

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

1. Question | 9709 Feb-March 2016 P3 V2 Q2

- 2** Express the equation $\tan(\theta + 45^\circ) - 2 \tan(\theta - 45^\circ) = 4$ as a quadratic equation in $\tan \theta$. Hence solve this equation for $0^\circ \leq \theta \leq 180^\circ$. [6]

2. Question | 9709 May-June 2016 P3 V1 Q3

- 3** By expressing the equation $\operatorname{cosec} \theta = 3 \sin \theta + \cot \theta$ in terms of $\cos \theta$ only, solve the equation for $0^\circ < \theta < 180^\circ$. [5]

3. Question | 9709 May-June 2016 P3 V2 Q5

- 5** (i) Prove the identity $\cos 4\theta - 4 \cos 2\theta \equiv 8 \sin^4 \theta - 3$. [4]

(ii) Hence solve the equation

$$\cos 4\theta = 4 \cos 2\theta + 3,$$

for $0^\circ \leq \theta \leq 360^\circ$. [4]

4. Question | 9709 May-June 2016 P3 V3 Q3

- 3** (i) Express $(\sqrt{5}) \cos x + 2 \sin x$ in the form $R \cos(x - \alpha)$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$, giving the value of α correct to 2 decimal places. [3]

(ii) Hence solve the equation

$$(\sqrt{5}) \cos \frac{1}{2}x + 2 \sin \frac{1}{2}x = 1.2,$$

for $0^\circ < x < 360^\circ$. [3]

5. Question | 9709 Oct-Nov 2016 P3 V1 Q3

- 3** Express the equation $\sec \theta = 3 \cos \theta + \tan \theta$ as a quadratic equation in $\sin \theta$. Hence solve this equation for $-90^\circ < \theta < 90^\circ$. [5]

6. Question | 9709 Oct-Nov 2016 P3 V1 Q5

- 5** (i) Prove the identity $\tan 2\theta - \tan \theta \equiv \tan \theta \sec 2\theta$. [4]

(ii) Hence show that $\int_0^{\frac{1}{6}\pi} \tan \theta \sec 2\theta \, d\theta = \frac{1}{2} \ln \frac{3}{2}$. [4]

7. Question | 9709 Oct-Nov 2016 P3 V2 Q3

- 3** Express the equation $\sec \theta = 3 \cos \theta + \tan \theta$ as a quadratic equation in $\sin \theta$. Hence solve this equation for $-90^\circ < \theta < 90^\circ$. [5]

8. Question | 9709 Oct-Nov 2016 P3 V3 Q3

- 3** Express the equation $\cot 2\theta = 1 + \tan \theta$ as a quadratic equation in $\tan \theta$. Hence solve this equation for $0^\circ < \theta < 180^\circ$. [6]

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4 (i) Express $8 \cos \theta - 15 \sin \theta$ in the form $R \cos(\theta + \alpha)$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$, stating the exact value of R and giving the value of α correct to 2 decimal places. [3]

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(ii) Hence solve the equation

for $0^\circ < x < 180^\circ$.

[4]

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8 (i) By first expanding $2 \sin(x - 30^\circ)$, express $2 \sin(x - 30^\circ) - \cos x$ in the form $R \sin(x - \alpha)$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$. Give the exact value of R and the value of α correct to 2 decimal places. [5]

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10. Question part 2/2 | 9709 May-June 2017 P3 V1 Q8

(ii) Hence solve the equation

$$2 \sin(x - 30^\circ) - \cos x = 1,$$

for $0^\circ < x < 180^\circ$.

[3]

[illegible]

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11. Question part 1/2 | 9709 May-June 2017 P3 V2 Q3

- 3 (i) Express the equation $\cot \theta - 2 \tan \theta = \sin 2\theta$ in the form $a \cos^4 \theta + b \cos^2 \theta + c = 0$, where a , b and c are constants to be determined. [3]

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11. Question part 2/2 | 9709 May-June 2017 P3 V2 Q3

(ii) Hence solve the equation $\cot \theta - 2 \tan \theta = \sin 2\theta$ for $90^\circ < \theta < 180^\circ$.

[2]

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7 (i) Prove that if $y = \frac{1}{\cos \theta}$ then $\frac{dy}{d\theta} = \sec \theta \tan \theta$. [2]

[illegible]

(ii) Prove the identity $\frac{1 + \sin \theta}{1 - \sin \theta} \equiv 2 \sec^2 \theta + 2 \sec \theta \tan \theta - 1$. [3]

[illegible]

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12. Question part 2/2 | 9709 May-June 2017 P3 V2 Q7

[illegible]

(iii) Hence find the exact value of $\int_0^{\frac{1}{4}\pi} \frac{1 + \sin \theta}{1 - \sin \theta} d\theta$. [4]

[illegible]

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13. Question | 9709 May-June 2017 P3 V3 Q1

1 Prove the identity $\frac{\cot x - \tan x}{\cot x + \tan x} \equiv \cos 2x$. [3]

[illegible]

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14. Question part 1/2 | 9709 Oct-Nov 2017 P3 V1 Q4

4 (i) Prove the identity $\tan(45^\circ + x) + \tan(45^\circ - x) \equiv 2 \sec 2x$.

