

Mathematics, 2014 EC, natural science, entrance exam, round 1

Grade 12 · Mathematics · 2014 E.C.

Time allowed: 120 minutes

Questions: 51

Total marks: 51

Name _____ Grade _____ ID No. _____ Date _____

1. What is the locus all points in the plane in which the sum of the distances from two fixed points is constant? (1)

A. Hyperbola

B. Parabola

C. Ellipse

D. Circle
2. The radian measure of an angle of 120° is equal to: (1)

A. $\frac{2\pi}{3}$

B. $\frac{4\pi}{3}$

C. $\frac{\pi}{2}$

D. $\frac{\pi}{4}$
3. What is the surface area of a sphere with radius 6 cm? (1)

A. $24\pi \text{ cm}^2$

B. $36\pi \text{ cm}^2$

C. $48\pi \text{ cm}^2$

D. $144\pi \text{ cm}^2$
4. Which of the following is the measure of an exterior angle of a 10 sided regular polygon? (1)

A. 72°

B. 144°

C. 180°

D. 36°
5. If the volume of a right circular cone is $64\pi \text{ cm}^3$ and the diameter of its base is 8 cm, what is the height of the cone? (1)

A. 4cm

B. 12cm

C. 8cm

D. 3cm
6. What are the quotient and remainder respectively, when 75 is divided by 20? (1)

A. 3 and 15

B. 4 and 5

C. 15 and 3

D. 2 and 19
7. In rolling a fair die, what is the probability of obtaining 3 or 5? (1)

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

B. $\frac{1}{4}$

C. $\frac{1}{6}$

D. $\frac{1}{2}$
8. Which one of the following is true? (1)

A. The range of arctangent function is $[-\pi, \pi]$

B. The range of arcsine function is $(-\infty, \infty)$

C. The domain of arccosine function is $[-1, 1]$

D. The domain of arcsine function is $[0, \pi]$
9. The angle of depression of the top of a flag pole from the top of a building that is 40.3 m away from the flag pole is 30° . If the height of the flag pole is 10m, what is the height of the building? (1)

A. 20.3 m

B. $10(4/\sqrt{3} + 1) \text{ m}$

C. 50 m

D. 40 m

10. Given matrices $A = \begin{pmatrix} 2 & 0 & 5 \\ 3 & 1 & 4 \\ 0 & 6 & -2 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 3 & 0 \\ 6 & 5 & 2 \\ 9 & 7 & 0 \end{pmatrix}$. Which one of the following is $A - B$? (1)

A. $\begin{pmatrix} 1 & 3 & 5 \\ -3 & -4 & 2 \\ 9 & 1 & 2 \end{pmatrix}$

B. $\begin{pmatrix} 1 & -3 & -5 \\ -3 & -4 & 2 \\ 9 & 1 & 2 \end{pmatrix}$

C. $\begin{pmatrix} 1 & 3 & 5 \\ -3 & -4 & -2 \\ -9 & 1 & 2 \end{pmatrix}$

D. $\begin{pmatrix} 1 & -3 & 5 \\ -3 & -4 & 2 \\ -9 & -1 & -2 \end{pmatrix}$

11. In order to find point P in space one can start from the origin (0,0, 0); move 5 units in the direction of negative x-axis, then move 5 units in the direction of positive y-axis and finally move 5 units in the direction of negative z-axis. Which one of the following is the ordered triple of numbers represented by point P? (1)

