AGA KHAN UNIVERSITY EXAMINATION BOARD

HIGHER SECONDARY SCHOOL CERTIFICATE

CLASS XII

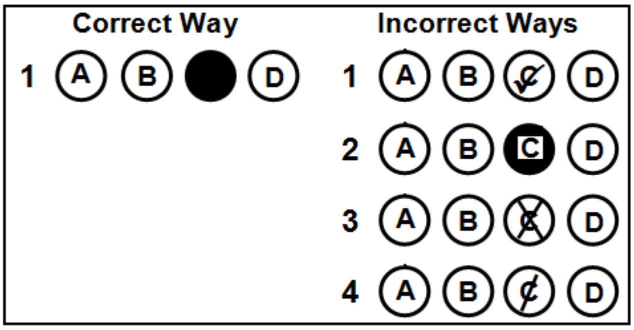
MODEL EXAMINATION PAPER 2023 AND ONWARDS

Mathematics Paper I

Time: 1 hour 30 minutes Marks: 50

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 50 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.



<u>Candidate's Signature</u>

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. A formulae list is provided on page 2 and 3. You may refer to it during the paper, if you wish.
8. You may use a scientific calculator if you wish.

Aga Khan University Examination Board
List of Formulae for Mathematics XII

Note:

- All symbols used in the formulae have their usual meaning.
- The same formulae will be provided in the annual and re-sit examinations.

Functions and Limits

$$\lim_{\theta\to 0}\frac{\sin\theta}{\theta}=1 \qquad \lim_{x\to 0}\frac{\sqrt{x+a}-\sqrt{a}}{x}=\frac{1}{2\sqrt{a}} \qquad \lim_{x\to a}\frac{x^n-a^n}{x-a}=na^{n-1}$$

$$\lim_{x\to 0}(1+x)^{\frac{1}{x}}=e \qquad \lim_{x\to +\infty}\left(1+\frac{1}{x}\right)^x=e \qquad \lim_{x\to 0}\frac{a^x-1}{x}=\log_e a$$

Differentiation

$$\frac{\Delta y}{\Delta x}=\frac{f(x+h)-f(x)}{h} \qquad \frac{d}{dx}(\sec x)=\sec x\tan x \qquad \frac{d}{dx}x^n=nx^{n-1} \qquad \frac{d}{dx}(\sin x)=\cos x$$

$$\frac{d}{dx}(\cos x)=-\sin x \qquad \frac{d}{dx}(\tan x)=\sec^2 x \qquad \frac{d}{dx}(\cot x)=-\operatorname{cosec}^2 x \qquad \frac{d}{dx}(\operatorname{cosec} x)=-\operatorname{cosec} x\cot x$$

$$\frac{d}{dx}\left[\sin^{-1}x\right]=\frac{1}{\sqrt{1-x^2}},\ x\in(-1,1) \qquad \frac{d}{dx}\left[\cos^{-1}x\right]=-\frac{1}{\sqrt{1-x^2}},\ x\in(-1,1) \qquad \frac{d}{dx}\left[\tan^{-1}x\right]=\frac{1}{x^2+1},\ x\in R \qquad \frac{d}{dx}\left[\sec^{-1}x\right]=\frac{1}{|x|\sqrt{x^2-1}},\ x\in[-1,1]'$$

$$\frac{d}{dx}\left[\operatorname{cosec}^{-1}x\right]=-\frac{1}{|x|\sqrt{x^2-1}},\ x\in[-1,1]' \qquad \frac{d}{dx}\left[\cot^{-1}x\right]=-\frac{1}{1+x^2},\ x\in R \qquad \frac{d}{dx}(a^x)=a^x\ln a \qquad \frac{d}{dx}(\log_a x)=\frac{1}{x}\times\frac{1}{\ln a}$$

$$\frac{d}{dx}(\sinh x)=\cosh x \qquad \frac{d}{dx}(\cosh x)=\sinh x \qquad \frac{d}{dx}(\tanh x)=\operatorname{sech}^2 x$$