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14. Question part 2/2 | 9709 Oct-Nov 2017 P3 V1 Q4

(ii) Hence sketch the graph of $y = \tan(45^\circ + x) + \tan(45^\circ - x)$ for $0^\circ \leq x \leq 90^\circ$. [3]

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15. Question part 1/2 | 9709 Oct-Nov 2017 P3 V2 Q3

- 3** By expressing the equation $\tan(\theta + 60^\circ) + \tan(\theta - 60^\circ) = \cot \theta$ in terms of $\tan \theta$ only, solve the equation for $0^\circ < \theta < 90^\circ$. [5]

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15. Question part 2/2 | 9709 Oct-Nov 2017 P3 V2 Q3

[illegible]

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16. Question part 1/2 | 9709 Oct-Nov 2017 P3 V3 Q4

4 (i) Prove the identity $\tan(45^\circ + x) + \tan(45^\circ - x) \equiv 2 \sec 2x$.

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16. Question part 2/2 | 9709 Oct-Nov 2017 P3 V3 Q4

(ii) Hence sketch the graph of $y = \tan(45^\circ + x) + \tan(45^\circ - x)$ for $0^\circ \leq x \leq 90^\circ$. [3]

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17. Question part 1/2 | 9709 Feb-March 2018 P3 V2 Q3

3 (i) Using the expansions of $\cos(3x+x)$ and $\cos(3x-x)$, show that

$$\frac{1}{2}(\cos 4x + \cos 2x) \equiv \cos 3x \cos x. \quad [3]$$

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17. Question part 2/2 | 9709 Feb-March 2018 P3 V2 Q3

(ii) Hence show that $\int_{-\frac{1}{6}\pi}^{\frac{1}{6}\pi} \cos 3x \cos x \, dx = \frac{3}{8}\sqrt{3}$. [3]

[illegible]

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18. Question | 9709 May-June 2018 P3 V1 Q2

2 (i) Given that $\sin(x - 60^\circ) = 3 \cos(x - 45^\circ)$, find the exact value of $\tan x$. [4]

[illegible]

(ii) Hence solve the equation $\sin(x - 60^\circ) = 3 \cos(x - 45^\circ)$, for $0^\circ < x < 360^\circ$. [2]

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19. Question | 9709 May-June 2018 P3 V2 Q2

2 Showing all necessary working, solve the equation $\cot \theta + \cot(\theta + 45^\circ) = 2$, for $0^\circ < \theta < 180^\circ$. [5]

[illegible]

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20. Question part 1/2 | 9709 May-June 2018 P3 V2 Q4

4 (i) Show that $\frac{2 \sin x - \sin 2x}{1 - \cos 2x} \equiv \frac{\sin x}{1 + \cos x}$. [4]

[illegible]

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20. Question part 2/2 | 9709 May-June 2018 P3 V2 Q4

(ii) Hence, showing all necessary working, find $\int_{\frac{1}{3}\pi}^{\frac{1}{2}\pi} \frac{2 \sin x - \sin 2x}{1 - \cos 2x} dx$, giving your answer in the form $\ln k$. [4]

[illegible]

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21. Question part 1/2 | 9709 May-June 2018 P3 V3 Q5

5 (i) By first expanding $(\cos^2 x + \sin^2 x)^3$, or otherwise, show that

$$\cos^6 x + \sin^6 x = 1 - \frac{3}{4} \sin^2 2x. \quad [4]$$

[illegible]

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21. Question part 2/2 | 9709 May-June 2018 P3 V3 Q5

(ii) Hence solve the equation

$$\cos^6 x + \sin^6 x = \frac{2}{3},$$

for $0^\circ < x < 180^\circ$.

[4]

[illegible]

- [illegible]

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22. Question part 2/2 | 9709 May-June 2018 P3 V3 Q7

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23. Question part 1/2 | 9709 Oct-Nov 2018 P3 V1 Q6

- 6** (i) Show that the equation $(\sqrt{2}) \operatorname{cosec} x + \cot x = \sqrt{3}$ can be expressed in the form $R \sin(x - \alpha) = \sqrt{2}$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$. [4]

[illegible]

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23. Question part 2/2 | 9709 Oct-Nov 2018 P3 V1 Q6

(ii) Hence solve the equation $(\sqrt{2}) \operatorname{cosec} x + \cot x = \sqrt{3}$, for $0^\circ < x < 180^\circ$.

[4]

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24. Question | 9709 Oct-Nov 2018 P3 V2 Q2

2 Showing all necessary working, solve the equation $\sin(\theta - 30^\circ) + \cos \theta = 2 \sin \theta$, for $0^\circ < \theta < 180^\circ$. [4]

[illegible]

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25. Question part 1/2 | 9709 Oct-Nov 2018 P3 V3 Q6

- 6** (i) Show that the equation $(\sqrt{2}) \operatorname{cosec} x + \cot x = \sqrt{3}$ can be expressed in the form $R \sin(x - \alpha) = \sqrt{2}$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$. [4]

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25. Question part 2/2 | 9709 Oct-Nov 2018 P3 V3 Q6

(ii) Hence solve the equation $(\sqrt{2}) \operatorname{cosec} x + \cot x = \sqrt{3}$, for $0^\circ < x < 180^\circ$.