A. (5, 5, 5)

B. (-5, 5, -5)

C. (5, -5, -5)

D. (-5, -5, 5)

12. Which one of the following quantities represents a vector? (1)

A. Weight of an object

B. Speed of a motorbike

C. Volume of a box

D. The width of your bedroom

13. Which one of the following is the derivative of $f(x) = \tan x + 3x$? (1)

A. $\sec^2 x + 3x \ln x$

B. $-\csc^2 x + 3x \ln x$

C. $-\tan x + 3x \ln x$

D. $\sec^2 x + 3x$

14. Which one of the following points is, inside the sphere with equation $x^2 + y^2 + z^2 = 5$? (1)

A. (1,-2,2)

B. (1,1,1)

C. (1,2,3)

D. (0,-2,3)

15. Which one of the following gives the polar form of the complex number $z = 2 - 2\sqrt{3}i$? (1)

A. $4 \left(\cos \frac{5}{3}\pi + i \sin \frac{5}{3}\pi \right)$

B. $4 \left(\cos \frac{5}{3}\pi + i \sin \frac{5}{3}\pi \right)$

C. $4 \left(\cos \frac{3}{4}\pi + i \sin \frac{3}{4}\pi \right)$

D. $4 \left(\cos \frac{1}{3}\pi + i \sin \frac{1}{3}\pi \right)$

16. What is the product of the two complex number $z = 2 - 3i$ and $w = 5 + 2i$? (1)

A. $16 + 11i$

B. $4 - 11i$

C. $16 - 11i$

D. 29

17. Which of the following is true about the Arithmetic Mean of a given data? (1)

A. It is affected by extreme values

B. There can be two means for a given data

C. It can also be used for qualitative data

D. It can be obtained even in the absence of some of the values in the data

18. In $\triangle ABC$, if $AB = 10$ units, $BC = 14$ units and $AC = 8$ units, then the area of the triangle is (1)

A. $10\sqrt{6}$ square unit

B. $16\sqrt{6}$ square unit

C. $16\sqrt{3}$ square unit

D. $16\sqrt{2}$ square unit

19. The integral $\int \left(\frac{1}{\sqrt{x}} - e^{-3x} + \frac{5}{x^2} \right) dx$ is equal to: (1)

A. $2\sqrt{x} + \frac{e^{-3x}}{3} + \frac{5}{x} + C$

B. $2\sqrt{x} + \frac{e^{-3x}}{3} - \frac{5}{x} + C$

C. $2\sqrt{x} - \frac{e^{-3x}}{3} - \frac{5}{x} + C$

D. $2\sqrt{x} - \frac{e^{-3x}}{3} + \frac{5}{x} + C$

20. Let f be a continuous function on $[a, b]$. Then which of the following is NOT true? (1)

A. $\int_a^b f(x) dx = - \int_b^a f(x) dx$

B. $\int_a^b k f(x) \, dx = k \int_a^b f(x) \, dx \quad \text{for any constant } k$

C. $\int_a^b f(x) \, dx = \int_a^c f(x) \, dx - \int_c^b f(x) \, dx \quad \text{for any } c \text{ in } (a, b).$

D. $\int_c^c f(x) dx = 0 \text{ for any } c \text{ in } (a, b).$

21. The simplified form of the expression (1)

$$\frac{6\sqrt{20} - 3\sqrt{45}}{3\sqrt{75}}$$

is:

A. $\sqrt{3}$

B. $\frac{\sqrt{15}}{15}$

C. $1/5$

D. 5

22. Which one of the following sets is the symmetric difference, $A \triangle B$, of the sets $A = \{1, 3, 5, 6, 8, 10\}$ and $B = \{2, 5, 8, 11\}$? (1)

A. $\{1, 2, 3, 5, 6, 8, 10, 11\}$

B. $\{2, 11\}$

C. $\{1, 2, 3, 6, 10, 11\}$

D. $\{1, 3, 6, 10\}$

23. Which of the following is the variance of the data given as: 2, 3, 4, 5, 7? (1)

A. 2.46

B. 2.96

C. 3.06

D. 3.70

24. Which of the following pairs of events are dependent? (1)

A. Tossing two coins simultaneously and obtaining head from one and tail from the other.

B. Drawing two cards one after the other from a well shuffled pack of cards without replacement.

C. Drawing two balls successively from a box containing balls having the same size and shape with replacement.

D. Any events obtaining from tossing a coin and rolling a die at the same time.

25. If $\lim_{x \rightarrow 2} f(x) = 6$ and $\lim_{x \rightarrow 2} g(x) = -9$, then $\lim_{x \rightarrow 2} \left(\frac{f - g}{2f - 7} \right) = \boxed{?}$ (1)

A. 3

B. -3

C. 15

D. -15

26. Let f and g be two functions. Which one of the following statements is true about f or g ? (1)

- A. The line $y = 0$ is the a tangent line to the graph of $f(x) = |x|$ at $(0, 0)$.
 - B. If f' differentiable at a , then it is continuous at a .
 - C. If $f'(a) = 0$, then the tangent line to the graph of f at $(a, f(a))$ is $y = a$.
 - D. If f and g differentiable at a , then f/g is differentiable at a .
-

