EXPRESSWALA ACADEMY

Maths 1A: Multiple and Submultiple Angles

MCQ Test, Set 05

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 $\sin 2A =$

A. $\frac{8}{17}$ **B.** $\frac{15}{17}$ **C.** $\frac{15}{34}$ **D.** $\frac{15}{8}$

2. If $\sin A = \frac{24}{25}$ and A is acute, then $\cos 2A =$

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

3. $\tan^2 255^\circ =$

A. $\frac{2+\sqrt{3}}{2}$ **B.** $\frac{2+\sqrt{3}}{4}$ **C.** $7 + 4\sqrt{3}$ **D.** $-\frac{\sqrt{3}}{4}$

4. If $\tan A = \frac{7}{6}$, then $\tan 3A =$

A. $\frac{413}{1098}$ **B.** $-\frac{413}{666}$ **C.** $-\frac{1099}{666}$ **D.** $-\frac{42}{37}$

5. If $\cos A = -\frac{6}{7}$, then $\cos 3A =$

A. $\frac{18}{343}$ **B.** $-\frac{570}{343}$ **C.** $-\frac{1746}{343}$ **D.** $-\frac{18}{343}$

6. If $\cos A = \frac{1}{4}$ and $0 < A < \pi$, then $\cos \frac{A}{2} =$

A. $\frac{\sqrt{6}}{4}$ **B.** $\frac{5}{8}$ **C.** $-\frac{\sqrt{10}}{4}$ **D.** $\frac{\sqrt{10}}{4}$

7. If $\tan \frac{A}{2} = \frac{5}{7}$, then $\sin A =$

A. $\frac{12}{37}$ **B.** $\frac{35}{74}$ **C.** $\frac{35}{37}$ **D.** $\frac{35}{12}$

8. $\frac{\sin A}{1-\cos A} =$

A. $\cot \frac{A}{2}$ **B.** $2\cot \frac{A}{2}$
C. $\cot A$ **D.** $\tan \frac{A}{2}$

9. $\sin 54^\circ =$

A. $-\frac{\sqrt{5}-1}{4}$ **B.** $\frac{\sqrt{5}+1}{4}$ **C.** $-\frac{\sqrt{5}+1}{4}$ **D.** $\frac{\sqrt{5}-1}{4}$

10. $4\cos 36^\circ \sin 54^\circ =$

A. $\frac{3+\sqrt{5}}{2}$ **B.** $3 + \sqrt{5}$ **C.** $\frac{3-\sqrt{5}}{2}$ **D.** $-\frac{3+\sqrt{5}}{2}$

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

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

12. $\tan 82\frac{1}{2}^\circ \tan 67\frac{1}{2}^\circ =$

A. $-4-3\sqrt{2}-3\sqrt{3}-2\sqrt{6}$ **B.** $8+4\sqrt{6}+6\sqrt{2}+6\sqrt{3}$

C. $4+2\sqrt{6}+3\sqrt{2}+3\sqrt{3}$ **D.** $\frac{4+2\sqrt{6}+3\sqrt{2}+3\sqrt{3}}{2}$

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13. $\sin^2 7\frac{1}{2}^\circ + \cos^4 7\frac{1}{2}^\circ =$

A. $\frac{6+\sqrt{3}}{8}$ **B.** $\frac{14+\sqrt{3}}{16}$

C. $\frac{2-\sqrt{3}}{16}$ **D.** $\frac{16+\sqrt{2}-\sqrt{6}}{16}$

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14. The least value of $3\left(\sin^4\theta+\cos^4\theta\right)$ is

A. $\frac{3}{2}$ **B.** $\frac{9}{4}$ **C.** 3 **D.** 6

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15. $\tan 75^\circ - \tan 15^\circ =$

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

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16. $\cos\frac{\pi}{33}\cos\frac{2\pi}{33}\cos\frac{4\pi}{33}\cos\frac{8\pi}{33}\cos\frac{16\pi}{33} =$

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

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17. $\tan\frac{5\pi}{96}\left(1+\sec\frac{5\pi}{48}\right)\left(1+\sec\frac{5\pi}{24}\right)\left(1+\sec\frac{5\pi}{12}\right) =$

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

C. $\sqrt{3}+\sqrt{6}-2-\sqrt{2}$ **D.** $-\frac{\sqrt{3}}{3}$

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18. $\sin 15^\circ + \sin 30^\circ + \sin 45^\circ + \cdots + \sin 165^\circ =$

A. $\cot 15^\circ$ **B.** $\tan 7\frac{1}{2}^\circ$

C. $2\cot 7\frac{1}{2}^\circ$ **D.** $\cot 7\frac{1}{2}^\circ$

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19. $\sin 15^\circ + \sin 45^\circ + \sin 75^\circ + \sin 105^\circ =$

