 11$ cm. Using the volume formula $V = \frac{1}{3}\pi h(R^2 + Rr + r^2)$ with $R = 3$ and $r = 2$ gives $V = \frac{11}{3}\pi(9 + 6 + 4) = \frac{209}{3}\pi\text{ cm}^3$.

12. Which one of the following statements defines frustum of a pyramid? (1)

- A. It is part of the pyramid included between the vertex and a cross-section made by a plane parallel to one of its lateral surfaces.
- B. It is part of the pyramid included between the vertex and the cross-section made by a plane parallel to the base.
- C. **It is part of the pyramid included between the base and the cross-section made by a plane parallel to the base.** ✓
- D. It is part of the pyramid included between the base and a cross-section made by a plane parallel to one of its lateral surfaces.

Answer: C

By definition, a frustum of a pyramid is the 3D solid that remains after cutting a pyramid with a plane parallel to its base, which represents the part of the pyramid included between the base and the parallel cross-section.

13. If the foci of a hyperbola are $(-2, 4)$ and $(8, 4)$ and the transverse axis is 8 cm long, which one of the following is the standard form of equation of the hyperbola? (1)

A. ✓ $\frac{(x-3)^2}{16} - \frac{(y-4)^2}{9} = 1$

B. $\frac{(y-4)^2}{9} - \frac{(x-3)^2}{16} = 1$

C. $\frac{(x-3)^2}{25} - \frac{(y-4)^2}{16} = 1$

D. $\frac{(y-4)^2}{16} - \frac{(x-3)^2}{25} = 1$

Answer: A

The foci $(-2, 4)$ and $(8, 4)$ lie on the horizontal line $y = 4$, so the hyperbola is horizontal with center $(3, 4)$. The distance between the foci is $2c = 10 \implies c = 5$, and the transverse axis length is $2a = 8 \implies a = 4$, which gives $b^2 = c^2 - a^2 = 25 - 16 = 9$, leading to the standard equation $\frac{(x-3)^2}{16} - \frac{(y-4)^2}{9} = 1$.

14. Which one of the following is the equation of the tangent line to the circle $(x - 2)^2 + y^2 = 10$ at the point $(5, 1)$? (1)
- A. $x + 3y - 16 = 0$ B. ✓ $3x + y - 16 = 0$
C. $-3x + y - 14 = 0$ D. $-x + 3y + 14 = 0$

Answer: B

The center of the circle is $(2, 0)$, so the slope of the radial line to $(5, 1)$ is $\frac{1-0}{5-2} = \frac{1}{3}$. Since the tangent line is perpendicular to the radial line, its slope is -3 , and its equation is $y - 1 = -3(x - 5)$, which simplifies to $3x + y - 16 = 0$.

15. Which one of the following is true about the determinant of a matrix? (1)
- A. The determinant of any two-by-two matrix is non-negative.
B. If $H = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$ and $T = \begin{pmatrix} d & c \\ b & a \end{pmatrix}$ are any matrices, then $|H| = -|T|$.
C. ✓ If $P = \begin{pmatrix} x+1 & \frac{1}{2} \\ -2 & x-1 \end{pmatrix}$ is a matrix, then $|P| \geq 0$ for all x in $\mathbb{R}$.
D. If $Q = \begin{pmatrix} m & n \\ r & p \end{pmatrix}$ is a matrix, then $|Q| = |q|$ for all t in $\mathbb{R}$ and $t \neq 0$.

Answer: C

Calculating the determinant of the matrix P gives $|P| = (x+1)(x-1) - (-2)(\frac{1}{2}) = x^2 - 1 + 1 = x^2$. Since $x^2 \geq 0$ for all real numbers x , option C is correct.

