EXPRESSWALA ACADEMY

Maths 1A: Multiple and Submultiple Angles

MCQ Test, Set 02

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 $\tan A = -\frac{4}{7}$, then $\cos 2A =$

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

2. If $\cos A = \frac{8}{17}$ and A is acute, then $\cos 2A =$

A. $\frac{240}{289}$ **B.** $\frac{161}{289}$ **C.** $-\frac{161}{289}$ **D.** $\frac{16}{17}$

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

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

4. If $\tan A = -\frac{1}{6}$, then $\tan 3A =$

A. $-\frac{6}{11}$ **B.** $-\frac{107}{198}$ **C.** $-\frac{107}{234}$ **D.** $-\frac{109}{198}$

5. If $\tan A = -\frac{7}{2}$, then $\tan 3A =$

A. $\frac{427}{286}$ **B.** $-\frac{259}{286}$ **C.** $\frac{42}{143}$ **D.** $\frac{259}{302}$

6. If $\cos A = \frac{7}{9}$ and $0 < A < \pi$, then $\sin \frac{A}{2} =$

A. $\frac{1}{3}$ **B.** $\frac{2\sqrt{2}}{3}$ **C.** $\frac{1}{9}$ **D.** $-\frac{1}{3}$

7. If $\tan \frac{A}{2} = \frac{1}{8}$, then $\cos A =$

A. $-\frac{63}{65}$ **B.** $\frac{65}{63}$ **C.** $\frac{63}{65}$ **D.** $\frac{16}{65}$

8. $\frac{\sin 2A}{1-\cos 2A} =$

A. $\cot 2A$ **B.** $2\cot A$ **C.** $\cot A$ **D.** $\tan A$

9. $\cos 288^\circ =$

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. $\cos 36^\circ - \cos 72^\circ =$

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

11. $\tan 37\frac{1}{2}^\circ =$

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

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

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

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

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

13. $\sin^4 37\frac{1}{2}^\circ + \cos^4 37\frac{1}{2}^\circ =$

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

C. $\frac{6-\sqrt{3}}{8}$ **D.** $\frac{2-\sqrt{3}}{4}$

14. The least value of $2\left(\sin^6\theta+\cos^6\theta\right)$ is

A. 2 **B.** $\frac{3}{2}$ **C.** $\frac{1}{2}$ **D.** $\frac{5}{4}$

15. $\operatorname{cosec} 30^\circ + \cot 30^\circ =$

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

16. $\cos 72^\circ \cos 144^\circ =$

A. $-\frac{1}{2}$ **B.** $-\frac{1}{8}$ **C.** $\frac{1}{4}$ **D.** $-\frac{1}{4}$

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

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

18. $\cos 15^\circ + \cos 75^\circ + \cos 135^\circ + \cos 195^\circ + \cos 255^\circ =$

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

19. $\cos 45^\circ + \cos 75^\circ + \cos 105^\circ + \cos 135^\circ + \cos 165^\circ =$

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

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

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

A. 98 **B.** -49 **C.** 50 **D.** 49

21. $\sin^2 40^\circ + \sin^2 160^\circ + \sin^2 80^\circ =$

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

22. $\cos 25^\circ \cos 35^\circ \cos 95^\circ =$

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

C. $\frac{\sqrt{2}}{4}-\frac{\sqrt{6}}{4}$ **D.** $\frac{\sqrt{2}}{32}-\frac{\sqrt{6}}{32}$

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

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

24. $\sqrt{1-\sin 60^\circ} =$

A. $\cos 30^\circ - \sin 30^\circ$ **B.** $\cos 30^\circ + \sin 30^\circ$

C. $-(\cos 30^\circ - \sin 30^\circ)$ **D.** $-(\cos 30^\circ + \sin 30^\circ)$

25. $\sqrt{1+\sin 200^\circ} =$

A. $-(\cos 100^\circ - \sin 100^\circ)$

B. $\cos 100^\circ - \sin 100^\circ$

C. $-(\cos 100^\circ + \sin 100^\circ)$

D. $\cos 100^\circ + \sin 100^\circ$

Key sheet

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

Solutions

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

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

$= \frac{33}{65}$

Ans: (A) $\frac{33}{65}$

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2. If $\cos A = \frac{8}{17}$ and A is acute, then $\cos 2A =$

$\sin A = \sqrt{1-\cos^2 A} = \frac{15}{17}$ ($\sin A$ is positive in this quadrant)

$\cos 2A = \cos^2 A - \sin^2 A = -\frac{161}{289}$

Ans: (C) $-\frac{161}{289}$

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

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

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

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

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

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

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4. If $\tan A = -\frac{1}{6}$, then $\tan 3A =$

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

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

$= -\frac{107}{198}$

Ans: (B) $-\frac{107}{198}$

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5. If $\tan A = -\frac{7}{2}$, then $\tan 3A =$

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

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

$= -\frac{259}{286}$

Ans: (B) $-\frac{259}{286}$

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6. If $\cos A = \frac{7}{9}$ and $0 < A < \pi$, then $\sin \frac{A}{2} =$

