AGA KHAN UNIVERSITY EXAMINATION BOARD

HIGHER SECONDARY SCHOOL CERTIFICATE

CLASS XI

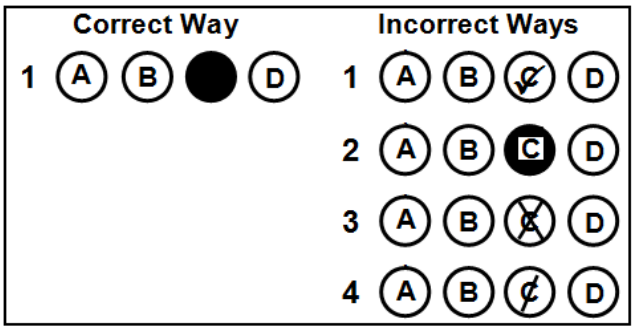
ANNUAL EXAMINATIONS 2021

Mathematics

Time: 2 hours 10 minutes Marks: 65

INSTRUCTIONS

1. Read each question carefully.
2. Answer the questions on the separate answer sheet provided. DO NOT write your answers on the question paper.
3. There are 100 answer numbers on the answer sheet. Use answer numbers 1 to 65 only.
4. In each question, there are four choices A, B, C, D. Choose ONE. On the answer grid, black out the circle for your choice with a pencil as shown below.



Candidate's Signature

5. If you want to change your answer, ERASE the first answer completely with a rubber, before blacking out a new circle.
6. DO NOT write anything in the answer grid. The computer only records what is in the circles.
7. The marks obtained on the 65 MCQs will be equated to the total marks of 100 for the theory examination results.
8. You may use a scientific calculator if you wish.

1. $\begin{bmatrix} 3 & 2 \\ 4 & 5 \end{bmatrix}^t \times \begin{bmatrix} a & b \\ c & d \end{bmatrix}^t$ is equal to

   A. $\left(\begin{bmatrix} 3 & 2 \\ 4 & 5 \end{bmatrix} \times \begin{bmatrix} a & b \\ c & d \end{bmatrix} \right)^t$.

   B. $\left(\begin{bmatrix} a & b \\ c & d \end{bmatrix} \times \begin{bmatrix} 3 & 2 \\ 4 & 5 \end{bmatrix} \right)^t$.

   C. $-\left(\begin{bmatrix} 3 & 2 \\ 4 & 5 \end{bmatrix} \times \begin{bmatrix} a & b \\ c & d \end{bmatrix} \right)^t$.

   D. $-\left(\begin{bmatrix} a & b \\ c & d \end{bmatrix} \times \begin{bmatrix} 3 & 2 \\ 4 & 5 \end{bmatrix} \right)^t$.

2. It is given that $Q = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$. The transpose of Q^2

   A. is $\begin{bmatrix} 2 & 0 \\ 0 & 2 \\ 0 & 0 \end{bmatrix}$.

   B. is $\begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 0 & 0 \end{bmatrix}$.

   C. is $\begin{bmatrix} 0 & 1 \\ 1 & 0 \\ 1 & 1 \end{bmatrix}$.

   D. does not exist.

3. The value of determinant $\begin{vmatrix} 3 & 6 & 3m \\ 1 & 2 & m \\ a & a & a \end{vmatrix}$ is

   A. 3
   B. m
   C. 0
   D. a

4. The matrix $\begin{bmatrix} 1 & 2 & 4 \\ 0 & 3 & 1 \\ 0 & 0 & 2 \end{bmatrix}$ is a/ an

I. symmetric matrix.
II. upper triangular matrix.
III. non-singular matrix.

A. I only
B. II only
C. I and III
D. II and III

5. If $\begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & -1 \\ x-1 & 0 & x-2 \end{bmatrix}$ is a singular matrix, then the value of x will be

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

6. The product $\begin{bmatrix} \cos\theta & \sin\theta \\ 1 & 1 \end{bmatrix} \times \begin{bmatrix} \sec\theta & 1 \\ \text{cosec}\,\theta & 1 \end{bmatrix}$ is equal to

A. $\begin{bmatrix} 1 & \sin\theta \\ \text{cosec}\,\theta & 1 \end{bmatrix}$.
B. $\begin{bmatrix} 1 & \cos\theta + \sin\theta \\ \sec\theta + \text{cosec}\,\theta & 1 \end{bmatrix}$.
C. $\begin{bmatrix} 2 & \cos\theta + \sin\theta \\ \sec\theta + \text{cosec}\,\theta & 2 \end{bmatrix}$.
D. $\begin{bmatrix} 1 & \cos\theta + \sin\theta \\ \sec\theta + \text{cosec}\,\theta & 2 \end{bmatrix}$.