$$\frac{d}{dx}(\operatorname{cosech} x)=-\coth x\operatorname{cosech} x \qquad \frac{d}{dx}(\operatorname{sech} x)=-\tanh x\operatorname{sech} x \qquad \frac{d}{dx}(\coth x)=-\operatorname{cosech}^2 x$$

$$\frac{d}{dx}\left[f(x)\times g(x)\right]=f(x)\frac{d}{dx}\left[g(x)\right]+g(x)\frac{d}{dx}\left[f(x)\right] \qquad \frac{d}{dx}\left(\frac{f(x)}{g(x)}\right)=\frac{g(x)\frac{d}{dx}\left[f(x)\right]-f(x)\frac{d}{dx}\left[g(x)\right]}{\left[g(x)\right]^2}$$

Maclaurin Series $f(x)=f(0)+f'(0)x+\dfrac{f''(0)}{2!}x^2+\dfrac{f'''(0)}{3!}x^3+\ldots+\dfrac{f^n(0)}{n!}x^n+\ldots$

Taylor's Series $f(x)=f(a)+f'(a)(x-a)+\dfrac{f''(a)}{2!}(x-a)^2+\dfrac{f'''(a)}{3!}(x-a)^3+\dfrac{f^{iv}(a)}{4!}(x-a)^4+\ldots+\dfrac{f^n(a)}{n!}(x-a)^n+\ldots$

Integration

$$\int f'(x)dx=f(x)+c \qquad \int[f(x)]^n f'(x)dx=\frac{[f(x)]^{n+1}}{n+1}+c,\quad (n\neq -1) \qquad \int f(x)g'(x)dx=f(x)g(x)-\int f'(x)g(x)dx$$

$$\int\frac{f'(x)}{f(x)}dx=\ln f(x)+c \qquad \int \operatorname{cosec}x\ dx=\ln|\operatorname{cosec}x-\cot x|+c \qquad \int\sec x\,dx=\ln|\sec x+\tan x|+c$$

Plane Analytical Geometry (Straight Line)

$$d=\frac{|ax_1+by_1+c|}{\sqrt{a^2+b^2}} \qquad y-y_1=\frac{y_2-y_1}{x_2-x_1}(x-x_1) \qquad \left(\frac{x_1+x_2}{2},\frac{y_1+y_2}{2}\right)$$

Point of internal division $\left(\dfrac{k_1x_2+k_2x_1}{k_1+k_2}, \dfrac{k_1y_2+k_2y_1}{k_1+k_2}\right)$	Point of external division $\left(\dfrac{k_1x_2-k_2x_1}{k_1-k_2}, \dfrac{k_1y_2-k_2y_1}{k_1-k_2}\right)$	$\dfrac{x-x_1}{\cos\alpha}=\dfrac{y-y_1}{\sin\alpha}=r$ (say)
$d=\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$	$\dfrac{x}{a}+\dfrac{y}{b}=1$	$x\cos\alpha+y\sin\alpha=p$
$y=mx+c$	$y-y_1=m(x-x_1)$	$\theta=\tan^{-1}\left[\dfrac{m_2-m_1}{1+m_1m_2}\right]$
$\theta=\tan^{-1}\left[\dfrac{2\sqrt{h^2-ab}}{a+b}\right]$	$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}=0$	$\Delta=\dfrac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$

Circles

$(x-h)^2+(y-k)^2=r^2$ $\quad$ $x^2+y^2+2gx+2fy+c=0$

Equation of normal to a circle $(y-y_1)(x_1+g)=(x-x_1)(y_1+f)$

Equation of tangent to a circle $xx_1+yy_1+g(x+x_1)+f(y+y_1)+c=0$

Length of tangent to a circle from a point (x_1, y_1), $l=\sqrt{x_1^{\,2}+y_1^{\,2}+2gx_1+2fy_1+c}$

