EXPRESSWALA ACADEMY

Maths 1A: Multiple and Submultiple Angles

MCQ Test, Set 04

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

A. $-\frac{12}{5}$ **B.** $\frac{12}{13}$ **C.** $\frac{6}{13}$ **D.** $-\frac{5}{13}$

2. If $\sin A = -\frac{20}{29}$ and $\frac{3\pi}{2} < A < 2\pi$, then $\sin 2A =$

A. $-\frac{840}{841}$ **B.** $\frac{840}{841}$ **C.** $\frac{41}{841}$ **D.** $-\frac{40}{29}$

3. If $\cos 2A = \frac{6}{7}$, then $\tan^2 A =$

A. 13 **B.** $\frac{13}{14}$ **C.** $\frac{1}{7}$ **D.** $\frac{1}{13}$

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

A. $\frac{37}{70}$ **B.** $\frac{37}{55}$ **C.** $\frac{15}{22}$ **D.** $\frac{38}{55}$

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

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

6. If $\cos A = \frac{1}{5}$ and $0 < A < \pi$, then $\tan \frac{A}{2} =$

A. $\frac{\sqrt{10}}{5}$ **B.** $-\frac{\sqrt{6}}{3}$ **C.** $\frac{\sqrt{6}}{3}$ **D.** $\frac{3}{5}$

7. If $\tan \frac{A}{2} = \frac{5}{4}$, then $\sin A =$

A. $\frac{40}{41}$ **B.** $-\frac{40}{9}$ **C.** $\frac{20}{41}$ **D.** $-\frac{9}{41}$

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

A. $\tan^2 A$ **B.** $\tan^2 \frac{A}{2}$

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

9. $\cos 72^\circ =$

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. $4 \sin 54^\circ \cos 72^\circ =$

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

11. $\cot 52\frac{1}{2}^\circ =$

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

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

13. $\sin^2 105^\circ + \cos^4 105^\circ =$

A. $\frac{9}{8}$ **B.** $\frac{7}{8}$ **C.** $\frac{15}{16}$ **D.** $\frac{1}{16}$

14. The least value of $2\left(\sin^4\theta + \cos^4\theta\right)$ is

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

15. $\cot 52\frac{1}{2}^\circ + \tan 52\frac{1}{2}^\circ =$

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

16. $\cos 100^\circ \cos 200^\circ \cos 400^\circ =$

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

17. $\left(2\cos\frac{2\pi}{7}-1\right)\left(2\cos\frac{4\pi}{7}-1\right)\left(2\cos\frac{8\pi}{7}-1\right) =$

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

18. $\sin 60^\circ + \sin 90^\circ + \sin 120^\circ =$

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

19. $\sin 60^\circ + \sin 90^\circ + \sin 120^\circ + \cdots + \sin 210^\circ =$

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

20. $\frac{\cos\frac{2\pi}{7}+\cos\frac{4\pi}{7}+\cos\frac{6\pi}{7}}{\cos\frac{\pi}{7}\cos\frac{3\pi}{7}\cos\frac{5\pi}{7}} =$

A. 5 **B.** 8 **C.** -4 **D.** 4

21. $\sin 10^\circ \sin 50^\circ \sin 110^\circ =$

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

22. $\tan 5^\circ \tan 55^\circ \tan 115^\circ =$

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

23. If $\frac{x}{y} = \frac{\sin 135^\circ}{\sin 15^\circ}$, then $\frac{x+y}{x-y} =$

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

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

24. $\sqrt{1-\sin 120^\circ} =$

A. $\cos 60^\circ - \sin 60^\circ$ **B.** $\cos 60^\circ + \sin 60^\circ$

C. $-(\cos 60^\circ + \sin 60^\circ)$ **D.** $-(\cos 60^\circ - \sin 60^\circ)$

25. $\sqrt{1-\sin 20^\circ} =$

A. $\cos 10^\circ - \sin 10^\circ$ **B.** $-(\cos 10^\circ + \sin 10^\circ)$

C. $-(\cos 10^\circ - \sin 10^\circ)$ **D.** $\cos 10^\circ + \sin 10^\circ$

Key sheet

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

Solutions

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

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

$= \frac{12}{13}$

Ans: (B) $\frac{12}{13}$

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2. If $\sin A = -\frac{20}{29}$ and $\frac{3\pi}{2} < A < 2\pi$, then $\sin 2A =$

$\cos A = \sqrt{1-\sin^2 A} = \frac{21}{29}$ ($\cos A$ is positive in this quadrant)

$\sin 2A = 2\sin A \cos A = -\frac{840}{841}$

Ans: (A) $-\frac{840}{841}$

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3. If $\cos 2A = \frac{6}{7}$, then $\tan^2 A =$

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

$= \frac{1}{13}$

Ans: (D) $\frac{1}{13}$

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

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

$= \frac{3(\frac{1}{5}) - (\frac{1}{5})^3}{1-3(\frac{1}{5})^2}$

$= \frac{37}{55}$

Ans: (B) $\frac{37}{55}$

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5. 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: (B) $\frac{23}{27}$

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6. If $\cos A = \frac{1}{5}$ and $0 < A < \pi$, then $\tan \frac{A}{2} =$

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

$\tan \frac{A}{2} = \frac{\sqrt{6}}{3}$

Ans: (C) $\frac{\sqrt{6}}{3}$

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7. If $\tan \frac{A}{2} = \frac{5}{4}$, then $\sin A =$