16. Let $M = \begin{pmatrix} -\frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & -\frac{1}{2} \end{pmatrix}$ and $Q = \begin{pmatrix} 1 & -1 \\ -1 & 1 \end{pmatrix}$ be given matrices. Which one of the following is true? (1)
- A. $2Q = M$ B. $3M = \frac{3}{2}Q$
C. ✓ $2M = -Q$ D. $\frac{1}{2}Q = 2M$

Answer: C

Multiplying matrix M by 2 yields $2M = \begin{pmatrix} -1 & 1 \\ 1 & -1 \end{pmatrix}$. Since $Q = \begin{pmatrix} 1 & -1 \\ -1 & 1 \end{pmatrix}$, we have $-Q = \begin{pmatrix} -1 & 1 \\ 1 & -1 \end{pmatrix}$, which means $2M = -Q$.

17. If we toss a coin three times, what is the number of possible events of getting at least two heads? (1)
- A. 3 B. ✓ 4
C. 5 D. 6

Answer: B

The sample space for tossing a coin three times contains 8 outcomes. The event of getting at least two heads contains the 4 outcomes: {HHH, HHT, HTH, THH}.

18. A committee of five members was formed from 6 females and 4 males. How many different committees can be formed that consists of 3 females and 2 males? (1)
- A. 20 B. 40
C. ✓ 120 D. 240

Answer: C

The number of ways to choose 3 females from 6 is $\binom{6}{3} = 20$, and the number of ways to choose 2 males from 4 is $\binom{4}{2} = 6$. By the multiplication principle, the total number of different committees is $20 \times 6 = 120$.

19. Let p, q and r be propositions. If the truth value of the proposition $[(p \implies q) \wedge r] \implies q$ is False. Then the converse of which proposition has truth value True? (1)

A. $p \implies \neg q$

B. $p \implies r$

C. $\checkmark \ r \implies q$

D. $q \implies \neg p$

Answer: C

For the implication $[(p \implies q) \wedge r] \implies q$ to be False, its antecedent must be True and its consequent False, which means $q = \text{False}$, $r = \text{True}$, and $p \implies q$ is True (so $p = \text{False}$). The converse of option C, $r \implies q$, is $q \implies r$, which has truth value $\text{False} \implies \text{True} = \text{True}$.

20. Which one of the following is the converse of the conditional statement "If life in Ethiopia was simpler, then people in Ethiopia would not go to other nations." (1)

- A. If life in Ethiopia was simpler, then people in Ethiopia would go to other nations.
B. If life in Ethiopia was not simpler, then people in Ethiopia would go to other nations.
C. If people of Ethiopia would go to other nations, then life in the Ethiopia was not simpler.
D. $\checkmark$ **If people of Ethiopia would not go to other nations, then life in Ethiopia was simpler.**

Answer: D

The converse of a conditional statement $P \implies Q$ is $Q \implies P$. Here, P is 'life in Ethiopia was simpler' and Q is 'people in Ethiopia would not go to other nations', so its converse is 'If people of Ethiopia would not go to other nations, then life in Ethiopia was simpler.'

21. Which one of the following is true about addition of complex numbers? (1)

A. $(a + bi) + (b + bi)i = (a + b) + (a + b)i$

B. $(x + yi) + x(i)^5 - y(i)^{10} = (x + y) + (x + \checkmark y)i$

C. $(3 + 12i) + (-7 - \sqrt{169})i = -4 + i$

D. $(5i + 9i)^2 = 14i$

Answer: B

Using the powers of i , we have $i^5 = i$ and $i^{10} = -1$. Substituting these into the left-hand side of option B yields $(x + yi) + xi - y(-1) = (x + y) + (x + y)i$, which equals the right-hand side.

22. Which one of the following is true about the system of linear equations

(1)

$$\begin{cases} 3x + y - z = 1 \\ 2x - y + 2z = 2 \\ -x + y + z = -1 \end{cases}$$

A. $x = \frac{\begin{vmatrix} 3 & 1 & 1 \\ 2 & -1 & 2 \\ -1 & 1 & -1 \end{vmatrix}}{\begin{vmatrix} 3 & 1 & -2 \\ 2 & -1 & 2 \\ -1 & 1 & 1 \end{vmatrix}}$

B. $z = \frac{\begin{vmatrix} 1 & 1 & 3 \\ 2 & -1 & 2 \\ -1 & 1 & -1 \end{vmatrix}}{\begin{vmatrix} 3 & 1 & -2 \\ 2 & -1 & 2 \\ -1 & 1 & 1 \end{vmatrix}}$