[4]

[illegible]

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3 (i) Given that $\sin(\theta + 45^\circ) + 2 \cos(\theta + 60^\circ) = 3 \cos \theta$, find the exact value of $\tan \theta$ in a form involving surds. You need not simplify your answer. [4]

[illegible]

- [illegible]

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27. Question | 9709 May-June 2019 P3 V1 Q4

- 4** By first expressing the equation $\cot \theta - \cot(\theta + 45^\circ) = 3$ as a quadratic equation in $\tan \theta$, solve the equation for $0^\circ < \theta < 180^\circ$. [6]

[illegible]

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28. Question part 1/2 | 9709 May-June 2019 P3 V1 Q6

6 (i) By first expanding $\sin(2x + x)$, show that $\sin 3x \equiv 3 \sin x - 4 \sin^3 x$.

[illegible]

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28. Question part 2/2 | 9709 May-June 2019 P3 V1 Q6

(ii) Hence, showing all necessary working, find the exact value of $\int_0^{\frac{1}{3}\pi} \sin^3 x \, dx$. [4]

[illegible]

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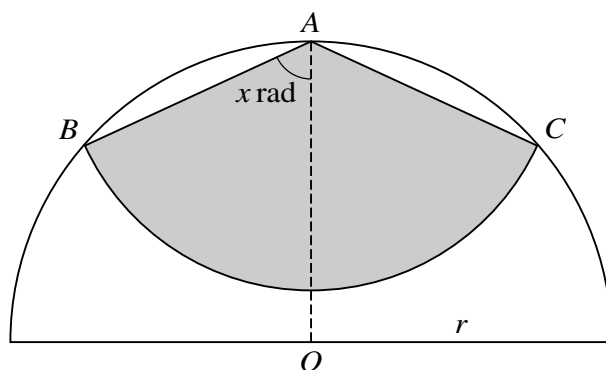
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29. Question | 9709 May-June 2019 P3 V2 Q3

3 Showing all necessary working, solve the equation $\cot 2\theta = 2 \tan \theta$ for $0^\circ < \theta < 180^\circ$. [5]

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6



(i) Use triangle OAB to show that $AB = 2r \cos x$. [1]

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(ii) Hence show that $x = \cos^{-1} \sqrt{\left(\frac{\pi}{16x}\right)}$. [2]

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(iii) Verify by calculation that x lies between 1 and 1.5.

[2]

[illegible]

- (iv) Use an iterative formula based on the equation in part (ii) to determine x correct to 3 decimal places. Give the result of each iteration to 5 decimal places. [3]

[3]

[illegible]

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31. Question part 1/2 | 9709 May-June 2019 P3 V3 Q3

3 Let $f(\theta) = \frac{1 - \cos 2\theta + \sin 2\theta}{1 + \cos 2\theta + \sin 2\theta}$.

(i) Show that $f(\theta) = \tan \theta$.

[3]

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9 **(i)** By first expanding $\cos(2x + x)$, show that $\cos 3x \equiv 4 \cos^3 x - 3 \cos x$. [4]

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(ii) Hence solve the equation $\cos 3x + 3 \cos x + 1 = 0$, for $0 \leq x \leq \pi$. [2]

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32. Question part 2/2 | 9709 Oct-Nov 2019 P3 V1 Q9

[illegible]

(iii) Find the exact value of $\int_{\frac{1}{6}\pi}^{\frac{1}{3}\pi} \cos^3 x \, dx$. [4]

[illegible]

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33. Question part 1/2 | 9709 Oct-Nov 2019 P3 V2 Q4

- 4** (i) Express $(\sqrt{6}) \sin x + \cos x$ in the form $R \sin(x + \alpha)$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$. State the exact value of R and give α correct to 3 decimal places. [3]

[illegible]

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33. Question part 2/2 | 9709 Oct-Nov 2019 P3 V2 Q4

(ii) Hence solve the equation $(\sqrt{6}) \sin 2\theta + \cos 2\theta = 2$, for $0^\circ < \theta < 180^\circ$.

[4]

[illegible]

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34. Question part 1/2 | 9709 Oct-Nov 2019 P3 V3 Q4

- 4** (i) By first expanding $\tan(2x + x)$, show that the equation $\tan 3x = 3 \cot x$ can be written in the form $\tan^4 x - 12 \tan^2 x + 3 = 0$. [4]

[illegible]

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34. Question part 2/2 | 9709 Oct-Nov 2019 P3 V3 Q4

(ii) Hence solve the equation $\tan 3x = 3 \cot x$ for $0^\circ < x < 90^\circ$.

