EXPRESSWALA ACADEMY

Maths 1A: Multiple and Submultiple Angles

MCQ Test, Set 09

Time: 30 minutes | Maximum marks: 25

Name: _____ Class: _____ Date: _____

1. There are 25 questions. Each has exactly one correct answer: choose A, B, C or D.
2. Each correct answer carries 1 mark. There is no negative marking.
3. The key sheet and worked solutions are at the end of this test.

1. If $\tan A = \frac{3}{5}$, then $\cos 2A =$

A. $-\frac{8}{17}$ **B.** $\frac{8}{17}$ **C.** $\frac{17}{8}$ **D.** $\frac{15}{17}$

2. If $\cos A = -\frac{24}{25}$ and $\frac{\pi}{2} < A < \pi$, then $\sin 2A =$

A. $-\frac{336}{625}$ **B.** $\frac{336}{625}$ **C.** $\frac{527}{625}$ **D.** $-\frac{48}{25}$

3. $\cos^2 157\frac{1}{2}^\circ =$

A. $\frac{2-\sqrt{2}}{4}$ **B.** $\frac{2-\sqrt{2}}{2}$ **C.** $\frac{\sqrt{2}}{4}$ **D.** $\frac{2+\sqrt{2}}{4}$

4. If $\sin A = -\frac{1}{3}$, then $\sin 3A =$

A. $-\frac{31}{27}$ **B.** $\frac{23}{27}$ **C.** $-\frac{26}{27}$ **D.** $-\frac{23}{27}$

5. If $\sin A = \frac{1}{5}$, then $\sin 3A =$

A. $\frac{71}{125}$ **B.** $\frac{79}{125}$ **C.** $\frac{74}{125}$ **D.** $-\frac{71}{125}$

6. If $\cos A = \frac{1}{5}$ and $\pi < A < 2\pi$, then $\cos \frac{A}{2} =$

A. $-\frac{\sqrt{10}}{5}$ **B.** $\frac{3}{5}$ **C.** $-\frac{\sqrt{15}}{5}$ **D.** $\frac{\sqrt{15}}{5}$

7. If $\tan \frac{A}{2} = \frac{4}{7}$, then $\tan A =$

A. $\frac{56}{65}$ **B.** $\frac{56}{33}$ **C.** $-\frac{56}{33}$ **D.** $\frac{28}{33}$

8. $\frac{\sin 3A}{\sin A} - \frac{\cos 3A}{\cos A} =$

A. $4\cos 2A$ **B.** 1 **C.** 0 **D.** 2

9. $\sin 36^\circ =$

A. $\frac{\sqrt{10+2\sqrt{5}}}{4}$ **B.** $-\frac{\sqrt{10-2\sqrt{5}}}{4}$

C. $-\frac{\sqrt{10+2\sqrt{5}}}{4}$ **D.** $\frac{\sqrt{10-2\sqrt{5}}}{4}$

10. $\sin 18^\circ + \cos 72^\circ =$

A. $\frac{1+\sqrt{5}}{2}$ **B.** $\frac{1-\sqrt{5}}{2}$ **C.** $\frac{\sqrt{5}-1}{2}$ **D.** $\sqrt{5}-1$

11. $\cot 82\frac{1}{2}^\circ =$

A. $(\sqrt{3}-\sqrt{2})(\sqrt{2}-1)$ **B.** $(\sqrt{3}+\sqrt{2})(\sqrt{2}-1)$

C. $\sqrt{2}-1$ **D.** $(\sqrt{3}+\sqrt{2})(\sqrt{2}+1)$

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12. $\tan 52\frac{1}{2}^\circ \tan 7\frac{1}{2}^\circ =$

A. $6-4\sqrt{2}$ **B.** $3-2\sqrt{2}$ **C.** $\frac{3-2\sqrt{2}}{2}$ **D.** $2\sqrt{2}-3$

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13. $\sin^6 105^\circ + \cos^6 105^\circ =$

A. $\frac{11}{8}$ **B.** $\frac{5}{8}$ **C.** $\frac{3}{16}$ **D.** $\frac{13}{16}$

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14. The least value of $8\left(\sin^4\theta+\cos^4\theta\right)$ is

A. 6 **B.** 16 **C.** 4 **D.** 8

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15. $\cot 7\frac{1}{2}^\circ + \tan 7\frac{1}{2}^\circ =$

A. $2\sqrt{6}-2\sqrt{2}$ **B.** $2\sqrt{2}+2\sqrt{6}$ **C.** $\sqrt{2}+\sqrt{6}$ **D.** $4+2\sqrt{3}$

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16. $\cos\frac{5\pi}{33}\cos\frac{10\pi}{33}\cos\frac{20\pi}{33}\cos\frac{40\pi}{33}\cos\frac{80\pi}{33} =$