C. $y = \frac{\begin{vmatrix} 3 & 1 & -1 \\ 2 & -1 & 2 \\ -1 & 1 & 1 \end{vmatrix}}{\begin{vmatrix} 3 & 1 & -2 \\ 2 & -1 & 2 \\ -1 & 1 & 1 \end{vmatrix}}$

D. ✓ $x = \frac{\begin{vmatrix} 1 & 1 & -1 \\ 2 & -1 & 2 \\ -1 & 1 & 1 \end{vmatrix}}{\begin{vmatrix} 3 & 1 & -1 \\ 2 & -1 & 2 \\ -1 & 1 & 1 \end{vmatrix}}$

Answer: D

According to Cramer's rule, $x = D_x/D$, where D is the determinant of the coefficient matrix and D_x is the determinant of the matrix formed by replacing the first column of D with the constant vector. Option D correctly represents this ratio.

23. A man deposited Birr 5000 in a bank with annual interest rate of 14% compounded semi-annually. What is the total interest earned at the end of the second year approximately? (1)

- A. Birr 6554
C. Birr 5554

- B. ✓ Birr 1554
D. Birr 1654

Answer: B

Using the compound interest formula $A = P(1 + r/n)^{nt}$, we get $A = 5000(1 + 0.14/2)^{2 \times 2} = 5000(1.07)^4 \approx 6554$ Birr. The interest earned is the accumulated amount minus the principal, which is $6554 - 5000 = 1554$ Birr.

24. Which one of the following is the minimum value of the objective function $Z = 2x - 5y$ subject to the constraints: (1)

$$\begin{cases} 3x + 2y \leq 6 \\ 2x + 5y \leq 10 \\ x \geq 0 \\ y \geq 0 \end{cases}$$

- A. $-\frac{150}{11}$
C. ✓ -10

- B. 4
D. 0

Answer: C

By checking the vertices of the feasible region, which are $(0, 0)$, $(2, 0)$, $(0, 2)$, and $(\frac{10}{11}, \frac{18}{11})$, the minimum value of $Z = 2x - 5y$ occurs at $(0, 2)$ where $Z = 2(0) - 5(2) = -10$.

25. Which one of the following geometric series is convergent?

(1)

A. $\sum_{n=1}^{\infty} (-3)^n$
C. $\sum_{n=1}^{\infty} \left(\frac{1}{10}\right)^{-n}$

B. ✓ $\sum_{n=1}^{\infty} \left(\frac{1}{2}\right)^n$
D. $\sum_{n=1}^{\infty} (\sqrt{3})^n$

Answer: B

An infinite geometric series $\sum r^n$ converges if and only if the absolute value of the common ratio is strictly less than 1 ($|r| < 1$). For option B, $r = 1/2 < 1$, so it is convergent.

26. A woman wants to buy a new car that costs Birr 1,100,000. She paid Birr 870,000 and agreed with the seller to pay Birr 10,000 per month to cover the remaining amount at 0% interest rate. How many months will it take the woman to pay all the remaining money?

(1)

A. ✓ **Twenty Three months.**

B. Seventeen months.

C. Thirteen months.

D. Seven months.

Answer: A

The remaining amount the woman has to pay is Birr $1,100,000 - 870,000 = 230,000$. Paying this off at Birr 10,000 per month with 0% interest takes $230,000/10,000 = 23$ months.

27. If f, g , and h are functions defined by $f(x) = \sqrt{1-x^2}$, $g(x) = \frac{x}{x-1}$, and $h(x) = \sin x$ respectively, which one of the following is true?

(1)

A. The function $f + g$ is continuous on $[-1, 1]$.

B. The function $h - g$ is continuous on $[-1, 1]$.

C. ✓ **The function $3g$ is continuous on the interval where g is continuous.**

D. The function hg is continuous on the interval $(-\infty, 1]$.

Answer: C

Multiplying a function by a constant scalar preserves its domain and continuity, so $3g$ is continuous on the exact same interval(s) where g is continuous. Options A, B, and D are false because g is discontinuous at $x = 1$, which is included in those specified intervals.