[3]

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35. Question part 1/2 | 9709 Feb-March 2020 P3 V2 Q5

5 (a) Show that $\frac{\cos 3x}{\sin x} + \frac{\sin 3x}{\cos x} = 2 \cot 2x$. [4]

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35. Question part 2/2 | 9709 Feb-March 2020 P3 V2 Q5

(b) Hence solve the equation $\frac{\cos 3x}{\sin x} + \frac{\sin 3x}{\cos x} = 4$, for $0 < x < \pi$. [3]

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36. Question | 9709 May-June 2020 P3 V1 Q3

- 3** Express the equation $\tan(\theta + 60^\circ) = 2 + \tan(60^\circ - \theta)$ as a quadratic equation in $\tan \theta$, and hence solve the equation for $0^\circ \leq \theta \leq 180^\circ$. [6]

[illegible]

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5 (a) Express $\sqrt{2} \cos x - \sqrt{5} \sin x$ in the form $R \cos(x + \alpha)$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$. Give the exact value of R and the value of α correct to 3 decimal places. [3]

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37. Question part 2/2 | 9709 May-June 2020 P3 V2 Q5

(b) Hence solve the equation $\sqrt{2} \cos 2\theta - \sqrt{5} \sin 2\theta = 1$, for $0^\circ < \theta < 180^\circ$. [4]

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38. Question part 1/2 | 9709 May-June 2020 P3 V3 Q5

5 By first expressing the equation

$$\tan \theta \tan(\theta + 45^\circ) = 2 \cot 2\theta$$

as a quadratic equation in $\tan \theta$, solve the equation for $0^\circ < \theta < 90^\circ$.

[6]

[illegible]

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38. Question part 2/2 | 9709 May-June 2020 P3 V3 Q5

[illegible]

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- $$x_{n+1} = \pi - \sin^{-1} \left(\frac{1}{e^{-\frac{1}{2}x_n} + 1} \right),$$

Use the formula to determine this root correct to 2 decimal places. Give the result of each iteration to 4 decimal places. [3]

[illegible]

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40. Question part 1/2 | 9709 Oct-Nov 2020 P3 V1 Q6

- 6 (a)** Express $\sqrt{6} \cos \theta + 3 \sin \theta$ in the form $R \cos(\theta - \alpha)$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$. State the exact value of R and give α correct to 2 decimal places. [3]

[illegible]

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40. Question part 2/2 | 9709 Oct-Nov 2020 P3 V1 Q6

(b) Hence solve the equation $\sqrt{6} \cos \frac{1}{3}x + 3 \sin \frac{1}{3}x = 2.5$, for $0^\circ < x < 360^\circ$. [4]

[illegible]

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41. Question part 1/2 | 9709 Oct-Nov 2020 P3 V2 Q4

4 (a) Show that the equation $\tan(\theta + 60^\circ) = 2 \cot \theta$ can be written in the form

$$\tan^2 \theta + 3\sqrt{3} \tan \theta - 2 = 0. \quad [3]$$

[illegible]

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41. Question part 2/2 | 9709 Oct-Nov 2020 P3 V2 Q4

(b) Hence solve the equation $\tan(\theta + 60^\circ) = 2 \cot \theta$, for $0^\circ < \theta < 180^\circ$.

[3]

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42. Question part 1/2 | 9709 Oct-Nov 2020 P3 V3 Q6

- 6 (a)** Express $\sqrt{6} \cos \theta + 3 \sin \theta$ in the form $R \cos(\theta - \alpha)$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$. State the exact value of R and give α correct to 2 decimal places. [3]

[illegible]

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42. Question part 2/2 | 9709 Oct-Nov 2020 P3 V3 Q6

(b) Hence solve the equation $\sqrt{6} \cos \frac{1}{3}x + 3 \sin \frac{1}{3}x = 2.5$, for $0^\circ < x < 360^\circ$. [4]

[illegible]

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43. Question | 9709 Feb-March 2021 P3 V2 Q3

- 3** By first expressing the equation $\tan(x + 45^\circ) = 2 \cot x + 1$ as a quadratic equation in $\tan x$, solve the equation for $0^\circ < x < 180^\circ$. [6]

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44. Question part 1/2 | 9709 Feb-March 2021 P3 V2 Q5

- 5 (a)** Express $\sqrt{7} \sin x + 2 \cos x$ in the form $R \sin(x + \alpha)$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$. State the exact value of R and give α correct to 2 decimal places. [3]

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44. Question part 2/2 | 9709 Feb-March 2021 P3 V2 Q5

(b) Hence solve the equation $\sqrt{7} \sin 2\theta + 2 \cos 2\theta = 1$, for $0^\circ < \theta < 180^\circ$. [5]

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45. Question | 9709 May-June 2021 P3 V1 Q3

3 (a) Given that $\cos(x - 30^\circ) = 2 \sin(x + 30^\circ)$, show that $\tan x = \frac{2 - \sqrt{3}}{1 - 2\sqrt{3}}$. [4]

[illegible]

(b) Hence solve the equation

$$\cos(x - 30^\circ) = 2 \sin(x + 30^\circ),$$

for $0^\circ < x < 360^\circ$. [2]

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4 (a) Prove that $\frac{1 - \cos 2\theta}{1 + \cos 2\theta} \equiv \tan^2 \theta$. [2]

[illegible]

(b) Hence find the exact value of $\int_{\frac{1}{2}\pi}^{\frac{1}{3}\pi} \frac{1 - \cos 2\theta}{1 + \cos 2\theta} d\theta$. [4]

[illegible]

Topical questions | 91 questions

6 (a) Prove that $\operatorname{cosec} 2\theta - \cot 2\theta \equiv \tan \theta$. [3]

This image shows a full page of white paper with ten horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and run across the entire width of the page. There is no text or other markings on the paper.