Parabola

$x^2=4ay$ $\quad$ $(x-h)^2=4a(y-k)$ $\quad$ $y^2=4ax$ $\quad$ $(y-k)^2=4a(x-h)$

Ellipse

$\dfrac{(x-h)^2}{a^2}+\dfrac{(y-k)^2}{b^2}=1$, $a>b$ $\quad$ $b^2=a^2(1-e^2)$ $\quad$ $c=ae$ $\quad$ $\dfrac{(y-k)^2}{a^2}+\dfrac{(x-h)^2}{b^2}=1$, $a>b$

Hyperbola

$\dfrac{(x-h)^2}{a^2}-\dfrac{(y-k)^2}{b^2}=1$ $\quad$ $b^2=a^2(e^2-1)$ $\quad$ $c=ae$ $\quad$ $\dfrac{(y-k)^2}{a^2}-\dfrac{(x-h)^2}{b^2}=1$

Translation and Rotation

$x=X+h$, $y=Y+k$ $\quad$ $X=x\cos\theta+y\sin\theta$, $Y=y\cos\theta-x\sin\theta$ $\quad$ $\tan 2\theta=\dfrac{2h}{a-b}$

Vectors

$\underline{u}.\underline{v}=|\underline{u}||\underline{v}|\cos\theta$ $\quad$ Area of a triangle $=\dfrac{1}{2}|\underline{u}\times\underline{v}|$ $\quad$ $\underline{u}\times\underline{v}=\left(|\underline{u}||\underline{v}|\sin\theta\right)\hat{\underline{n}}$ $\quad$ $\underline{r}=\dfrac{q\underline{a}+p\underline{b}}{p+q}$

$\left|\overrightarrow{P_1P_2}\right|=\sqrt{(x_2-x_1)^2+(y_2-y_1)^2+(z_2-z_1)^2}$ $\quad$ $\dfrac{1}{6}(\underline{u}\times\underline{v}).\underline{w}=\dfrac{1}{6}[\underline{u}\ \underline{v}\ \underline{w}]$ $\quad$ $\underline{u}.(\underline{v}\times\underline{w})=\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$

Some Trigonometric Identities

$\cos(\alpha\pm\beta)=\cos\alpha\cos\beta\mp\sin\alpha\sin\beta$

$\sin(\alpha\pm\beta)=\sin\alpha\cos\beta\pm\cos\alpha\sin\beta$

$\cos P+\cos Q=2\cos\dfrac{P+Q}{2}\cos\dfrac{P-Q}{2}$

$\cos P-\cos Q=-2\sin\dfrac{P+Q}{2}\sin\dfrac{P-Q}{2}$

$\sin P+\sin Q=2\sin\dfrac{P+Q}{2}\cos\dfrac{P-Q}{2}$

$\sin P-\sin Q=2\cos\dfrac{P+Q}{2}\sin\dfrac{P-Q}{2}$

$\sin 2\alpha=2\sin\alpha\cos\alpha$ $\quad$ $\cos 2\alpha=\cos^2\alpha-\sin^2\alpha$

1. Among the given functions, the odd function(s) is/ are

I. $f(x) = -\sqrt{x^2 - 1}$
II. $f(x) = -x^3$
III. $f(x) = x^3$

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

2. If x is measured in radian, then $\lim_{x \to 0}\left(\frac{\sin px}{x}\right)$ is

A. p
B. 0
C. 1
D. not defined

3. The value of x which does NOT belong to the domain of the real valued function

$f(x) = \sqrt{x^2 - 4}$ is

(**Note:** $x \in Z$)

A. 2
B. – 1
C. – 2
D. – 4

4. For the function $f(x) = x^2$ and $g(x) = (x+1)^2$, the value of $f \circ g(-1)$ equals

A. 0
B. 2
C. 4
D. 16

5. For $y = x^2$, when $x = 2$ and $\delta x = 0.1$, the value of δy is

A. 0.04
B. 0.41
C. 0.44
D. 8.40

6. $\frac{d}{dx}\left(a^{x} \times e^{2}\right)$ is equal to

A. $2e \times a^{x}$.
B. $e^{2} \times xa^{x-1}$.
C. $e^{2} \times a^{x} \times \ln a$.
D. $2e \times xa^{x-1} \times \ln a$.

