EXPRESSWALA ACADEMY

Maths 1A: Multiple and Submultiple Angles

MCQ Test, Set 06

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 $\tan A = \frac{1}{3}$, then $\tan 2A =$

A. $\frac{3}{4}$ **B.** $\frac{3}{8}$ **C.** $-\frac{3}{4}$ **D.** $\frac{3}{5}$

2. If $\cos A = \frac{9}{41}$ and A is acute, then $\cos 2A =$

A. $\frac{1519}{1681}$ **B.** $\frac{18}{41}$ **C.** $-\frac{1519}{1681}$ **D.** $\frac{720}{1681}$

3. $\tan^2 15^\circ =$

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

4. If $\sin A = -\frac{1}{7}$, then $\sin 3A =$

A. $\frac{143}{343}$ **B.** $-\frac{151}{343}$ **C.** $-\frac{146}{343}$ **D.** $-\frac{143}{343}$

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

A. $\frac{18}{125}$ **B.** $-\frac{182}{125}$ **C.** $\frac{118}{125}$ **D.** $-\frac{118}{125}$

6. If $\cos A = \frac{4}{9}$ and $-\pi < A < 0$, then $\cos \frac{A}{2} =$

A. $\frac{\sqrt{26}}{6}$ **B.** $\frac{13}{18}$ **C.** $-\frac{\sqrt{26}}{6}$ **D.** $\frac{\sqrt{10}}{6}$

7. If $\tan \frac{A}{2} = -\frac{1}{4}$, then $\tan A =$

A. $\frac{8}{15}$ **B.** $-\frac{8}{15}$ **C.** $-\frac{4}{15}$ **D.** $-\frac{8}{17}$

8. $\cos^4 A - \sin^4 A =$

A. $\sin 2A$ **B.** 1 **C.** $\cos 2A$ **D.** $\cos^2 2A$

9. $\sin 126^\circ =$

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. $\sin^2 54^\circ - \sin^2 18^\circ =$

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

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

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

12. $\tan 22\frac{1}{2}^\circ + \tan 52\frac{1}{2}^\circ =$

A. $\sqrt{3} - 1 - \sqrt{6}$ **B.** $2 + 2\sqrt{6} - 2\sqrt{3}$

C. $\frac{1+\sqrt{6}-\sqrt{3}}{2}$ **D.** $1 + \sqrt{6} - \sqrt{3}$

13. $\sin^6 82\frac{1}{2}^\circ + \cos^6 82\frac{1}{2}^\circ =$

A. $\frac{16+3\sqrt{2}-3\sqrt{6}}{16}$ **B.** $\frac{2+3\sqrt{3}}{8}$

C. $\frac{6-3\sqrt{3}}{16}$ **D.** $\frac{10+3\sqrt{3}}{16}$

14. The least value of $3\left(\sin^6\theta + \cos^6\theta\right)$ is

A. $\frac{3}{4}$ **B.** $\frac{15}{8}$ **C.** 3 **D.** $\frac{9}{4}$

15. $\operatorname{cosec} 105^\circ - \cot 105^\circ =$

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

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

16. $\cos\frac{4\pi}{7}\cos\frac{8\pi}{7}\cos\frac{16\pi}{7} =$

A. $-\frac{1}{8}$ **B.** $\frac{1}{8}$ **C.** $\frac{1}{4}$ **D.** $\frac{1}{16}$

17. $\left(2\cos\frac{4\pi}{15} - 1\right)\left(2\cos\frac{8\pi}{15} - 1\right)\left(2\cos\frac{16\pi}{15} - 1\right)\left(2\cos\frac{32\pi}{15} - 1\right) =$

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

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

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

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

19. $\cos 15^\circ + \cos 45^\circ + \cos 75^\circ + \cos 105^\circ + \cos 135^\circ =$

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

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

20. $\left(\operatorname{cosec}^2\frac{\pi}{7} + \operatorname{cosec}^2\frac{2\pi}{7} + \operatorname{cosec}^2\frac{3\pi}{7}\right) + \left(\tan\frac{\pi}{7}\tan\frac{2\pi}{7} + \tan\frac{2\pi}{7}\tan\frac{4\pi}{7} + \tan\frac{4\pi}{7}\tan\frac{\pi}{7}\right) =$