A. $\frac{1}{64}$ **B.** $-\frac{1}{32}$ **C.** $\frac{1}{16}$ **D.** $\frac{1}{32}$

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17. $\left(2\cos\frac{2\pi}{5}-1\right)\left(2\cos\frac{4\pi}{5}-1\right) =$

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

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18. $\sin 45^\circ + \sin 105^\circ + \sin 165^\circ + \sin 225^\circ + \sin 285^\circ =$

A. $\frac{4+\sqrt{6}-\sqrt{2}}{4}$ **B.** $\frac{\sqrt{6}}{2}-\frac{\sqrt{2}}{2}$

C. $\frac{\sqrt{6}}{4}-\frac{\sqrt{2}}{4}$ **D.** $\frac{\sqrt{2}}{4}-\frac{\sqrt{6}}{4}$

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19. $\cos 12^\circ + \cos 36^\circ + \cos 60^\circ + \cdots + \cos 156^\circ =$

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

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20. $\frac{\tan\frac{\pi}{7}+\tan\frac{2\pi}{7}+\tan\frac{4\pi}{7}}{\cos\frac{2\pi}{7}\cos\frac{4\pi}{7}\cos\frac{6\pi}{7}} =$

A. $-16\sqrt{7}$ **B.** $-8\sqrt{7}$ **C.** $1-8\sqrt{7}$ **D.** $8\sqrt{7}$

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21. $\cos 5^\circ \cos 55^\circ \cos 115^\circ =$

A. $-\frac{\sqrt{2}}{16}-\frac{\sqrt{6}}{16}$ **B.** $-\frac{\sqrt{2}}{4}-\frac{\sqrt{6}}{4}$

C. $\frac{\sqrt{6}}{16}-\frac{\sqrt{2}}{16}$ **D.** $-\frac{\sqrt{2}}{32}-\frac{\sqrt{6}}{32}$

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22. $\cos^2 5^\circ + \cos^2 55^\circ - \cos 5^\circ \cos 55^\circ =$

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

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23. If $\frac{x}{y}=\frac{\tan 120^\circ}{\tan 30^\circ}$, then $\frac{x+y}{x-y} =$

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

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24. $\sqrt{1-\sin 380^\circ} =$

A. $\cos 190^\circ + \sin 190^\circ$ **B.** $-(\cos 190^\circ + \sin 190^\circ)$

C. $-(\cos 190^\circ - \sin 190^\circ)$ **D.** $\cos 190^\circ - \sin 190^\circ$

25. $\sqrt{1-\sin 420^\circ} =$

A. $-(\cos 210^\circ - \sin 210^\circ)$

B. $\cos 210^\circ - \sin 210^\circ$

C. $\cos 210^\circ + \sin 210^\circ$

D. $-(\cos 210^\circ + \sin 210^\circ)$

Key sheet

1. B	**2.** A	**3.** D	**4.** D	**5.** A
6. C	**7.** B	**8.** D	**9.** D	**10.** C
11. A	**12.** B	**13.** D	**14.** C	**15.** B
16. D	**17.** A	**18.** C	**19.** D	**20.** B
21. A	**22.** C	**23.** B	**24.** C	**25.** A

Solutions

1. If $\tan A = \frac{3}{5}$, then $\cos 2A =$

$\cos 2A = \frac{1-\tan^2 A}{1+\tan^2 A}$

$= \frac{8}{17}$

Ans: (B) $\frac{8}{17}$

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2. If $\cos A = -\frac{24}{25}$ and $\frac{\pi}{2} < A < \pi$, then $\sin 2A =$

$\sin A = \sqrt{1-\cos^2 A} = \frac{7}{25}$ ($\sin A$ is positive in this quadrant)

$\sin 2A = 2\sin A \cos A = -\frac{336}{625}$

Ans: (A) $-\frac{336}{625}$

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3. $\cos^2 157\frac{1}{2}^\circ =$

$\cos^2 A = \frac{1+\cos 2A}{2}$

$\cos^2 157\frac{1}{2}^\circ = \frac{1+\cos 315^\circ}{2}$

$\cos 315^\circ = \frac{\sqrt{2}}{2}$

$= \frac{2+\sqrt{2}}{4}$

Ans: (D) $\frac{2+\sqrt{2}}{4}$

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4. If $\sin A = -\frac{1}{3}$, then $\sin 3A =$

$\sin 3A = 3\sin A - 4\sin^3 A$

$= 3(-\frac{1}{3}) - 4(-\frac{1}{3})^3$

$= -\frac{23}{27}$

Ans: (D) $-\frac{23}{27}$

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5. If $\sin A = \frac{1}{5}$, then $\sin 3A =$

$\sin 3A = 3\sin A - 4\sin^3 A$

$= 3(\frac{1}{5}) - 4(\frac{1}{5})^3$

$= \frac{71}{125}$

Ans: (A) $\frac{71}{125}$

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6. If $\cos A = \frac{1}{5}$ and $\pi < A < 2\pi$, then $\cos \frac{A}{2} =$

Here $\frac{\pi}{2} < \frac{A}{2} < \pi$.