7. The derivative of $\left(\ln \frac{a^{2}}{x}\right)$, with respect to *x*, is

A. $\frac{1}{x}$.
B. $-\frac{1}{x}$.
C. $\left(2a \ln a + \frac{1}{x}\right)$.
D. $\left(2a \ln a - \frac{1}{x}\right)$.

8. The slope of the tangent to the curve $y = x^{2} + 2x + 1$ at point $(2, 9)$ is

A. 4
B. 6
C. 7
D. 9

9. The derivative of $f(x) = \sin(\ln x)$, with respect to *x*, is

A. $\frac{\cos(\ln x)}{x}$.
B. $-\frac{\cos(\ln x)}{x}$.
C. $\cos\left(\frac{\ln x}{x}\right)$.
D. $-\cos(\ln x)$.

10. If $x = 2t$ and $y = t^2$, where t is the parameter, then $\frac{dy}{dx}$ is equal to

A. $4t$.
B. $\frac{1}{4t}$.
C. $\frac{1}{t}$.
D. t.

11. If $k''(x) = x - x^3$, where $x \in [-1.5, 1.5]$, then $k(x)$ will be maximum at

A. $x = 0$
B. $x = \frac{1}{2}$
C. $x = \sqrt{2}$
D. $x = -\sqrt{2}$

12. The derivative of $a^2 - \frac{1}{x}$, with respect to x, is

A. $\frac{1}{x^2}$.
B. $-\frac{1}{x^2}$.
C. $2a - \frac{1}{x^2}$.
D. $2a + \frac{1}{x^2}$.

13. If $\frac{3}{x-1}$ and $-\frac{1}{x-3}$ are the partial fractions of an algebraic expression, then the expression will be

A. $\frac{2x-8}{x^2-4x+3}$.
B. $\frac{2x+8}{x^2-4x+3}$.
C. $\frac{2x+8}{x^2+4x-3}$.
D. $\frac{2x-8}{x^2+4x-3}$.

14. The area bounded by the curve $y = 9 - x^2$ and the x-axis can be found by

A. $\int_{0}^{9}\left(9 - x^2\right)dx.$

B. $\int_{-9}^{9}\left(9 - x^2\right)dx.$

C. $\int_{-3}^{3}\left(9 - x^2\right)dx.$

D. $\int_{0}^{3}\left(9 - x^2\right)dx.$

15. The integral of $e^{a^2x+b^2}$, with respect to x, is

A. $e^{a^2x+b^2} + C.$

B. $e^{2ax+2b} + C.$

C. $\frac{1}{a^2}e^{a^2x+b^2} + C.$

D. $\frac{1}{a^2+b^2}e^{a^2x+b^2} + C.$

16. The integral of $\sqrt{ax-b}$, with respect to x, is

A. $\frac{2a(ax-b)^{\frac{3}{2}}}{3} + C.$

B. $\frac{3a(ax-b)^{\frac{3}{2}}}{2} + C.$

C. $\frac{2(ax-b)^{\frac{3}{2}}}{3a} + C.$

D. $\frac{3(ax-b)^{\frac{3}{2}}}{2a} + C.$

17. The integral of $\frac{e}{\sqrt{ax-b}}$, with respect to x, is

A. $\frac{\sqrt{(ax-b)}}{2ae} + C.$

B. $\frac{e\sqrt{(ax-b)}}{2a} + C.$

C. $\frac{e\sqrt{(ax-b)}}{a} + C.$

D. $\frac{2e\sqrt{(ax-b)}}{a} + C.$

18. The value of $\int_{1}^{e} \frac{dx}{x}$ is

A. 1
B. 0
C. -1
D. not defined

19. For the function $f(x) = x$, where $f(-x) = -f(x)$, the value of $\int_{-\pi}^{\pi} x\,dx$ is

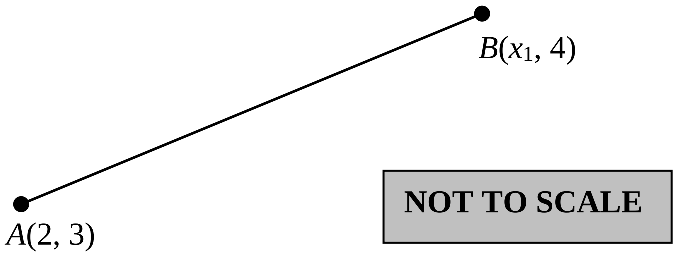
A. 0
B. $\frac{1}{2}$
C. π^2
D. $\frac{\pi^2}{2}$