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

$= \frac{40}{41}$

Ans: (A) $\frac{40}{41}$

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

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

Ans: (B) $\tan^2 \frac{A}{2}$

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9. $\cos 72^\circ =$

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

Ans: (D) $\frac{\sqrt{5}-1}{4}$

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10. $4 \sin 54^\circ \cos 72^\circ =$

$\sin 54^\circ = \frac{\sqrt{5}+1}{4},\ \cos 72^\circ = \frac{\sqrt{5}-1}{4}$

$4 \sin 54^\circ \cos 72^\circ = 1$

Ans: (D) 1

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11. $\cot 52\frac{1}{2}^\circ =$

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

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

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

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

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

$\tan 82\frac{1}{2}^\circ + \cot 82\frac{1}{2}^\circ = 2\sqrt{2}+2\sqrt{6}$

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

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13. $\sin^2 105^\circ + \cos^4 105^\circ =$

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

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

$\sin^2 105^\circ + \cos^4 105^\circ = 1 - \frac{1}{4}\cdot\frac{1}{4} = \frac{15}{16}$

Ans: (C) $\frac{15}{16}$

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14. The least value of $2\left(\sin^4\theta + \cos^4\theta\right)$ 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 1.

Ans: (B) 1

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15. $\cot 52\frac{1}{2}^\circ + \tan 52\frac{1}{2}^\circ =$

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

With $A = 52\frac{1}{2}^\circ$: $\cot 52\frac{1}{2}^\circ + \tan 52\frac{1}{2}^\circ = 2\sqrt{6}-2\sqrt{2}$

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

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16. $\cos 100^\circ \cos 200^\circ \cos 400^\circ =$

This is $\cos\theta\cos 2\theta\cdots\cos 2^2\theta = \frac{\sin 2^3\theta}{2^3\sin\theta}$ with $\theta = 100^\circ$.

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

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

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

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17. $\left(2\cos\frac{2\pi}{7}-1\right)\left(2\cos\frac{4\pi}{7}-1\right)\left(2\cos\frac{8\pi}{7}-1\right)=$

$(2\cos\theta-1)(2\cos 2\theta-1)\cdots(2\cos 2^2\theta-1)=\frac{2\cos 2^3\theta+1}{2\cos\theta+1}$ with $\theta=\frac{2\pi}{7}$

$2^3\theta$ differs from $\pm\theta$ by a multiple of 2π, so $\cos 2^3\theta=\cos\theta$ and the value is 1.

Ans: (C) 1

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18. $\sin 60^\circ+\sin 90^\circ+\sin 120^\circ=$

$a_1=60^\circ$, $d=30^\circ$, $n=3$, $a_n=120^\circ$

$\text{Sum}=\frac{\sin\left(\frac{a_1+a_n}{2}\right)\sin\frac{nd}{2}}{\sin\frac{d}{2}}=\frac{\sin 90^\circ\ \sin 45^\circ}{\sin 15^\circ}$

$=1+\sqrt{3}$

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

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19. $\sin 60^\circ+\sin 90^\circ+\sin 120^\circ+\cdots+\sin 210^\circ=$

$a_1=60^\circ$, $d=30^\circ$, $n=6$, $a_n=210^\circ$

$\text{Sum}=\frac{\sin\left(\frac{a_1+a_n}{2}\right)\sin\frac{nd}{2}}{\sin\frac{d}{2}}=\frac{\sin 135^\circ\ \sin 90^\circ}{\sin 15^\circ}$

$=1+\sqrt{3}$

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

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20. $\frac{\cos\frac{2\pi}{7}+\cos\frac{4\pi}{7}+\cos\frac{6\pi}{7}}{\cos\frac{\pi}{7}\cos\frac{3\pi}{7}\cos\frac{5\pi}{7}}=$

Known results: $\cos\frac{2\pi}{7}+\cos\frac{4\pi}{7}+\cos\frac{6\pi}{7}=-\frac{1}{2}$ and $\cos\frac{\pi}{7}\cos\frac{3\pi}{7}\cos\frac{5\pi}{7}=-\frac{1}{8}$

$\text{Value}=4$

Ans: (D) 4

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21. $\sin 10^\circ\sin 50^\circ\sin 110^\circ=$

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

With $\theta=50^\circ$: value $=\frac{1}{8}$

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

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22. $\tan 5^\circ\tan 55^\circ\tan 115^\circ=$

$\tan\theta\tan(60^\circ-\theta)\tan(60^\circ+\theta)=\tan 3\theta$

With $\theta=55^\circ$: value $=\sqrt{3}-2$

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

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23. If $\frac{x}{y}=\frac{\sin 135^\circ}{\sin 15^\circ}$, then $\frac{x+y}{x-y}=$

$\frac{x+y}{x-y}=\frac{\sin A+\sin B}{\sin A-\sin B}=\frac{\tan\frac{A+B}{2}}{\tan\frac{A-B}{2}}$

$=\frac{\tan 75^\circ}{\tan 60^\circ}=\frac{3+2\sqrt{3}}{3}$

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

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24. $\sqrt{1-\sin 120^\circ}=$

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

$\frac{A}{2}=60^\circ$, where $\cos\frac{A}{2}-\sin\frac{A}{2}$ is negative.

Ans: (D) $-(\cos 60^\circ-\sin 60^\circ)$

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25. $\sqrt{1-\sin 20^\circ} =$

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

$\frac{A}{2} = 10^\circ$, where $\cos\frac{A}{2} - \sin\frac{A}{2}$ is positive.

Ans: (A) $\cos 10^\circ - \sin 10^\circ$