7. If the determinant of the matrix $\begin{bmatrix} x & 0 & 1 \\ -3 & x & 1 \\ 0 & -3 & 3 \end{bmatrix}$ is 9, then the value(s) of x will be

A. -1 only
B. $-\frac{1}{3}$ only
C. 0 and -1
D. 0 and $-\frac{1}{3}$

8. In the matrix $\begin{bmatrix} 3 & 1 & x \\ 1 & 4 & -1 \\ 2 & -2 & 2 \end{bmatrix}$, the minor of the element x will be

A. -10
B. -6
C. 6
D. 10

9. In the matrix $\begin{bmatrix} 2 & 2 & -7 \\ 1 & 1 & 3 \\ x & y & z \end{bmatrix}$, the cofactor of the element x will be

A. -13
B. -1
C. 1
D. 13

10. If the determinant of $\begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}$ is x, then the determinant of $\begin{bmatrix} a & 3a+b & c \\ d & 3d+e & f \\ g & 3g+h & i \end{bmatrix}$

A. is x.
B. is $3x$.
C. is $3+x$.
D. cannot be determined.

11. If a matrix equation is given as $5B+\begin{bmatrix}2&0&0\\0&2&0\\0&0&2\end{bmatrix}=3\begin{bmatrix}1&0&0\\0&1&0\\0&0&1\end{bmatrix}$, then the matrix B will be

A. $\begin{bmatrix}1&0&0\\0&1&0\\0&0&1\end{bmatrix}$.

B. $\begin{bmatrix}\frac{1}{5}&0&0\\0&\frac{1}{5}&0\\0&0&\frac{1}{5}\end{bmatrix}$.

C. $\begin{bmatrix}-1&0&0\\0&-1&0\\0&0&-1\end{bmatrix}$.

D. $\begin{bmatrix}-\frac{1}{5}&0&0\\0&-\frac{1}{5}&0\\0&0&-\frac{1}{5}\end{bmatrix}$.

12. In an arithmetic progression, if the 31st term is 250 more than the 6th term, i.e. $T_{31}=250+T_6$, then the common difference is

A. -10

B. $-\frac{50}{7}$

C. $\frac{50}{7}$

D. 10

13. The arithmetic mean between two numbers $\sqrt{3}$ and $\sqrt{5}$ is

A. $\sqrt{8}$

B. $\frac{\sqrt{8}}{2}$

C. $\sqrt{3}+\sqrt{5}$

D. $\frac{\sqrt{3}+\sqrt{5}}{2}$

14. The sum of the infinite geometric series $\frac{2}{3}+\frac{2}{9}+\frac{2}{27}+\ldots$ will be

A. $\frac{4}{9}$
B. $\frac{1}{2}$
C. 1
D. ∞

15. The common difference of the sequence $\log x^2, \log x^3, \log x^4, \log x^5, \ldots$ is

A. 1
B. 0
C. $\log x^2$
D. $\log x$

16. For the geometric sequence 8, 4, 2, 1, …, the 7th term of the geometric sequence will be

A. $\frac{1}{2}$
B. $\frac{1}{4}$
C. $\frac{1}{6}$
D. $\frac{1}{8}$

17. For any two numbers, the relation among their arithmetic (AM), geometric (GM) and harmonic (HM) means will be

A. $HM = \frac{(GM)^2}{AM}$.
B. $HM = \frac{(GM)^2}{2AM}$.
C. $GM = \frac{(HM)^2}{AM}$.
D. $GM = \frac{(HM)^2}{2AM}$.

18. If harmonic mean and geometric mean between two numbers are $\frac{72}{13}$ and 6 respectively, then the arithmetic mean between the numbers will be