20. The solution of the differential equation $x\cos y\frac{dy}{dx} = 1$ is

A. $\sin y = \ln x + C.$
B. $-\sin y = \ln x + C.$
C. $\sin y = \frac{x^2}{2} + C.$
D. $-\sin y = \frac{x^2}{2} + C.$

21. In the given diagram, the slope of the line segment AB is $\frac{1}{3}$. The value of x_1 will be

A. -1
B. $\frac{7}{3}$
C. $\frac{5}{3}$
D. 5

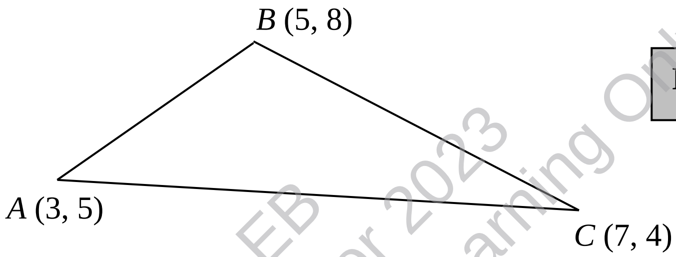


22. The line $2x + y = 1$ is perpendicular to the line l. If the line l is passing through the point (0, 0), then its equation will be

A. $y = 2x$.
B. $x = 2y$.
C. $y = -2x$.
D. $x = -2y$.

23. In the given triangle *ABC*, the slope of the median intersecting the side *BC* is

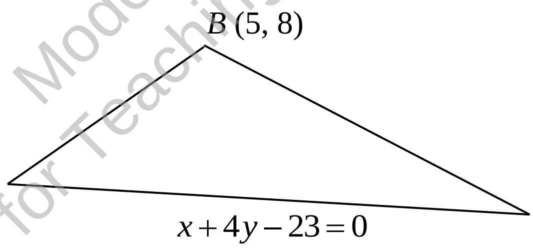
A. -2
B. $-\frac{1}{3}$
C. $\frac{1}{3}$
D. 2



NOT TO SCALE

24. In the given triangle *ABC*, the length of altitude from vertex *B* to the side *AC* is

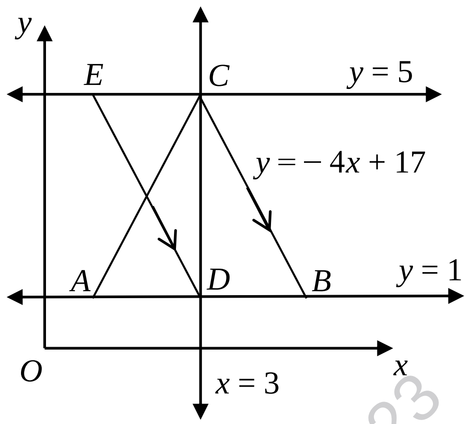
A. $\frac{14}{\sqrt{17}}$.
B. $\frac{14}{\sqrt{89}}$.
C. $\frac{5}{\sqrt{17}}$.
D. $\frac{5}{\sqrt{89}}$.



NOT TO SCALE

Use the given information to answer Q.25, Q.26 and Q.27.

In the given diagram, triangle *ABC* is an isosceles triangle. The equation of the line *AB* is $y = 1$, line *EC* is $y = 5$ and line *CB* is $y = -4x + 17$. However, line *CB* is parallel to line *ED*.