$\cos \frac{A}{2} = -\frac{\sqrt{15}}{5}$

Ans: (C) $-\frac{\sqrt{15}}{5}$

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7. If $\tan \frac{A}{2} = \frac{4}{7}$, then $\tan A =$

$\tan A = \frac{2\tan \frac{A}{2}}{1-\tan^2 \frac{A}{2}}$

$= \frac{56}{33}$

Ans: (B) $\frac{56}{33}$

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8. $\frac{\sin 3A}{\sin A} - \frac{\cos 3A}{\cos A} =$

$= (3 - 4\sin^2 A) - (4\cos^2 A - 3) = 6 - 4 = 2$

Ans: (D) 2

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9. $\sin 36^\circ =$

$\sin 36^\circ = \frac{\sqrt{10-2\sqrt{5}}}{4}$

Ans: (D) $\frac{\sqrt{10-2\sqrt{5}}}{4}$

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10. $\sin 18^\circ + \cos 72^\circ =$

$\sin 18^\circ = \frac{\sqrt{5}-1}{4},\ \cos 72^\circ = \frac{\sqrt{5}-1}{4}$

$\sin 18^\circ + \cos 72^\circ = \frac{\sqrt{5}-1}{2}$

Ans: (C) $\frac{\sqrt{5}-1}{2}$

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11. $\cot 82\frac{1}{2}^\circ =$

$\tan\frac{A}{2} = \frac{1-\cos A}{\sin A}$ with the half of a known angle, simplified.

$\cot 82\frac{1}{2}^\circ = (\sqrt{3}-\sqrt{2})(\sqrt{2}-1)$

Ans: (A) $(\sqrt{3}-\sqrt{2})(\sqrt{2}-1)$

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12. $\tan 52\frac{1}{2}^\circ\ \tan 7\frac{1}{2}^\circ =$

$\tan 52\frac{1}{2}^\circ = (\sqrt{3}+\sqrt{2})(\sqrt{2}-1),\ \tan 7\frac{1}{2}^\circ = (\sqrt{3}-\sqrt{2})(\sqrt{2}-1)$

$\tan 52\frac{1}{2}^\circ\ \tan 7\frac{1}{2}^\circ = 3 - 2\sqrt{2}$

Ans: (B) $3 - 2\sqrt{2}$

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13. $\sin^6 105^\circ + \cos^6 105^\circ =$

$\sin^6\theta + \cos^6\theta = 1 - \frac{3}{4}\sin^2 2\theta$

$\sin 210^\circ = -\frac{1}{2}$

$\sin^6 105^\circ + \cos^6 105^\circ = 1 - \frac{3}{4}\cdot\frac{1}{4} = \frac{13}{16}$

Ans: (D) $\frac{13}{16}$

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14. The least value of $8\left(\sin^4\theta + \cos^4\theta\right)$ is

$\sin^4\theta + \cos^4\theta = 1 - \frac{1}{2}\sin^2 2\theta$

$0 \le \sin^2 2\theta \le 1$, so the least value is 4.

Ans: (C) 4

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15. $\cot 7\frac{1}{2}^\circ + \tan 7\frac{1}{2}^\circ =$

$\cot A + \tan A = 2\operatorname{cosec} 2A$

With $A = 7\frac{1}{2}^\circ$: $\cot 7\frac{1}{2}^\circ + \tan 7\frac{1}{2}^\circ = 2\sqrt{2} + 2\sqrt{6}$

Ans: (B) $2\sqrt{2} + 2\sqrt{6}$

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16. $\cos\frac{5\pi}{33}\cos\frac{10\pi}{33}\cos\frac{20\pi}{33}\cos\frac{40\pi}{33}\cos\frac{80\pi}{33} =$

This is $\cos\theta\cos 2\theta\cdots\cos 2^4\theta = \frac{\sin 2^5\theta}{2^5\sin\theta}$ with $\theta = \frac{5\pi}{33}$.