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

C. $\frac{4+3\sqrt{2}+3\sqrt{6}}{4}$ **D.** $\frac{3\sqrt{2}+3\sqrt{6}}{4}$

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20. $\left(\tan\frac{\pi}{7}\tan\frac{2\pi}{7}\tan\frac{4\pi}{7}\right)^2 =$

A. 7 **B.** -7 **C.** 8 **D.** 14

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21. $\cos^2 110^\circ + \cos^2 50^\circ - \cos 110^\circ \cos 50^\circ =$

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

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22. $\sin^2 5^\circ + \sin^2 55^\circ + \sin^2 65^\circ =$

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

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23. If $\frac{x}{y} = \frac{\tan 60^\circ}{\tan 30^\circ}$, then $\frac{x+y}{x-y} =$

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

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24. $\sqrt{1-\sin 520^\circ} =$

A. $-(\cos 260^\circ + \sin 260^\circ)$ **B.** $\cos 260^\circ + \sin 260^\circ$

C. $\cos 260^\circ - \sin 260^\circ$ **D.** $-(\cos 260^\circ - \sin 260^\circ)$

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25. $\sqrt{1-\sin 700^\circ} =$

A. $-(\cos 350^\circ + \sin 350^\circ)$

B. $\cos 350^\circ - \sin 350^\circ$

C. $\cos 350^\circ + \sin 350^\circ$

D. $-(\cos 350^\circ - \sin 350^\circ)$

Key sheet

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

Solutions

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

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

$= \frac{15}{17}$

Ans: (B) $\frac{15}{17}$

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2. If $\sin A = \frac{24}{25}$ and A is acute, then $\cos 2A =$

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

$\cos 2A = \cos^2 A - \sin^2 A = -\frac{527}{625}$

Ans: (D) $-\frac{527}{625}$

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3. $\tan^2 255^\circ =$

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

$\tan^2 255^\circ = \frac{1-\cos 510^\circ}{1+\cos 510^\circ}$

$\cos 510^\circ = -\frac{\sqrt{3}}{2}$

$= 7 + 4\sqrt{3}$

Ans: (C) $7 + 4\sqrt{3}$

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4. If $\tan A = \frac{7}{6}$, then $\tan 3A =$

$\tan 3A = \frac{3\tan A - \tan^3 A}{1-3\tan^2 A}$

$= \frac{3(\frac{7}{6}) - (\frac{7}{6})^3}{1-3(\frac{7}{6})^2}$

$= -\frac{413}{666}$

Ans: (B) $-\frac{413}{666}$

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5. If $\cos A = -\frac{6}{7}$, then $\cos 3A =$

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

$= 4(-\frac{6}{7})^3 - 3(-\frac{6}{7})$

$= \frac{18}{343}$

Ans: (A) $\frac{18}{343}$

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6. If $\cos A = \frac{1}{4}$ and $0 < A < \pi$, then $\cos \frac{A}{2} =$

Here $0 < \frac{A}{2} < \frac{\pi}{2}$.

$\cos \frac{A}{2} = \frac{\sqrt{10}}{4}$

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

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7. If $\tan \frac{A}{2} = \frac{5}{7}$, then $\sin A =$

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

$= \frac{35}{37}$

Ans: (C) $\frac{35}{37}$

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8. $\frac{\sin A}{1-\cos A} =$

$= \frac{2\sin\frac{A}{2}\cos\frac{A}{2}}{2\sin^2\frac{A}{2}} = \cot\frac{A}{2}$

Ans: (A) $\cot\frac{A}{2}$

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9. $\sin 54^\circ =$

$\sin 54^\circ = \frac{\sqrt{5}+1}{4}$

Ans: (B) $\frac{\sqrt{5}+1}{4}$

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10. $4\cos 36^\circ \sin 54^\circ =$

$\cos 36^\circ = \frac{\sqrt{5}+1}{4},\ \sin 54^\circ = \frac{\sqrt{5}+1}{4}$

$4\cos 36^\circ \sin 54^\circ = \frac{3+\sqrt{5}}{2}$

Ans: (A) $\frac{3+\sqrt{5}}{2}$

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

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

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

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

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12. $\tan 82\frac{1}{2}^\circ \tan 67\frac{1}{2}^\circ =$

$\tan 82\frac{1}{2}^\circ = (\sqrt{3}+\sqrt{2})(\sqrt{2}+1),\ \tan 67\frac{1}{2}^\circ = \sqrt{2}+1$

$\tan 82\frac{1}{2}^\circ \tan 67\frac{1}{2}^\circ = 4+2\sqrt{6}+3\sqrt{2}+3\sqrt{3}$

Ans: (C) $4+2\sqrt{6}+3\sqrt{2}+3\sqrt{3}$

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13. $\sin^2 7\frac{1}{2}^\circ + \cos^4 7\frac{1}{2}^\circ =$

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

$\sin 15^\circ = \frac{\sqrt{6}}{4} - \frac{\sqrt{2}}{4}$

$\sin^2 7\frac{1}{2}^\circ + \cos^4 7\frac{1}{2}^\circ = 1 - \frac{1}{4}\cdot\frac{2-\sqrt{3}}{4} = \frac{14+\sqrt{3}}{16}$

Ans: (B) $\frac{14+\sqrt{3}}{16}$

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14. The least value of $3\left(\sin^4\theta + \cos^4\theta\right)$ 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 $\frac{3}{2}$.