28. Which one of the following limit values is correct for the limit of the given function?

(1)

A. $\lim_{x \rightarrow 2} \frac{x^3-8}{2-x} = 12$

B. ✓ $\lim_{x \rightarrow 1} \frac{1-x^2}{x-1} = -2$

C. $\lim_{x \rightarrow 10} 2^x = 100$

D. $\lim_{x \rightarrow \sqrt{5}} \frac{x^2-5}{x^4-25} = \frac{1}{5}$

Answer: B

Factoring the numerator gives $1 - x^2 = -(x-1)(1+x)$, so $\lim_{x \rightarrow 1} \frac{1-x^2}{x-1} = \lim_{x \rightarrow 1} -(1+x) = -2$, which is correct.

29. If f, g, h , and m are functions defined by $f(x) = \frac{x+7}{x^2+9x+14}$, $g(x) = \frac{\cos x}{\sqrt{x}}$, $h(x) = \sqrt{\frac{5x-1}{x-3}}$, and $m(x) = \frac{\sin x \cos x}{x}$, which one of the following is the correct result?

(1)

A. $\lim_{x \rightarrow 0} m(x) = 0$

B. ✓ $\lim_{x \rightarrow -7} f(x) = -\frac{1}{5}$

C. $\lim_{x \rightarrow 3^+} h(x) = \sqrt{15}$

D. $\lim_{x \rightarrow 0^+} g(x) = 1$

Answer: B

Factoring the denominator of $f(x)$ gives $x^2 + 9x + 14 = (x+7)(x+2)$. Canceling the common factor $(x+7)$ for $x \neq -7$ yields $\lim_{x \rightarrow -7} \frac{1}{x+2} = \frac{1}{-7+2} = -\frac{1}{5}$.

30. Which one of the following is the correct definition of continuity of a function on the given interval? (1)
- A. If a function h is continuous on the open interval (a, b) , then $\lim_{x \rightarrow k} h(x) = h(k)$, $\forall k \in [a, b]$.
- B. If a function g is continuous on the interval $[a, b]$, then g is continuous on (a, b) and continuous from the right of b .
- C. **If a function m is continuous on the interval $[a, \infty)$, then m is continuous on (a, ∞) and continuous from the right of a .**
- D. If a function f is continuous on the interval $[a, b]$, then f is continuous for every point c in the interval $[a, b]$.

Answer: C

By standard calculus definitions, a function is continuous on a half-open interval $[a, \infty)$ if it is continuous at every point in the open interval (a, ∞) and is right-continuous at the endpoint a (meaning the limit as x approaches a from the right equals the function's value at a).

31. Which one of the following is NOT true about the derivative of a function? (1)
- A. **The derivative of a function at a point is equal to the area of the region enclosed by the graph of the function and the coordinate axes.**
- B. The derivative of a function f at a point x_0 is the instantaneous rate of change of $f(x)$ at $(x_0, f(x_0))$.
- C. The derivative of a function g at a point t is equal to the limit of the ratio of the difference of functional values of g at x and at t to the difference $x - t$ as x approaches t .
- D. The derivative of a function f at a point x is the slope of a line tangent to the graph of the function at the point $(x, f(x))$.

Answer: A

The derivative of a function at a point represents the instantaneous rate of change or the slope of the tangent line. The area of a region enclosed by a function's graph and the coordinate axes is evaluated using the definite integral, not the derivative.

32. If f and g are functions defined by $f(x) = x^7 - 10x^5 + x^3$ and $g(x) = e^{-2x}$ respectively, then which one of the following is true? (1)
- A. $f^{(n)}(x) = 0, \forall n \geq 6$
- B. $\checkmark g^{(n)}(x) = (-1)^n 2^n e^{-2x}, \forall n \in \mathbb{N}$
- C. $(\frac{1}{2}f)^{(n)}(x) = 0, \forall n \geq 6$
- D. $(-g)^{(n)}(x) = (-1)^n 2^{n+1} e^{-2x}, \forall n \in \mathbb{N}$

Answer: B

The derivatives of $g(x) = e^{-2x}$ follow the pattern $g'(x) = -2e^{-2x}$, $g''(x) = 4e^{-2x}$, and generally $g^{(n)}(x) = (-1)^n 2^n e^{-2x}$ for all natural numbers n .