NOT TO SCALE

25. The altitude of the triangle *ABC* is

    A. 3 units.
    B. 4 units.
    C. 5 units.
    D. 6 units.

26. If the equation of the line *ED* is $y = mx + 13$, then the value of *m* will be

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

27. The distance of line *CD* from *y*-axis is

    A. 1 unit.
    B. 3 units.
    C. 4 units.
    D. 5 units.

28. The two parallel lines *P* and *Q* are given as $3y = 6$ and $y = -8$. The perpendicular distance between *P* and *Q* is

    A. 2 units.
    B. 6 units.
    C. 10 units.
    D. 14 units.

29. If the vertices $O(0, 0)$, $P(0, a)$ and $Q(a, 0)$ form a triangle, then the area of the triangle *OPQ* is

A. a^2 square units.
B. $\frac{a^2}{2}$ square units.
C. $2a^2$ square units.
D. $\frac{1}{2a^2}$ square units.

30. In a Cartesian plane, two points $A\ (0, -1)$ and $B\ (-1, 0)$ are given. If point $P(x, y)$ divides the line segment *AB* such that *AP*:*PB* = 2:1, then *x* is equal to

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

31. The given table shows the information of a factory that produces jackets.

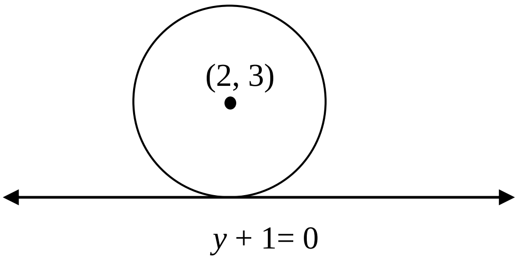
	Small Jacket	**Medium Jacket**
Quantity	x	y
Time Required (min)	50	60
Cost per Jacket (Rs)	400	500

If the total labour hours available per day are at most 200 hours, then

the condition for the time constraint will be

A. $60x + 50y \leq 12{,}000$
B. $50x + 60y \leq 12{,}000$
C. $60x + 50y \geq 12{,}000$
D. $50x + 60y \geq 12{,}000$

32. In the given diagram, a circle has the centre at point (2, 3) and touches the line $y + 1 = 0$. Its radius will be



NOT TO SCALE

A. $\frac{3}{\sqrt{13}}$ units.

B. $\frac{4}{\sqrt{13}}$ units.

C. 3 units.

D. 4 units.

33. The centre of the circle represented by the equation $(2x+3)^2 + (2y-4)^2 = 16$ is

A. $\left(-\frac{3}{4}, 1\right)$.

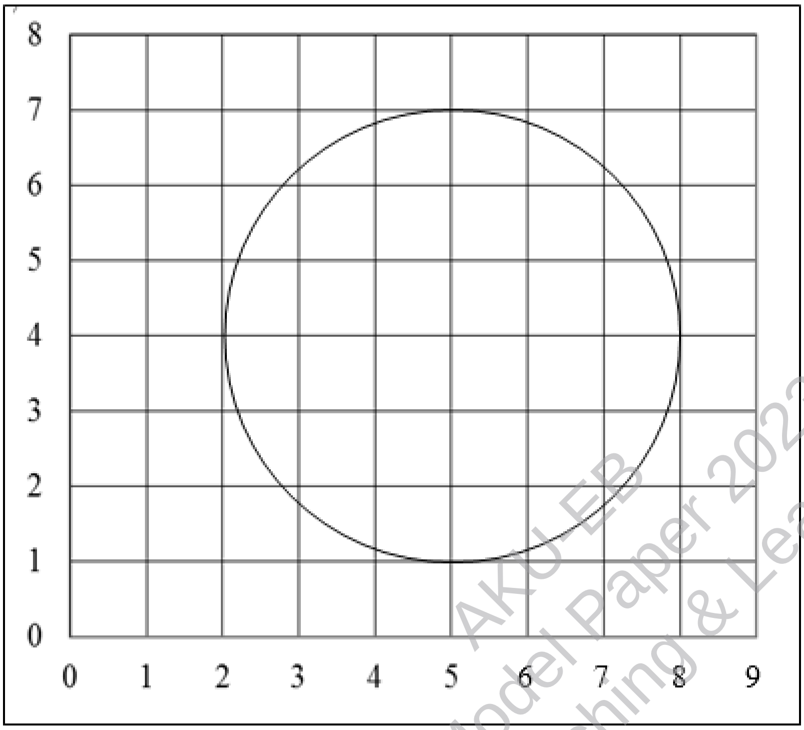
B. $\left(\frac{3}{4}, -1\right)$.