A. $\frac{2}{13}$
B. $\frac{12}{13}$
C. $\frac{13}{12}$
D. $\frac{13}{2}$

19. If $T_{n-1} = (-1)^{n-2}$ is term of a sequence, then T_n will be

A. $(-1)^n$
B. $(-1)^{n-1}$
C. $(-1)^{n+1}$
D. $(-1)^{n-3}$

20. If T_n is a term of an arithmetic sequence, then the term T_{2n} will be

A. $a + 2(n-1)d.$
B. $a + 2(n-2)d.$
C. $[a + (2n-1)d].$
D. $[a + (2n-2)d].$

21. If $S_n = \frac{a(1-r^n)}{1-r}$, then the expression for $S_n : S_\infty$ will be

A. $\frac{n}{1-r}.$
B. $1-r^n.$
C. $(1-r)^n.$
D. $\frac{1}{(1-r)^n}.$

22. The arithmetic mean between two numbers is 5. If the first number is 3, then the sum of second number and 5 is

A. 8
B. 10
C. 12
D. 14

23. A bag contains 5 green, 6 white and 4 blue identical balls. Two balls are drawn randomly without replacement.

The probability that the first ball is green and the second ball is white, will be

A. $\frac{5}{15} \times \frac{6}{14}$

B. $\frac{5}{15} \times \frac{6}{15}$

C. $\frac{5}{11} \times \frac{6}{10}$

D. $\frac{5}{11} \times \frac{6}{11}$

24. If $(m + 1)$ distinct objects are placed in a circular form, then the arrangement of these objects will be in

A. m ways.

B. $\frac{m}{2}$ ways.

C. $m!$ ways.

D. $\frac{m!}{2}$ ways.

25. A fair cubical die shows numbers 1, 2, 3, 4, 5 and 6. If these numbers on the die are squared, then the probability of getting a number less than 13 on rolling the die is

A. 0

B. $\frac{1}{2}$

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

D. $\frac{1}{12}$

26. A spinner shows the numbers 1, 4, 6 and 8. If these numbers are halved, then the probability of getting a prime number is

A. 0

B. 1

C. $\frac{1}{2}$

D. $\frac{3}{4}$

27. If $P(E^C) = \frac{2}{m}$, then the value of $1 - P(E)$ is equal to

A. 0
B. $\frac{m}{2}$
C. $\frac{2}{m}$
D. $1 - \frac{2}{m}$

28. The number of possible passwords that can be formed, using any three letters without repetition of the word 'MUSCLE', is

A. 18
B. 120
C. 216
D. 729

29. The number of possible passwords that start with a vowel and can be formed using all the letters without repetition of the word 'MUSCLE', is

A. 48
B. 240
C. 720
D. 46,656

30. There are 6 red and 7 white identical balls in a bag. Two balls are drawn at random from the bag with replacement, then the total number of ways to draw these balls is

A. 13×12
B. 13×13
C. ${}^6P_1 \times {}^7P_1$
D. ${}^6C_1 \times {}^7C_1$

31. Consider the digits 1, 2, 3, 5, 7 and 9. The possible distinct 4-digit numbers formed from these digits will be

A. 18
B. 24
C. 360
D. 1,296

32. $\left(2\omega^{12} + 4\omega + 4\omega^2\right)^2$ is equal to

A. 4
B. 16
C. 36
D. 144

33. For the equation $4x^2 + bx + 64 = 0$, the sum of the roots is equal to the product of the roots. The value of *b* will be

A. 64
B. -64
C. 16
D. -16

34. The value of $\left(1-\omega^{90}\right)^5$ is

A. 0
B. 1
C. 10
D. 32

35. To reduce the equation $(x-4)(x+6)(x-8)(x+2)=m$ into suitable quadratic form, it should be re-arranged as

A. $(x-4)(x-8)(x+6)(x+2)=m.$
B. $(x-4)(x+2)(x-8)(x+6)=m.$
C. $(x+2)(x-8)(x+6)(x-4)=m.$
D. $(x+2)(x+6)(x-8)(x-4)=m.$

36. The nature of roots of the equation $x^2 - 2bx + b^2 = 0$, where $b \in Z$, is

A. real and equal.
B. real and unequal.
C. complex and equal.
D. complex and unequal.

37. The roots of a quadratic equation are reciprocal to each other. If $\frac{1}{\alpha}$ is one of the roots, then the quadratic equation will be