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

21. $\sin^2 100^\circ + \sin^2 40^\circ - \sin 100^\circ \sin 40^\circ =$

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

22. $\cos 10^\circ \cos 50^\circ \cos 70^\circ =$

A. $\frac{1}{8}$ **B.** $\frac{\sqrt{3}}{2}$ **C.** $\frac{\sqrt{3}}{16}$ **D.** $\frac{\sqrt{3}}{8}$

23. If $\frac{x}{y} = \frac{\tan 75^\circ}{\tan 45^\circ}$, then $\frac{x+y}{x-y} =$

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

24. $\sqrt{1 - \sin 440^\circ} =$

A. $-(\cos 220^\circ + \sin 220^\circ)$ **B.** $-(\cos 220^\circ - \sin 220^\circ)$

C. $\cos 220^\circ - \sin 220^\circ$ **D.** $\cos 220^\circ + \sin 220^\circ$

25. $\sqrt{1-\sin 620^\circ} =$

A. $\cos 310^\circ + \sin 310^\circ$

B. $\cos 310^\circ - \sin 310^\circ$

C. $-(\cos 310^\circ - \sin 310^\circ)$

D. $-(\cos 310^\circ + \sin 310^\circ)$

Key sheet

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

Solutions

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

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

$= \frac{3}{4}$

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

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2. If $\cos A = \frac{9}{41}$ and A is acute, then $\cos 2A =$

$\sin A = \sqrt{1-\cos^2 A} = \frac{40}{41}$ ($\sin A$ is positive in this quadrant)

$\cos 2A = \cos^2 A - \sin^2 A = -\frac{1519}{1681}$

Ans: (C) $-\frac{1519}{1681}$

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3. $\tan^2 15^\circ =$

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

$\tan^2 15^\circ = \frac{1-\cos 30^\circ}{1+\cos 30^\circ}$

$\cos 30^\circ = \frac{\sqrt{3}}{2}$

$= 7 - 4\sqrt{3}$

Ans: (D) $7 - 4\sqrt{3}$

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4. If $\sin A = -\frac{1}{7}$, then $\sin 3A =$

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

$= 3(-\frac{1}{7}) - 4(-\frac{1}{7})^3$

$= -\frac{143}{343}$

Ans: (D) $-\frac{143}{343}$

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

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

$= 4(-\frac{2}{5})^3 - 3(-\frac{2}{5})$

$= \frac{118}{125}$

Ans: (C) $\frac{118}{125}$

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6. If $\cos A = \frac{4}{9}$ and $-\pi < A < 0$, then $\cos \frac{A}{2} =$

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

$\cos \frac{A}{2} = \frac{\sqrt{26}}{6}$

Ans: (A) $\frac{\sqrt{26}}{6}$

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7. If $\tan \frac{A}{2} = -\frac{1}{4}$, then $\tan A =$

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

$= -\frac{8}{15}$

Ans: (B) $-\frac{8}{15}$

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8. $\cos^4 A - \sin^4 A =$

$= (\cos^2 A - \sin^2 A)(\cos^2 A + \sin^2 A) = \cos 2A$

Ans: (C) $\cos 2A$

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9. $\sin 126^\circ =$

$\sin 126^\circ = \sin 54^\circ$

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

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

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10. $\sin^2 54^\circ - \sin^2 18^\circ =$

$\sin 54^\circ = \frac{\sqrt{5}+1}{4},\ \sin 18^\circ = \frac{\sqrt{5}-1}{4}$

$\sin^2 54^\circ - \sin^2 18^\circ = \frac{\sqrt{5}}{4}$

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

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

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

$\tan 67\frac{1}{2}^\circ = \sqrt{2}+1$

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

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12. $\tan 22\frac{1}{2}^\circ + \tan 52\frac{1}{2}^\circ =$

$\tan 22\frac{1}{2}^\circ = \sqrt{2}-1,\ \tan 52\frac{1}{2}^\circ = (\sqrt{3}+\sqrt{2})(\sqrt{2}-1)$

$\tan 22\frac{1}{2}^\circ + \tan 52\frac{1}{2}^\circ = 1+\sqrt{6}-\sqrt{3}$

Ans: (D) $1+\sqrt{6}-\sqrt{3}$

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13. $\sin^6 82\frac{1}{2}^\circ + \cos^6 82\frac{1}{2}^\circ =$

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

$\sin 165^\circ = \frac{\sqrt{6}}{4} - \frac{\sqrt{2}}{4}$

$\sin^6 82\frac{1}{2}^\circ + \cos^6 82\frac{1}{2}^\circ = 1 - \frac{3}{4}\cdot\frac{2-\sqrt{3}}{4} = \frac{10+3\sqrt{3}}{16}$

Ans: (D) $\frac{10+3\sqrt{3}}{16}$

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14. The least value of $3\left(\sin^6\theta + \cos^6\theta\right)$ is

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

$0 \le \sin^2 2\theta \le 1$, so the least value is $\frac{3}{4}$.