C. $\left(-\frac{3}{2}, 2\right)$.

D. $\left(\frac{3}{2}, -2\right)$.

Use the given information to answer Q.34 and Q.35.

The given figure shows a circle whose equation is $x^2 + y^2 + 2gx + 2fy + c = 0$.



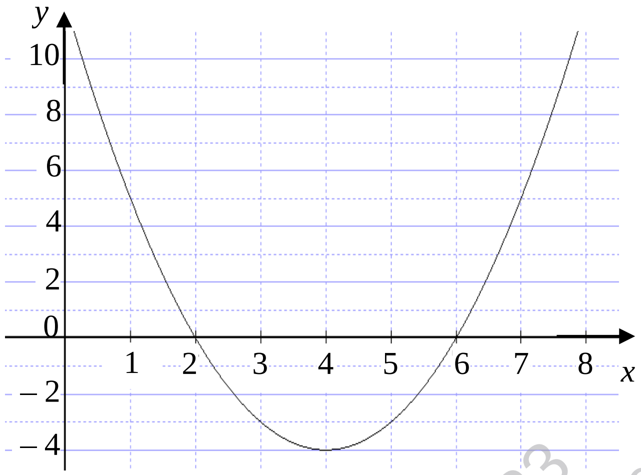
34. If the value of *c* is 32, then the equation of the circle is expressed as

A. $x^2 + y^2 - 10x - 8y + 32 = 0$
B. $x^2 + y^2 + 8x + 10y + 32 = 0$
C. $x^2 + y^2 + 10x + 8y + 32 = 0$
D. $x^2 + y^2 - 8x - 10y + 32 = 0$

35. One of the points that lies on the given circle is

A. (5, 4).
B. (4, 4).
C. (7, 5).
D. (5, 7).

Use the given diagram to answer Q.36, Q.37 and Q.38.



36. The equation of the parabola is

A. $y+4=(x-4)^2$
B. $x-4=(y-4)^2$
C. $y-4=(x+4)^2$
D. $x+4=(y+4)^2$

37. The coordinates of the focus of the parabola is

A. $\left(-\frac{17}{4}, -4\right)$.
B. $\left(-\frac{15}{4}, -4\right)$.
C. $\left(4, -\frac{17}{4}\right)$.
D. $\left(4, -\frac{15}{4}\right)$.

38. The equation of the directrix of the parabola is

A. $x=-\frac{17}{4}$.
B. $x=-\frac{15}{4}$.
C. $y=-\frac{17}{4}$.
D. $y=-\frac{15}{4}$.

39. The major axis of the ellipse $2x^2 + 8y^2 - 4 = 0$ is along the

A. x-axis and has a length of 2 units.
B. y-axis and has a length of 2 units.
C. x-axis and has a length of $2\sqrt{2}$ units.
D. y-axis and has a length of $2\sqrt{2}$ units.