A. $\left(x+\frac{1}{\alpha}\right)(x-\alpha)=0$
B. $\left(x-\frac{1}{\alpha}\right)(x+\alpha)=0$
C. $\left(x+\frac{1}{\alpha}\right)(x+\alpha)=0$
D. $\left(x-\frac{1}{\alpha}\right)(x-\alpha)=0$

38. If $\frac{y^2}{x^2} = k^2$ and $\frac{y^2}{k^2} = 1$, then the value of x^2 is equal to

A. $-k^2$
B. k^2
C. 1
D. 0

39. The equation $x^2 - \frac{x}{5} = 1$ can be converted into the standard quadratic form as

A. $5x^2 - x - 5 = 0$
B. $5x^2 + x - 5 = 0$
C. $5x^2 + 5x - 1 = 0$
D. $5x^2 + 5x + 1 = 0$

40. The solution set of $x^2 - \frac{4x}{3} = 0$ is

A. $\left\{\frac{2}{3}, 0\right\}$.
B. $\left\{\frac{4}{3}, 0\right\}$.
C. $\left\{-\frac{4}{3}, 0\right\}$.
D. $\left\{-\frac{2}{3}, 0\right\}$.

41. The roots of the quadratic equation $x^2 - 4bx - 4c = 0$ are

A. $x = \frac{b \pm \sqrt{b^2 + c}}{8}$.
B. $x = \frac{b \pm \sqrt{b^2 - c}}{8}$.
C. $x = 2\left(-b \pm \sqrt{b^2 - c}\right)$.
D. $x = 2\left(b \pm \sqrt{b^2 + c}\right)$.

42. A quadratic equation has rational coefficients. If one of its root is $1 + \sqrt{2}$, then the sum of its roots will be

A. 2
B. -2
C. $2 + 2\sqrt{2}$
D. $2 - 2\sqrt{2}$

43. A quadratic equation has roots α and β. If the sum of roots is -1 and the product of roots -6, then the value of $(\alpha-\beta)^2$ will be

A. -23
B. -11
C. 1
D. 25

44. If $1+\tan^2\alpha=\sec^2\alpha$, then the value of $\tan^2\left(\frac{\alpha}{2}\right)-\sec^2\left(\frac{\alpha}{2}\right)$ will become

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

45. If $m\angle A=1935^{\circ}$, then the terminal ray of angle A will be in the quadrant

A. I.
B. II.
C. III.
D. IV.

46. The distance between the points (0, 0) and $(\sin\alpha,-\cos\beta)$ is

A. 1
B. $\sin\alpha-\cos\beta$
C. $\sqrt{\sin^2\alpha-\cos^2\beta}$
D. $\sqrt{\sin^2\alpha+\cos^2\beta}$

47. $\cos\left(\frac{3\pi}{2}-\theta\right)$ is equal to

A. $\sin\theta$.
B. $-\sin\theta$.
C. $\cos\theta$.
D. $-\cos\theta$.

48. If $\text{cosec}\theta = \frac{1}{p}$, then the value of $\cos^2\theta$ is equal to

A. p^2.

B. $\frac{1}{p^2}$.

C. $1-p^2$.

D. $1-\frac{1}{p^2}$.

49. If $2\sec^2\theta = 3$, then the value of $\left[\left(\frac{\sin\theta}{\cos\theta}\right)^2 + 1\right]$

A. is $-\frac{1}{2}$

B. is $\frac{9}{4}$

C. is $\frac{3}{2}$

D. cannot be determined

50. The expression $2\left[\cos^2\theta - \frac{1}{2}\right]$ can also be written as

A. $\sin^2\theta$.

B. $2\sin^2\theta$.

C. $\cos 2\theta$.

D. $2\cos 2\theta$.

51. Which of the following trigonometric ratios has positive sign?

A. $\sin 210^o$

B. $\cos 350^o$

C. $\tan 310^o$

D. $\text{cosec } 240^o$

52. If $\cos\theta = -\frac{2}{5}$ and $\tan\theta = \frac{\sqrt{21}}{2}$, then the value of $\sin\theta$ will be

A. $-\frac{\sqrt{21}}{5}$

B. $-\frac{5\sqrt{21}}{4}$

C. $\frac{\sqrt{21}}{4}$

D. $\frac{5\sqrt{21}}{4}$

53. $\sin^2\theta + \cos^2\theta + \tan^2\theta$ is equal to

A. $\sec^2\theta$.

B. $\cot^2\theta$.

C. $2\sin^2\theta$.

D. $2\cos^2\theta$.

54. $\frac{1-\sin\theta}{\cos\theta} \times \frac{1+\sin\theta}{\sin\theta}$ is equal to