33. If a rectangular region of length x and width y has an area of 64 m^2 , what are the values of x and y such that its perimeter is minimum? (1)
- A. $x = 16$ and $y = 4$
- B. $\checkmark x = 8$ and $y = 8$
- C. $x = 64$ and $y = 1$
- D. $x = 32$ and $y = 2$

Answer: B

For a given area ($xy = 64$), the perimeter ($2x + 2y$) is minimized when the rectangle is a square. Thus, $x = y = 8 \text{ m}$.

34. Which one of the following is true about the zeros of a function? (1)
- A. The zero of a function f is the functional value of the function at zero.
- B. If h is a function defined by $h(x) = \frac{x^3-27}{x-3}$, then 3 is the zero of h .
- C. The functions g and h given by $g(x) = \sqrt{1-x^2} + 1 - x^2$ and $h(x) = \frac{1}{\sqrt{1-x^2}}$ have identical zeros.
- D. ✓ **The zeros of a given function f and c/f for $c \neq 0$ are identical, if it exist(s).**

Answer: D

Multiplying a function by a non-zero constant does not change where it equals zero. Therefore, $f(x) = 0$ if and only if $c f(x) = 0$ for any non-zero c .

35. Which one of the following is true about the derivative of the given functions? (1)
- A. $\frac{d}{dx}(x \sin x) = \cos x - x \sin x$
- B. $\frac{d}{dx} \left(\frac{x - \ln x}{x^4} \right) = \frac{-4x^2 + x - 1 + 4x \ln x}{x^6}, x \neq 0$
- C. If $f(x) = \frac{\cos x}{1 + \sin x}$, then $\frac{d}{dx}[f(x)]|_{x=\pi} = 0$
- D. ✓ **If $h(x) = {}^3\sqrt{x}e^x$, then $\frac{d}{dx}[h(x)]|_{x=27} = \frac{82}{27}e^{27}$**

Answer: D

Using the product rule on $h(x) = x^{1/3}e^x$ gives $h'(x) = e^x/(3x^{2/3}) + x^{1/3}e^x$. Evaluating this at $x = 27$ yields $e^{27}(1/27 + 3) = (82/27)e^{27}$.

36. Which one of the following is an equation of the line tangent to the graph of the function $f(x) = x^3 - 3x^2 + x + 1$ at $(1, 0)$? (1)
- A. $y = 2x + 2$
- B. $y = -2x - 2$
- C. ✓ $y = -2x + 2$
- D. $y = 2x - 2$

Answer: C

The derivative $f'(x) = 3x^2 - 6x + 1$ evaluates to -2 at $x = 1$. Using the point-slope form with point $(1, 0)$ and slope -2 gives $y - 0 = -2(x - 1)$, which simplifies to $y = -2x + 2$.

37. Which one of the following is true about integration and differentiation? (1)
- A. Integral of a function is an anti-derivative of its derivative.
- B. The process of finding $f(x)$ from $\int f(x)dx$ is called integration.
- C. ✓ **Integration is the reverse process of differentiation.**
- D. Any continuous function has only one anti-derivative.

Answer: C

Integration is defined conceptually as the reverse process of differentiation, where one seeks an anti-derivative whose derivative is the given function.

38. Which one of the following statements is true? (1)
- A. If the price of an egg reduced from Birr 13.00 to Birr 11.25, then the percent decrease is 0.142%.
- B. If a woman buys 20 kg of sugar by Birr 2000.00, and she sells one kilogram of it by Birr 85.00, then she sells by 30% price decrease.
- C. ✓ **If a shop owner offered 75 T-shirts by a price of Birr 325.00 for each and he bought all by Birr 25,000.00, then the percent decrease he had made for one T-shirt is 2.5%.**
- D. A person earns Birr 175.00 commission per service he provides. If he provided 13 services and got Birr 2000.00, then the percent decrease of his income is approximately 10%.