Ans: (A) $\frac{3}{2}$

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15. $\tan 75^\circ - \tan 15^\circ =$

$\tan(45^\circ + A) - \tan(45^\circ - A) = 2\tan 2A$

With $A = 30^\circ$: $\tan 75^\circ - \tan 15^\circ = 2\sqrt{3}$

Ans: (D) $2\sqrt{3}$

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16. $\cos\frac{\pi}{33}\cos\frac{2\pi}{33}\cos\frac{4\pi}{33}\cos\frac{8\pi}{33}\cos\frac{16\pi}{33} =$

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

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

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

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

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17. $\tan\frac{5\pi}{96}\left(1+\sec\frac{5\pi}{48}\right)\left(1+\sec\frac{5\pi}{24}\right)\left(1+\sec\frac{5\pi}{12}\right) =$

$\tan\frac{\theta}{2}(1+\sec\theta) = \tan\theta$, and repeating, the product is $\tan 2^2\theta$ with $\theta = \frac{5\pi}{48}$.

$\tan\frac{5\pi}{12} = 2+\sqrt{3}$

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

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18. $\sin 15^\circ + \sin 30^\circ + \sin 45^\circ + \cdots + \sin 165^\circ =$

$a_1 = 15^\circ$, $d = 15^\circ$, $n = 11$, $a_n = 165^\circ$

$\text{Sum} = \frac{\sin\left(\frac{a_1+a_n}{2}\right)\sin\frac{nd}{2}}{\sin\frac{d}{2}} = \frac{\sin 90^\circ\,\sin 82\frac{1}{2}^\circ}{\sin 7\frac{1}{2}^\circ}$

$= \cot 7\frac{1}{2}^\circ$

Ans: (D) $\cot 7\frac{1}{2}^\circ$

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19. $\sin 15^\circ + \sin 45^\circ + \sin 75^\circ + \sin 105^\circ =$

$a_1 = 15^\circ$, $d = 30^\circ$, $n = 4$, $a_n = 105^\circ$

$\text{Sum} = \frac{\sin\left(\frac{a_1+a_n}{2}\right)\sin\frac{nd}{2}}{\sin\frac{d}{2}} = \frac{\sin 60^\circ\,\sin 60^\circ}{\sin 15^\circ}$

$= \frac{3\sqrt{2}+3\sqrt{6}}{4}$

Ans: (D) $\frac{3\sqrt{2}+3\sqrt{6}}{4}$

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20. $\left(\tan\frac{\pi}{7}\tan\frac{2\pi}{7}\tan\frac{4\pi}{7}\right)^2 =$

Known result: $\tan\frac{\pi}{7}\tan\frac{2\pi}{7}\tan\frac{4\pi}{7} = -\sqrt{7}$

$\text{Square} = 7$

Ans: (A) 7

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21. $\cos^2 110^\circ + \cos^2 50^\circ - \cos 110^\circ\,\cos 50^\circ =$

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

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

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

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22. $\sin^2 5^\circ + \sin^2 55^\circ + \sin^2 65^\circ =$

$\sin^2\theta + \sin^2(60^\circ+\theta) + \sin^2(60^\circ-\theta) = \frac{3}{2}$

Here $\theta = 5^\circ$, so the sum is $\frac{3}{2}$.

Ans: (D) $\frac{3}{2}$

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23. If $\frac{x}{y} = \frac{\tan 60^\circ}{\tan 30^\circ}$, then $\frac{x+y}{x-y} =$

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

$= \frac{\sin 90^\circ}{\sin 30^\circ} = 2$

Ans: (B) 2

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24. $\sqrt{1-\sin 520^\circ} =$

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

$\frac{A}{2} = 260^\circ$, where $\cos\frac{A}{2} - \sin\frac{A}{2}$ is positive.

Ans: (C) $\cos 260^\circ - \sin 260^\circ$

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25. $\sqrt{1-\sin 700^\circ} =$

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

$\frac{A}{2} = 350^\circ$, where $\cos\frac{A}{2} - \sin\frac{A}{2}$ is positive.

Ans: (B) $\cos 350^\circ - \sin 350^\circ$