(b) Hence show that $\int_{\frac{1}{4}\pi}^{\frac{1}{3}\pi} (\operatorname{cosec} 2\theta - \cot 2\theta) \, d\theta = \frac{1}{2} \ln 2.$ [4]

This image shows a full page of white paper with horizontal dashed lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

48. Question part 1/2 | 9709 May-June 2021 P3 V3 Q5

- 5 (a)** By first expanding $\tan(2\theta + 2\theta)$, show that the equation $\tan 4\theta = \frac{1}{2} \tan \theta$ may be expressed as $\tan^4 \theta + 2 \tan^2 \theta - 7 = 0$. [4]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

48. Question part 2/2 | 9709 May-June 2021 P3 V3 Q5

(b) Hence solve the equation $\tan 4\theta = \frac{1}{2} \tan \theta$, for $0^\circ < \theta < 180^\circ$. [3]

[illegible]

Topical questions | 91 questions

2 (a) Express $5 \sin x - 3 \cos x$ in the form $R \sin(x - \alpha)$, where $R > 0$ and $0 < \alpha < \frac{1}{2}\pi$. Give the exact value of R and give α correct to 2 decimal places. [3]

[illegible]

- [illegible]

Topical questions | 91 questions

5 (a) Show that the equation

can be expressed as a quadratic equation in $\tan \theta$. [3]

[illegible][illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

51. Question part 1/2 | 9709 Oct-Nov 2021 P3 V2 Q6

6 (a) Using the expansions of $\sin(3x + 2x)$ and $\sin(3x - 2x)$, show that

$$\frac{1}{2}(\sin 5x + \sin x) \equiv \sin 3x \cos 2x. \quad [3]$$

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9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

51. Question part 2/2 | 9709 Oct-Nov 2021 P3 V2 Q6

(b) Hence show that $\int_0^{\frac{1}{4}\pi} \sin 3x \cos 2x \, dx = \frac{1}{5}(3 - \sqrt{2})$. [3]

[illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

52. Question part 1/2 | 9709 Oct-Nov 2021 P3 V2 Q8

8 (a) By first expanding $(\cos^2 \theta + \sin^2 \theta)^2$, show that

$$\cos^4 \theta + \sin^4 \theta \equiv 1 - \frac{1}{2} \sin^2 2\theta. \quad [3]$$

[illegible]

Topical questions | 91 questions

(b) Hence solve the equation

$$\text{for } 0^\circ < \theta < 180^\circ. \quad [4]$$

[illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

53. Question | 9709 Oct-Nov 2021 P3 V3 Q5

5 Solve the equation $\sin \theta = 3 \cos 2\theta + 2$, for $0^\circ \leq \theta \leq 360^\circ$.

[illegible]

6 (a) By first expanding $\cos(x - 60^\circ)$, show that the expression

$$2 \cos(x - 60^\circ) + \cos x$$

can be written in the form $R \cos(x - \alpha)$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$. Give the exact value of R and the value of α correct to 2 decimal places. [5]

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(b) Hence find the value of x in the interval $0^\circ < x < 360^\circ$ for which $2 \cos(x - 60^\circ) + \cos x$ takes its least possible value. [2]

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9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

55. Question | 9709 Feb-March 2022 P3 V2 Q5

- 5** The angles α and β lie between 0° and 180° and are such that

$$\tan(\alpha + \beta) = 2 \quad \text{and} \quad \tan \alpha = 3 \tan \beta.$$

Find the possible values of α and β .

[6]

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9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

56. Question | 9709 May-June 2022 P3 V1 Q3

3 Solve the equation $2 \cot 2x + 3 \cot x = 5$, for $0^\circ < x < 180^\circ$.

[illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

57. Question | 9709 May-June 2022 P3 V2 Q2

2 Solve the equation $3 \cos 2\theta = 3 \cos \theta + 2$, for $0^\circ \leq \theta \leq 360^\circ$.

[illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

58. Question | 9709 May-June 2022 P3 V3 Q2

2 Solve the equation $\cos(\theta - 60^\circ) = 3 \sin \theta$, for $0^\circ \leq \theta \leq 360^\circ$.

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Topical questions | 91 questions

59. Question | 9709 Oct-Nov 2022 P3 V1 Q4

4 Solve the equation $\tan(x + 45^\circ) = 2 \cot x$ for $0^\circ < x < 180^\circ$.

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9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

60. Question part 1/2 | 9709 Oct-Nov 2022 P3 V1 Q6

6 (a) Prove the identity $\cos 4\theta + 4\cos 2\theta + 3 \equiv 8\cos^4 \theta$.

[4]

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9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

60. Question part 2/2 | 9709 Oct-Nov 2022 P3 V1 Q6

(b) Hence solve the equation $\cos 4\theta + 4 \cos 2\theta = 4$ for $0^\circ \leq \theta \leq 180^\circ$.