27. What is the value of a for which the function defined by, (1)

$$f(x) = \begin{cases} ax + 3, & \text{for } x \geq 1 \\ x^2 - 2x + 3, & \text{for } x < 1 \end{cases} \text{ is continuous at } 1?$$

- | | |
|------|-------|
| A. 1 | B. -1 |
| C. 3 | D. 4 |
-

28. What is the derivative of the function (1)

$$f(x) = \frac{xe^x}{\cos x} \quad \text{at } x = 0?$$

- | | |
|------|-------|
| A. 2 | B. -1 |
| C. 1 | D. 0 |
-

29. Which of the following is true about bounded sequence? (1)

- A. Every bounded sequence is convergent.
 - B. Every increasing bounded sequence converges to the greatest lower bound of the sequence.
 - C. Every decreasing bounded sequence converges to the least upper bound of the sequence.
 - D. Every monotone bounded sequence converges.
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30. If f and g are continuous functions at a , then which of the following functions may NOT be continuous at a ? (1)

- | | |
|--------------|-------------|
| A. $2f + 3g$ | B. fg |
| C. f/g | D. $f - 2g$ |
-

31. Let f be a continuous function on $\mathbb{R}$ and c be a number in the domain of f . Which one of the following must be true about the function? (1)

- A. An absolute maximum value of f which is attained at a critical number is also a local maximum value of f .
 - B. If $f'(c) = 0$, then $(c, f(c))$ is an inflection point of f .
 - C. If $f(c)$ is a local minimum value of f , then $f'(c) = 0$.
 - D. If c is a critical number of f , then $f(c)$ is a local extreme value of f .
-

32. If the perimeter of a rectangle is 120 m, what are the length l and width w of the rectangle that maximizes its area? (1)

- | | |
|------------------------------|------------------------------|
| A. $l = 50$ m and $w = 10$ m | B. $l = 30$ m and $w = 30$ m |
| C. $l = 35$ m and $w = 25$ m | D. $l = 40$ m and $w = 20$ m |

33. The sum of the first 8 terms of a geometric sequence with first term 0.3 and common ratio $1/10$ is equal to: (1)

A. $\frac{3}{10} \left(\frac{10^8 - 1}{10^8} \right)$

B. $\frac{1}{3} \left(\frac{10^8 - 1}{10^8} \right)$

C. $\frac{1}{3} \left(\frac{10^8 - 1}{10^7} \right)$

D. $\frac{3}{10} \left(\frac{10^8 - 1}{10^9} \right)$

34. Suppose f is a continuous function on an interval $[a, b]$ and differentiable on (a, b) with the property $f(a) = f(b)$. Which one of the following must be true? (1)

A. The function has a zero in (a, b) .

B. The function has minimum value in (a, b) .

C. The function has maximum value in (a, b) .

D. The graph of f has horizontal tangent line at $(c, f(c))$ for some $c \in (a, b)$.

35. The distance from the point $P(3, 4)$ to the line L with equation $3x + 4y - 5 = 0$ is: (1)

A. 5 units

B. 6 units

C. 4 units

D. 7 units

36. A line segment chord in an ellipse which passes through the center and perpendicular to the major axis is called: (1)