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

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15. $\operatorname{cosec} 105^\circ - \cot 105^\circ =$

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

With $A = 52\frac{1}{2}^\circ$: $\operatorname{cosec} 105^\circ - \cot 105^\circ = 2+\sqrt{6}-\sqrt{2}-\sqrt{3}$

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

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16. $\cos\frac{4\pi}{7}\cos\frac{8\pi}{7}\cos\frac{16\pi}{7} =$

This is $\cos\theta\cos 2\theta\cdots\cos 2^2\theta = \frac{\sin 2^3\theta}{2^3\sin\theta}$ with $\theta = \frac{4\pi}{7}$.

$\sin 2^3\theta = \sin\theta$

$\text{Value} = \frac{1}{8}$

Ans: (B) $\frac{1}{8}$

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17. $\left(2\cos\frac{4\pi}{15}-1\right)\left(2\cos\frac{8\pi}{15}-1\right)\left(2\cos\frac{16\pi}{15}-1\right)\left(2\cos\frac{32\pi}{15}-1\right) =$

$(2\cos\theta-1)(2\cos 2\theta-1)\cdots(2\cos 2^3\theta-1) = \frac{2\cos 2^4\theta+1}{2\cos\theta+1}$ with $\theta = \frac{4\pi}{15}$

$2^4\theta$ differs from $\pm\theta$ by a multiple of 2π, so $\cos 2^4\theta = \cos\theta$ and the value is 1.

Ans: (A) 1

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

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

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

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

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

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19. $\cos 15^\circ + \cos 45^\circ + \cos 75^\circ + \cos 105^\circ + \cos 135^\circ =$

$a_1 = 15^\circ$, $d = 30^\circ$, $n = 5$, $a_n = 135^\circ$

$\text{Sum} = \frac{\cos\left(\frac{a_1+a_n}{2}\right)\sin\frac{nd}{2}}{\sin\frac{d}{2}} = \frac{\cos 75^\circ\ \sin 75^\circ}{\sin 15^\circ}$

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

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

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20. $\left(\text{cosec}^2\frac{\pi}{7} + \text{cosec}^2\frac{2\pi}{7} + \text{cosec}^2\frac{3\pi}{7}\right) + \left(\tan\frac{\pi}{7}\tan\frac{2\pi}{7} + \tan\frac{2\pi}{7}\tan\frac{4\pi}{7} + \tan\frac{4\pi}{7}\tan\frac{\pi}{7}\right) =$

Known results: $\text{cosec}^2\frac{\pi}{7} + \text{cosec}^2\frac{2\pi}{7} + \text{cosec}^2\frac{3\pi}{7} = 8$ and $\tan\frac{\pi}{7}\tan\frac{2\pi}{7} + \tan\frac{2\pi}{7}\tan\frac{4\pi}{7} + \tan\frac{4\pi}{7}\tan\frac{\pi}{7} = -7$

$\text{Value} = 1$

Ans: (B) 1

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21. $\sin^2 100^\circ + \sin^2 40^\circ - \sin 100^\circ\ \sin 40^\circ =$

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

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

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

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22. $\cos 10^\circ\cos 50^\circ\cos 70^\circ =$

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

With $\theta = 10^\circ$: value $= \frac{\sqrt{3}}{8}$

Ans: (D) $\frac{\sqrt{3}}{8}$

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23. If $\frac{x}{y} = \frac{\tan 75^\circ}{\tan 45^\circ}$, then $\frac{x+y}{x-y} =$

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

$= \frac{\sin 120^\circ}{\sin 30^\circ} = \sqrt{3}$

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

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24. $\sqrt{1 - \sin 440^\circ} =$

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

$\frac{A}{2} = 220^\circ$, where $\cos \frac{A}{2} - \sin \frac{A}{2}$ is negative.

Ans: (B) $-(\cos 220^\circ - \sin 220^\circ)$

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25. $\sqrt{1 - \sin 620^\circ} =$

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

$\frac{A}{2} = 310^\circ$, where $\cos \frac{A}{2} - \sin \frac{A}{2}$ is positive.

Ans: (B) $\cos 310^\circ - \sin 310^\circ$