$\sin 2^5\theta = \sin\theta$

$\text{Value} = \frac{1}{32}$

Ans: (D) $\frac{1}{32}$

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17. $\left(2\cos\frac{2\pi}{5}-1\right)\left(2\cos\frac{4\pi}{5}-1\right) =$

$(2\cos\theta-1)(2\cos 2\theta-1)\cdots(2\cos 2\theta-1) = \frac{2\cos 2^2\theta+1}{2\cos\theta+1}$ with $\theta = \frac{2\pi}{5}$

$2^2\theta$ differs from $\pm\theta$ by a multiple of 2π, so $\cos 2^2\theta = \cos\theta$ and the value is 1.

Ans: (A) 1

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18. $\sin 45^\circ + \sin 105^\circ + \sin 165^\circ + \sin 225^\circ + \sin 285^\circ =$

$a_1 = 45^\circ$, $d = 60^\circ$, $n = 5$, $a_n = 285^\circ$

$\text{Sum} = \frac{\sin\left(\frac{a_1+a_n}{2}\right)\sin\frac{nd}{2}}{\sin\frac{d}{2}} = \frac{\sin 165^\circ\ \sin 150^\circ}{\sin 30^\circ}$

$= \frac{\sqrt{6}}{4} - \frac{\sqrt{2}}{4}$

Ans: (C) $\frac{\sqrt{6}}{4} - \frac{\sqrt{2}}{4}$

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19. $\cos 12^\circ + \cos 36^\circ + \cos 60^\circ + \cdots + \cos 156^\circ =$

$a_1 = 12^\circ$, $d = 24^\circ$, $n = 7$, $a_n = 156^\circ$

$\text{Sum} = \frac{\cos\left(\frac{a_1+a_n}{2}\right)\sin\frac{nd}{2}}{\sin\frac{d}{2}} = \frac{\cos 84^\circ\ \sin 84^\circ}{\sin 12^\circ}$

The angles in the numerator add to π, so $\cos x\sin x = \frac{1}{2}\sin 2x$ and $\sin(\pi - y) = \sin y$ cancel the denominator.

$= \frac{1}{2}$

Ans: (D) $\frac{1}{2}$

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20. $\frac{\tan\frac{\pi}{7}+\tan\frac{2\pi}{7}+\tan\frac{4\pi}{7}}{\cos\frac{2\pi}{7}\cos\frac{4\pi}{7}\cos\frac{6\pi}{7}} =$

Known results: $\tan\frac{\pi}{7}+\tan\frac{2\pi}{7}+\tan\frac{4\pi}{7} = -\sqrt{7}$ and $\cos\frac{2\pi}{7}\cos\frac{4\pi}{7}\cos\frac{6\pi}{7} = \frac{1}{8}$

$\text{Value} = -8\sqrt{7}$

Ans: (B) $-8\sqrt{7}$

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21. $\cos 5^\circ\cos 55^\circ\cos 115^\circ =$

$\cos\theta\cos(60^\circ-\theta)\cos(60^\circ+\theta) = \frac{1}{4}\cos 3\theta$

With $\theta = 55^\circ$: value $= -\frac{\sqrt{2}}{16} - \frac{\sqrt{6}}{16}$

Ans: (A) $-\frac{\sqrt{2}}{16} - \frac{\sqrt{6}}{16}$

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22. $\cos^2 5^\circ + \cos^2 55^\circ - \cos 5^\circ\ \cos 55^\circ =$

$A + B = 60^\circ \Rightarrow \cos^2 A + \cos^2 B - \cos A\cos B = \frac{3}{4}$

Here the two angles add to 60°, so the value is $\frac{3}{4}$.

Ans: (C) $\frac{3}{4}$

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23. If $\frac{x}{y} = \frac{\tan 120^\circ}{\tan 30^\circ}$, then $\frac{x+y}{x-y} =$

$\frac{x+y}{x-y} = \frac{\tan A + \tan B}{\tan A - \tan B} = \frac{\sin(A+B)}{\sin(A-B)}$

$= \frac{\sin 150^\circ}{\sin 90^\circ} = \frac{1}{2}$

Ans: (B) $\frac{1}{2}$

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24. $\sqrt{1 - \sin 380^\circ} =$

$\sqrt{1 - \sin A} = \left|\cos \frac{A}{2} - \sin \frac{A}{2}\right|$

$\frac{A}{2} = 190^\circ$, where $\cos \frac{A}{2} - \sin \frac{A}{2}$ is negative.

Ans: (C) $-(\cos 190^\circ - \sin 190^\circ)$

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25. $\sqrt{1 - \sin 420^\circ} =$

$\sqrt{1 - \sin A} = \left|\cos \frac{A}{2} - \sin \frac{A}{2}\right|$

$\frac{A}{2} = 210^\circ$, where $\cos \frac{A}{2} - \sin \frac{A}{2}$ is negative.

Ans: (A) $-(\cos 210^\circ - \sin 210^\circ)$