A. $\cot\theta$.

B. $\tan\theta$.

C. $\sec\theta$.

D. $\text{cosec}\theta$.

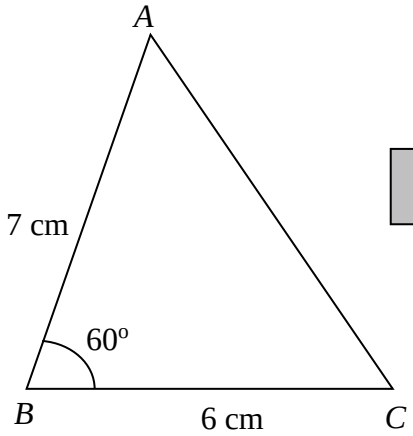
55. In the given diagram, the area of the triangle ABC is

A. 21 cm^2.

B. $\frac{21}{2}$ cm^2.

C. $21\sqrt{3}$ cm^2.

D. $\frac{21\sqrt{3}}{2}$ cm^2.



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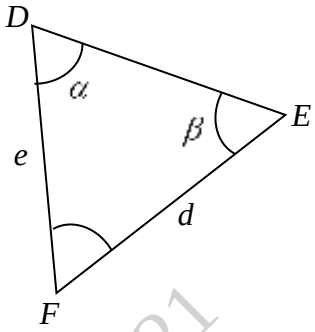
56. A triangle *DEF* is shown in the given diagram with $EF = d$ units, $DF = e$ units, $\angle D = \alpha$ and $\angle E = \beta$.

The value of $\dfrac{\sin \angle F}{DE}$ can be calculated as



A. $\dfrac{e}{\sin \beta}$.

B. $\dfrac{\sin \alpha}{d}$.

C. $\dfrac{e}{\sin \alpha}$.

D. $\dfrac{\sin \beta}{d}$.

57. The length of hypotenuse of a right angled triangle is three times the length of its base. If its base is *b* cm long, then the length of perpendicular will be

A. $8b$.
B. $10b$.
C. $\sqrt{8}\,b$.
D. $\sqrt{10}\,b$.

58. The amplitude of the trigonometric function $y = 4 + 5\cos 6x$ is

A. 4
B. 5
C. 9
D. $\dfrac{9}{2}$

59. If $0 \le x \le \pi$, then the set of values of *x* for which $\dfrac{\sin 2x}{\cos x} = 1$ are

A. $\dfrac{\pi}{3}$ and $\dfrac{\pi}{2}$

B. $\dfrac{\pi}{6}$ and $\dfrac{\pi}{3}$

C. $\dfrac{\pi}{6}$ and $\dfrac{5\pi}{6}$

D. $\dfrac{\pi}{6}$ and $\dfrac{7\pi}{6}$

60. The range of $\sec A$ is same as the range of

A. $\cot A$.
B. $\sin A$.
C. $\cos A$.
D. $\text{cosec} A$.

61. A trigonometric equation is given as $\cot A = p$.

(**Note**: p is a constant and $0 \le A \le \frac{\pi}{2}$.)

If $p = 0$, then the value of A

A. is 0
B. is $\frac{\pi}{2}$
C. is $\frac{\pi}{4}$
D. cannot be determined

62. The range of $-\frac{1}{6}\sin(6x+1)$ is equal to

A. $\left[-\frac{1}{6}, \frac{1}{6}\right]$.
B. $[-1, 1]$.
C. $[-6, 6]$.
D. $\left[-\frac{7}{6}, \frac{7}{6}\right]$.

63. The period of $2\sin\frac{\theta}{2}$ is

A. $\frac{\pi}{2}$.
B. π.
C. 2π.
D. 4π.

64. The domain of principal cotangent function is

A. $(0, \pi)$.
B. $[0, \pi]$.
C. $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$.
D. $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$.

65. Which of the following functions is an even function?

A. $\cos^2\theta \sin\theta$
B. $\text{cosec}\,\theta \sec\theta$
C. $\sin^2\theta \sec\theta$
D. $\cos\theta \,\text{cosec}\,\theta$

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