[3]

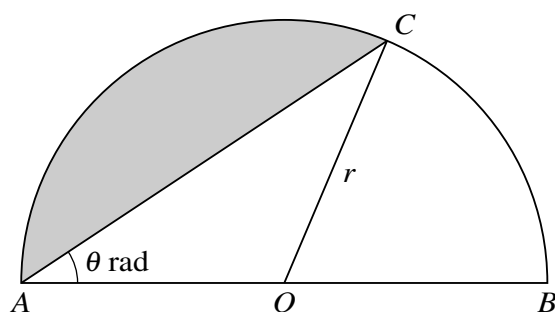
[illegible]

Topical questions | 91 questions

4 (a) Express $4 \cos x - \sin x$ in the form $R \cos(x + \alpha)$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$. State the exact value of R and give α correct to 2 decimal places. [3]

[illegible]

- [illegible]



(a) Show that $\theta = \frac{1}{3}(\pi - 1.5 \sin 2\theta)$. [4]

[illegible]

Topical questions | 91 questions

- [illegible]

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- This image shows a full page of primary-ruled paper. It features ten sets of horizontal lines across the page. Each set consists of three lines: a solid top line, a dashed middle line, and a solid bottom line. The lines are evenly spaced and extend from the left margin to the right edge of the page. There is no handwriting or other markings on the paper.

Topical questions | 91 questions

7 (a) Show that the equation $\sqrt{5} \sec x + \tan x = 4$ can be expressed as $R \cos(x + \alpha) = \sqrt{5}$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$. Give the exact value of R and the value of α correct to 2 decimal places. [4]

[illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

63. Question part 2/2 | 9709 Oct-Nov 2022 P3 V3 Q7

(b) Hence solve the equation $\sqrt{5} \sec 2x + \tan 2x = 4$, for $0^\circ < x < 180^\circ$. [4]

This image shows a full page of a handwriting practice worksheet. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for writing. The lines are evenly spaced across the entire page, providing a guide for letter height and placement. There is no text or other markings on the page.

Topical questions | 91 questions

8 The curve with equation $y = \frac{x^3}{e^x - 1}$ has a stationary point at $x = p$, where $p > 0$.

[illegible]

Topical questions | 91 questions

- [illegible]

- [illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

65. Question part 1/2 | 9709 Feb-March 2023 P3 V2 Q6

6 (a) Express $5 \sin \theta + 12 \cos \theta$ in the form $R \cos(\theta - \alpha)$, where $R > 0$ and $0 < \alpha < \frac{1}{2}\pi$. [3]

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9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

65. Question part 2/2 | 9709 Feb-March 2023 P3 V2 Q6

(b) Hence solve the equation $5 \sin 2x + 12 \cos 2x = 6$ for $0 \leq x \leq \pi$.

[4]

[illegible]

66. Question | 9709 May-June 2023 P3 V1 Q4

4 (a) Show that the equation $\sin 2\theta + \cos 2\theta = 2 \sin^2 \theta$ can be expressed in the form

$$\cos^2 \theta + 2 \sin \theta \cos \theta - 3 \sin^2 \theta = 0. \quad [2]$$

[illegible]

(b) Hence solve the equation $\sin 2\theta + \cos 2\theta = 2 \sin^2 \theta$ for $0^\circ < \theta < 180^\circ$. [4]

This image shows a full page of a handwriting practice worksheet. It consists of ten sets of horizontal dashed lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

67. Question | 9709 May-June 2023 P3 V2 Q4

4 Solve the equation $2 \cos x - \cos \frac{1}{2}x = 1$ for $0 \leq x \leq 2\pi$. [5]

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Topical questions | 91 questions

6 (a) Express $3 \cos x + 2 \cos(x - 60^\circ)$ in the form $R \cos(x - \alpha)$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$. State the exact value of R and give α correct to 2 decimal places. [4]

This image shows a full page of a handwriting practice worksheet. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for writing. The lines are evenly spaced across the entire page, providing a guide for letter height and placement. There is no text or other markings on the page.

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

68. Question part 2/2 | 9709 May-June 2023 P3 V3 Q6

(b) Hence solve the equation

$$3 \cos 2\theta + 2 \cos(2\theta - 60^\circ) = 2.5$$

for $0^\circ < \theta < 180^\circ$.

[4]

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9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

69. Question part 1/2 | 9709 Oct-Nov 2023 P3 V1 Q5

5 (a) Given that

$$\sin\left(x + \frac{1}{6}\pi\right) - \sin\left(x - \frac{1}{6}\pi\right) = \cos\left(x + \frac{1}{3}\pi\right) - \cos\left(x - \frac{1}{3}\pi\right),$$

find the exact value of $\tan x$.

[4]

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9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

69. Question part 2/2 | 9709 Oct-Nov 2023 P3 V1 Q5

(b) Hence find the exact roots of the equation

$$\sin\left(x + \frac{1}{6}\pi\right) - \sin\left(x - \frac{1}{6}\pi\right) = \cos\left(x + \frac{1}{3}\pi\right) - \cos\left(x - \frac{1}{3}\pi\right)$$

for $0 \leq x \leq 2\pi$.