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

$\sin \frac{A}{2} = \frac{1}{3}$

Ans: (A) $\frac{1}{3}$

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7. If $\tan \frac{A}{2} = \frac{1}{8}$, then $\cos A =$

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

$= \frac{63}{65}$

Ans: (C) $\frac{63}{65}$

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8. $\frac{\sin 2A}{1-\cos 2A} =$

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

Ans: (C) $\cot A$

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9. $\cos 288^\circ =$

$\cos 288^\circ = \cos 72^\circ$

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

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

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10. $\cos 36^\circ - \cos 72^\circ =$

$\cos 36^\circ = \frac{\sqrt{5}+1}{4},\ \cos 72^\circ = \frac{\sqrt{5}-1}{4}$

$\cos 36^\circ - \cos 72^\circ = \frac{1}{2}$

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

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11. $\tan 37\frac{1}{2}^\circ =$

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

$\tan 37\frac{1}{2}^\circ = (\sqrt{3}-\sqrt{2})(\sqrt{2}+1)$

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

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

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

$\tan 52\frac{1}{2}^\circ\ \tan 22\frac{1}{2}^\circ = 3\sqrt{2}+3\sqrt{3}-4-2\sqrt{6}$

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

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13. $\sin^4 37\frac{1}{2}^\circ + \cos^4 37\frac{1}{2}^\circ =$

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

$\sin 75^\circ = \frac{\sqrt{2}}{4} + \frac{\sqrt{6}}{4}$

$\sin^4 37\frac{1}{2}^\circ + \cos^4 37\frac{1}{2}^\circ = 1 - \frac{1}{2}\cdot\frac{2+\sqrt{3}}{4} = \frac{6-\sqrt{3}}{8}$

Ans: (C) $\frac{6-\sqrt{3}}{8}$

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14. The least value of $2\left(\sin^6\theta + \cos^6\theta\right)$ 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 $\frac{1}{2}$.

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

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15. $\operatorname{cosec} 30^\circ + \cot 30^\circ =$

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

With $A = 15^\circ$: $\operatorname{cosec} 30^\circ + \cot 30^\circ = 2+\sqrt{3}$

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

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16. $\cos 72^\circ \cos 144^\circ =$

This is $\cos\theta\cos 2\theta\cdots\cos 2\theta = \frac{\sin 2^2\theta}{2^2\sin\theta}$ with $\theta = 72^\circ$.

$\sin 2^2\theta = -\sin\theta$

$\text{Value} = -\frac{1}{4}$

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

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

$(2\cos\theta-1)(2\cos 2\theta-1)\cdots(2\cos 2^3\theta-1) = \frac{2\cos 2^4\theta+1}{2\cos\theta+1}$ with $\theta = \frac{2\pi}{17}$

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

Ans: (C) 1

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18. $\cos 15^\circ + \cos 75^\circ + \cos 135^\circ + \cos 195^\circ + \cos 255^\circ =$

$a_1 = 15^\circ$, $d = 60^\circ$, $n = 5$, $a_n = 255^\circ$

$\text{Sum} = \frac{\cos\left(\frac{a_1+a_n}{2}\right)\sin\frac{nd}{2}}{\sin\frac{d}{2}} = \frac{\cos 135^\circ\ \sin 150^\circ}{\sin 30^\circ}$

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

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

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19. $\cos 45^\circ + \cos 75^\circ + \cos 105^\circ + \cos 135^\circ + \cos 165^\circ =$

$a_1 = 45^\circ$, $d = 30^\circ$, $n = 5$, $a_n = 165^\circ$

$\text{Sum} = \frac{\cos\left(\frac{a_1+a_n}{2}\right)\sin\frac{nd}{2}}{\sin\frac{d}{2}} = \frac{\cos 105^\circ\ \sin 75^\circ}{\sin 15^\circ}$

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

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

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

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

$\text{Square} = 49$

Ans: (D) 49

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21. $\sin^2 40^\circ + \sin^2 160^\circ + \sin^2 80^\circ =$

$\sin^2\theta + \sin^2(120^\circ+\theta) + \sin^2(120^\circ-\theta) = \frac{3}{2}$

Here $\theta = 40^\circ$, so the sum is $\frac{3}{2}$.

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

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22. $\cos 25^\circ \cos 35^\circ \cos 95^\circ =$

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

With $\theta = 35^\circ$: value $= \frac{\sqrt{2}}{16} - \frac{\sqrt{6}}{16}$

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

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

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

$= \frac{\tan 45^\circ}{\tan 15^\circ} = 2+\sqrt{3}$

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

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24. $\sqrt{1-\sin 60^\circ} =$

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

$\frac{A}{2} = 30^\circ$, where $\cos\frac{A}{2} - \sin\frac{A}{2}$ is positive.

Ans: (A) $\cos 30^\circ - \sin 30^\circ$

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25. $\sqrt{1+\sin 200^\circ} =$

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

$\frac{A}{2} = 100^\circ$, where $\cos\frac{A}{2} + \sin\frac{A}{2}$ is positive.

Ans: (D) $\cos 100^\circ + \sin 100^\circ$