A. Semi-major axis

B. Minor axis

C. Eccentricity

D. Latus rectum

37. If A is a 3×3 matrix with $\det(A) = 5$, then what is the determinant of $2A$? (1)

A. 10

B. $2/5$

C. 40

D. 30

38. Which one of the following is the augmented matrix associated to the system of equations: (1)

$$\begin{cases} 2x + y + 3z = 4 \\ x - z = 1 \\ -4x + y = 3 \end{cases}$$

A. $\begin{pmatrix} 3 & 2 & 1 & 1 \\ -1 & 1 & -1 & 3 \\ -1 & -4 & 1 & 4 \end{pmatrix}$

B. $\begin{pmatrix} 3 & 1 & 2 & 4 \\ -1 & 0 & 1 & 1 \\ -4 & 1 & -3 & 0 \end{pmatrix}$

C. $\begin{pmatrix} 1 & 2 & 3 & 4 \\ -1 & 1 & -1 & 1 \\ 1 & -4 & -1 & 3 \end{pmatrix}$

D. $\begin{pmatrix} 2 & 1 & 3 & 4 \\ 1 & 0 & -1 & 1 \\ -4 & 1 & 0 & 3 \end{pmatrix}$

39. Which one of the following compound statements has a converse with truth value False? (1)

A. If 6 is a prime integer, then 4 is an even number.

B. If man is immortal, then the earth does not rotate around the sun.

C. If athlete Derartu Tulu was born on October 21, 1971, then 6 is prime.

D. If man is mortal, then the earth does not rotate around the sun.

40. The solution set of the equation given by $\log(x^2 - 3) = 2 \log(x - 1)$ is: (1)
- A. $\{1\}$ B. $\{2\}$
C. $\{4\}$ D. $\emptyset$
-
41. Which of the following is true about the trigonometric values of the given pairs of angles? (1)
- A. $\tan(75^\circ) = \tan(105^\circ)$ B. $\sin(75^\circ) = \cos(105^\circ)$
C. $\cos(120^\circ) = \cos(60^\circ)$ D. $\sin(120^\circ) = \sin(60^\circ)$
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42. Which one of the following intervals is the solution set of the inequality $x^2 - 5x + 6 \leq 0$? (1)
- A. $[0, 2]$ B. $[2, 3]$
C. $(3, \infty)$ D. $(-\infty, 2]$
-
43. What are the coordinates of a point that divides the line segment with endpoints $P(0, 1)$ and $Q(5, 6)$ in the ratio 2:3 from P? (1)
- A. $(2, 3)$ B. $(0, 2)$
C. $(3, 2)$ D. $(0, 3)$
-
44. Which one of the following trigonometric values is correct? (1)
- A. $\sin(-120^\circ) = 0.5$ B. $\cos(-120^\circ) = -0.5$
C. $\tan(-120^\circ) = -1$ D. $\cos(-60^\circ) = \sqrt{3}/2$
-
45. Which one of the following is an onto function from $\mathbb{R}$ on to $[0, \infty)$? (1)
- A. $f(x) = \sqrt{x^2}$ B. $f(x) = |x| + 2$
C. $f(x) = x^2 + 1$ D. $f(x) = 2^x$
-
46. Which one of the following is the simplified form of $\frac{4x^4 - 64}{2 - x}$ for $x \neq 2$? (1)
- A. $4(x + 2)(x^2 + 4)$ B. $4(x - 2)(x^2 - 4)$
C. $-4(x + 2)(x^2 + 4)$ D. $-4(x - 2)(x^2 + 4)$
-
47. If Btu 20,000 is deposited in a Bank at a rate of 12% interest compounded monthly, how long will it take to double the amount? (1)
- A. 7.59 years B. 6 years
C. 5.81 years D. 5 years
-
48. Which one of the following is true about the matrix $\begin{pmatrix} 1 & 3 & 5 \\ 6 & 4 & 2 \\ 9 & 7 & 0 \end{pmatrix}$? (1)
- A. The minor of the entry 3 is 18. B. The cofactor of the entry 5 is -6.
C. The minor of the entry 0 is 14. D. The cofactor of the entry 1 is -14.
-
49. What is the image of the circle with equation $(x + 2)^2 + (y - 2)^2 = 1$, when it is rotated through $\pi/6$ about the origin? (1)
- A. $(x + (\sqrt{3} - 1))^2 + (y - (\sqrt{3} - 1))^2 = 1$ B. $(x - (\sqrt{3} + 1))^2 + (y + (\sqrt{3} - 1))^2 = 1$
C. $(x + (\sqrt{3} + 1))^2 + (y - (\sqrt{3} - 1))^2 = 1$ D. $(x - (\sqrt{3} - 1))^2 + (y + (\sqrt{3} + 1))^2 = 1$
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50. What is the dot (scalar) product of the vectors $u = i + 2j$ and $v = -2i + 4j$? (1)
- A. -8 B. 5
C. 6 D. 7

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- 51.** The following is the distribution of the marks of students obtained in Mathematics test out of 50: Range of marks Frequency 20 - 25 15 26 - 31 25 32 - 37 25 38 - 43 20 44 - 50 10 (1)
- A. The first quartile of the distribution is 28.
- B. The first quartile of the distribution is 26.
- C. The first quartile of the distribution is 26.5.
- D. The first quartile of the distribution is 27.5

— END OF EXAMINATION —

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