[2]

[illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

70. Question part 1/2 | 9709 Oct-Nov 2023 P3 V2 Q7

7 (a) By expressing 3θ as $2\theta + \theta$, prove the identity $\cos 3\theta \equiv 4\cos^3 \theta - 3\cos \theta$. [3]

[illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

70. Question part 2/2 | 9709 Oct-Nov 2023 P3 V2 Q7

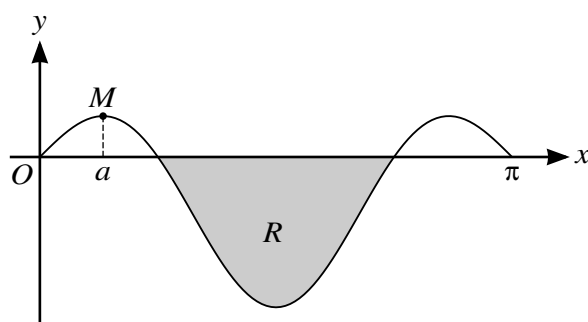
(b) Hence solve the equation

$$\cos 3\theta + \cos \theta \cos 2\theta = \cos^2 \theta$$

for $0^\circ \leq \theta \leq 180^\circ$.

[5]

[illegible]



(a) Find the value of a correct to 2 decimal places. [5]

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dashed lines, providing a guide for letter height and placement. The lines are evenly spaced across the entire page, which is otherwise blank white space.

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

71. Question part 2/2 | 9709 Oct-Nov 2023 P3 V2 Q9

(b) Find the exact area of the region R , giving your answer in simplified form.

[4]

[illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

72. Question part 1/2 | 9709 Oct-Nov 2023 P3 V3 Q6

6 (a) Show that the equation $\cot^2 \theta + 2 \cos 2\theta = 4$ can be written in the form

$$4 \sin^4 \theta + 3 \sin^2 \theta - 1 = 0. \quad [3]$$

[illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

72. Question part 2/2 | 9709 Oct-Nov 2023 P3 V3 Q6

(b) Hence solve the equation $\cot^2 \theta + 2 \cos 2\theta = 4$, for $0^\circ < \theta < 360^\circ$.

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9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

73. Question part 1/2 | 9709 Feb-March 2024 P3 V2 Q8

- 8 (a)** Express $3 \sin x + 2\sqrt{2} \cos\left(x + \frac{1}{4}\pi\right)$ in the form $R \sin(x + \alpha)$, where $R > 0$ and $0 < \alpha < \frac{1}{2}\pi$. State the exact value of R and give α correct to 3 decimal places. [4]

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dashed lines, providing a guide for letter height and placement. The lines are evenly spaced across the entire page, leaving ample room for writing practice. There is no text or other markings on the page.

Topical questions | 91 questions

(b) Hence solve the equation

$$6 \sin \frac{1}{2} \theta + 4 \sqrt{2} \cos \left(\frac{1}{2} \theta + \frac{1}{4} \pi \right) = 3$$

for $-4\pi < \theta < 4\pi$.

[5]

This image shows a full page of a handwriting practice worksheet. It consists of multiple rows of horizontal dotted lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.

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Topical questions | 91 questions

74. Question part 1/2 | 9709 May-June 2024 P3 V2 Q7

7 (a) Show that $\cos^4 \theta - \sin^4 \theta \equiv \cos 2\theta$. [3]

[illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

74. Question part 2/2 | 9709 May-June 2024 P3 V2 Q7

(b) Hence find the exact value of $\int_{-\frac{1}{8}\pi}^{\frac{1}{8}\pi} (\cos^4 \theta - \sin^4 \theta + 4 \sin^2 \theta \cos^2 \theta) d\theta$. [6]

This image shows a full page of white paper designed for handwriting practice. It features approximately 20 evenly spaced horizontal dotted lines running across the width of the page. There are no margins, text, or other markings present.

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Topical questions | 91 questions

75. Question part 1/2 | 9709 May-June 2024 P3 V3 Q8

- 8** (a) Express $3 \cos 2x - \sqrt{3} \sin 2x$ in the form $R \cos(2x + \alpha)$, where $R > 0$ and $0 < \alpha < \frac{1}{2}\pi$. Give the exact values of R and α . [3]

This image shows a full page of white paper with horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and run across the entire width of the page. There are no margins, text, or other markings present.

(b) Hence find the exact value of $\int_0^{\frac{1}{12}\pi} \frac{3}{(3 \cos 2x - \sqrt{3} \sin 2x)^2} dx$, simplifying your answer. [5]

[illegible]

9709 Mathematics Paper 3 - Trigonometry

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76. Question part 1/2 | 9709 Oct-Nov 2024 P3 V1 Q4

4 (a) Show that $\sec^4 \theta - \tan^4 \theta \equiv 1 + 2 \tan^2 \theta$. [3]

[illegible]

Topical questions | 91 questions

[illegible]

Topical questions | 91 questions

2 (a) By sketching a suitable pair of graphs, show that the equation $\cot 2x = \sec x$ has exactly one root in the interval $0 < x < \frac{1}{2}\pi$. [2]

$$x_{n+1} = \frac{1}{2} \tan^{-1}(\cos x_n)$$

converges, then it converges to the root in part (a). [1]

[illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

78. Question part 1/2 | 9709 Oct-Nov 2024 P3 V2 Q7

7 (a) Show that the equation $\tan^3 x + 2 \tan 2x - \tan x = 0$ may be expressed as

$$\tan^4 x - 2 \tan^2 x - 3 = 0$$

for $\tan x \neq 0$.