40. The vertices and co-vertices of an ellipse are $(\pm 5, 0)$ and $(0, \pm 3)$ respectively. The equation of the ellipse is

A. $\dfrac{x^2}{3} + \dfrac{y^2}{5} = 1$
B. $\dfrac{x^2}{5} + \dfrac{y^2}{3} = 1$
C. $\dfrac{x^2}{9} + \dfrac{y^2}{25} = 1$
D. $\dfrac{x^2}{25} + \dfrac{y^2}{9} = 1$

41. The distance between foci of a hyperbola is $8\sqrt{2}$ and the length of its semi transverse axis is 4. The eccentricity of the hyperbola will be

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

42. If the eccentricity of a conic is greater than 1, then we have

A. $a^2 = e^2 - b^2$.
B. $b^2 = a^2 - e^2$.
C. $b^2 = a^2(e^2 - 1)$.
D. $a^2 = b^2(e^2 - 1)$.

43. A hyperbola satisfies the given conditions.

   I. Centre at $(1, -1)$
   II. Length of semi conjugate axis is 3 units
   III. Length of semi transverse axis is 4 units
   IV. Conjugate axis is along x-axis

   The equation of the hyperbola will be

   A. $\dfrac{(y-1)^2}{9} - \dfrac{(x+1)^2}{16} = 1$
   B. $\dfrac{(y+1)^2}{16} - \dfrac{(x-1)^2}{9} = 1$
   C. $\dfrac{(x+1)^2}{16} - \dfrac{(y-1)^2}{9} = 1$
   D. $\dfrac{(x-1)^2}{9} - \dfrac{(y+1)^2}{16} = 1$

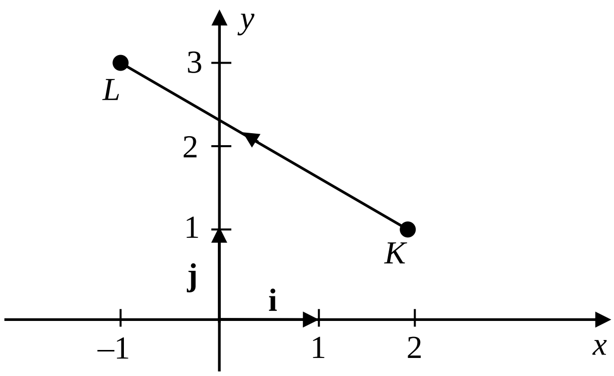
44. If x-axis and y-axis are rotated through an angle of 25°, then x-coordinate of the point (6, 8) will become

   (**Note**: The answer is given in TWO decimal places.)

   A. 8.82
   B. 9.79
   C. 2.06
   D. 4.71

45. The geometrical representation of vector KL is shown in the given diagram.
   The vector KL will be

   A. $-\mathbf{i}+2\mathbf{j}$.
   B. $\mathbf{i}+3\mathbf{j}$.
   C. $-3\mathbf{i}+2\mathbf{j}$.
   D. $2\mathbf{i}-3\mathbf{j}$.



46. If $\overrightarrow{MP} = -(-3\mathbf{i})$ and $\overrightarrow{MO} = 3\mathbf{j}+3\mathbf{i}$, then the position vector of P will be

   A. $3\mathbf{j}$.
   B. $-3\mathbf{j}$.
   C. $-6\mathbf{i}+3\mathbf{j}$.
   D. $6\mathbf{i}-3\mathbf{j}$.

47. Which of the following two vectors give the dot product 48?

A. 6**i** and 8**j**.
B. – 12**i** and – 4**j**.
C. 6**i**+3**j** and 14**j**.
D. 5**i**+**j** and 9**i**+3**j**.

48. Which of the following statements is CORRECT for $\mathbf{a} - 2\mathbf{b} = \mathbf{0}$ and $\mathbf{c} + 3\mathbf{a} = \mathbf{0}$?

(**Note:** **a**, **b**, and **c** are non-zero vectors and **0** is a zero vector.)

I. Vectors **a** and **b** are parallel and have opposite direction.
II. Vectors **a** and **c** are parallel and have same direction.
III. Vectors **a**, **b** and **c** are parallel to each other.

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

49. If a vector **w** is perpendicular to each of the vectors **u** and **v**, then **w** will be determined by the

A. dot product of **u** and **v**.
B. unit vectors of **u** and **v**.
C. projection of **u** along **v**.
D. cross product of **u** and **v**.

50. The direction of cosine of the vector $2\boldsymbol{i} + \boldsymbol{j} - 2\boldsymbol{k}$ with respect to *z*-axis will be

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

END OF PAPER

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