Answer: C

The cost of one T-shirt is $25,000 / 75 = 333.33$ Birr. The decrease in price is $333.33 - 325 = 8.33$ Birr. The percent decrease is $(8.33 / 333.33) * 100\% = 2.5\%$.

39. Which one of the following integrals of trigonometric functions is the true? (1)

- A. $\int (\sin 2x) dx = \frac{1}{2} \cos 2x + C$ B. $\int 10(\cos 10x) dx = -\sin 10x + C$
C. $\int 5(\cos 7x + 3) dx = -\frac{5}{7} \sin 7x + C$ D. ✓ $\int \cos(-5x) dx = \frac{1}{5} \sin(5x) + C$

Answer: D

Since cosine is an even function, $\cos(-5x) = \cos(5x)$. The integral of $\cos(5x)$ is $(1/5)\sin(5x) + C$.

40. The following table shows the mean score and the standard deviation of scores of the students in each class P, Q, R and S who took a similar test which is marked out of 20. Which of the following statements is true about these data? Class Mean Standard deviation P 16 3.05 Q 16 2.62 R 16 3.05 S 16 3.02 (1)

- A. The most consistent test result is class P students' result.
B. Test result of class Q students is highly variable.
C. Test result of class P students is more consistent than class R students.
D. ✓ **Test result of class S students is more consistent than class R students.**

Answer: D

A lower standard deviation indicates less variability and therefore greater consistency. Since the standard deviation of class S (3.02) is lower than that of class R (3.05), class S is more consistent than class R.

41. What is the area (in square units) of the regions bounded by the graph of the equation $f(x) = 2x + 1$, $y = 0$, $x = -1$ and $x = 4$? (1)

- A. 41 B. ✓ **20.5**
C. 40 D. 21.5

Answer: B

The function $f(x) = 2x + 1$ crosses the x-axis at $x = -1/2$. The total area is the sum of the areas of the two triangles formed: from $x = -1$ to $x = -1/2$ (area = 0.25) and from $x = -1/2$ to $x = 4$ (area = 20.25), giving a total area of 20.5 square units.

42. What is the area (in square units) of the region enclosed by the curve $f(x) = x^2 - 4x + 3$, the x-axis, the vertical lines $x = -1$ and $x = 3$? (1)

- A. ✓ **8** B. 12
C. 5 D. 17

Answer: A

The curve crosses the x-axis at $x = 1$ and $x = 3$. The area is the integral of $f(x)$ from -1 to 1 (which equals $20/3$) minus the integral from 1 to 3 (which equals $-4/3$), yielding a total absolute area of $20/3 + 4/3 = 24/3 = 8$ square units.

43. The following table shows the first quartile Q_1 and the third quartile Q_3 of two data sets X and Y. Which of the following is true about the given data? X Y Q_1 5 3 Q_3 9 6 (1)

- A. ✓ **Data X possesses higher variability than data Y.**
B. Data Y possesses higher variability than data X.
C. The inter quartile range of data X is 7.
D. The inter quartile range of data Y is 4.5

Answer: A

The interquartile range (IQR = $Q_3 - Q_1$) is a measure of variability. The IQR for data X is $9 - 5 = 4$, and for data Y it is $6 - 3 = 3$; therefore, data X has higher variability than data Y.

44. Suppose the following data represents the weight in kg of 10 students in a classroom: 61, 49, 52, 68, 61, 55, 64, 63, 67, 60 Which one of the following statements is NOT true about the data? (1)
- A. Mean deviation about the mean of the data is 4.8
 - B. Mean deviation about the median of the data is 4.6
 - C. Mean deviation about the mode of the data is 4.6
 - D. ✓ **Mean deviation about the mean of the data is 4.7**

Answer: D

The mean of the data is 60, and the sum of the absolute deviations from the mean is 48, giving a mean deviation about the mean of 4.8. Therefore, statement D, which claims it is 4.7, is the only one that is not true.

END OF THE MARKING KEY

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