[3]

[illegible]

9709 Mathematics Paper 3 - Trigonometry

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78. Question part 2/2 | 9709 Oct-Nov 2024 P3 V2 Q7



- (b) Hence solve the equation $\tan^3 2\theta + 2 \tan 4\theta - \tan 2\theta = 0$ for $0 < \theta < \pi$. Give your answers in exact form. [3]

[illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

79. Question part 1/2 | 9709 Oct-Nov 2024 P3 V3 Q5

5 (a) Show that $\cos^4 \theta - \sin^4 \theta - 4 \sin^2 \theta \cos^2 \theta \equiv \cos^2 2\theta + \cos 2\theta - 1$. [3]

This image shows a full page of a handwriting practice worksheet. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for letter height. The entire page is otherwise blank, with no text or other markings.

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

79. Question part 2/2 | 9709 Oct-Nov 2024 P3 V3 Q5



(b) Solve the equation $\cos^4 \alpha - \sin^4 \alpha = 4 \sin^2 \alpha \cos^2 \alpha$ for $0^\circ \leq \alpha \leq 180^\circ$. [3]

This image shows a full page of a handwriting practice worksheet. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for letter height. The entire page is otherwise blank, with no margins, text, or other markings.

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

80. Question | 9709 Feb-March 2025 P3 V2 Q4

- 4** By first expressing the equation $\tan(x - 60^\circ) = 2 \cot x$ as a quadratic equation in $\tan x$, solve the equation for $0^\circ \leq x \leq 180^\circ$. [6]

[illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

81. Question part 1/2 | 9709 May-June 2025 P3 V1 Q7

- 7 (a) Express $5 \sin\left(x + \frac{1}{6}\pi\right) - 4 \cos x$ in the form $R \sin(x - \alpha)$, where $R > 0$ and $0 < \alpha < \frac{1}{2}\pi$. State the exact value of R and give the value of α correct to 3 decimal places. [4]

[illegible]

Topical questions | 91 questions



- [illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

82. Question | 9709 May-June 2025 P3 V2 Q4

4 Solve the equation $3 \cot x - 4 \cot 2x = 3$ for $0^\circ \leq x \leq 180^\circ$. [6]

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9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

83. Question part 1/2 | 9709 May-June 2025 P3 V2 Q7

- 7 (a) Express $7 \sin \theta + 24 \cos \theta$ in the form $R \cos(\theta - \alpha)$, where $R > 0$ and $0 < \alpha < \frac{1}{2}\pi$. Give the value of α correct to 4 decimal places. [3]

[illegible]

Topical questions | 91 questions

[illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

84. Question part 1/2 | 9709 May-June 2025 P3 V3 Q8

8 (a) Prove the identity $\cot^2\theta - \tan^2\theta \equiv 4 \cot 2\theta \operatorname{cosec} 2\theta$. [4]

[illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

84. Question part 2/2 | 9709 May-June 2025 P3 V3 Q8



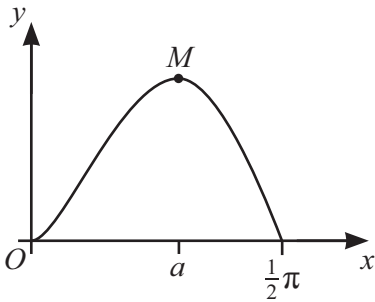
(b) Hence solve the equation $\cot^2 x - \tan^2 x = 5 \sec 2x$ for $0^\circ < x < 90^\circ$.

[4]

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85. Question part 1/3 | 9709 May-June 2025 P3 V3 Q11

11



The diagram shows the curve $y = \sqrt{x} \sin 2x$ for $0 \leq x \leq \frac{1}{2}\pi$. The curve has a maximum point at M , where $x = a$.

(a) Show that $\tan 2a = -4a$ [4]

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(b) Show by calculation that $0.9 < a < 0.95$. [2]

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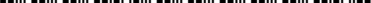
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- $$x_{n+1} = \frac{1}{2} \left(\pi - \tan^{-1}(4x_n) \right)$$

[illegible]

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- This image shows a full page of white paper with horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings present.

Topical questions | 91 questions



If you use the following page to complete the answer to any question, the question number must be clearly shown.

[illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

86. Question | 9709 May-June 2025 P3 V5 Q2

2 Solve the equation $3 \cot \theta - 4 \operatorname{cosec}^2 \theta + 5 = 0$ for $-\pi \leq \theta \leq \pi$. [5]

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Topical questions | 91 questions

8 (a) By sketching a suitable pair of graphs, show that the equation $\sec 2x = -2x - \frac{1}{2}$ has exactly one root in the interval $0 \leq x \leq \frac{1}{2}\pi$. [2]

(b) Show by calculation that this root lies between 0.8 and 1.2. [2]

[illegible]

- $$x_{n+1} = \frac{1}{2} \cos^{-1} \left(\frac{-2}{4x_n + 1} \right)$$

[illegible]

-
- This image shows a full page of primary-ruled paper. It contains ten identical horizontal rows. Each row is defined by three evenly spaced dotted lines, creating a template for handwriting practice where students can learn to form letters consistently in size and position. The entire page is white, and the dotted lines are light gray or black.

9709 Mathematics Paper 3 - Trigonometry

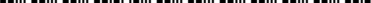
Topical questions | 91 questions

88. Question part 1/2 | 9709 Oct-Nov 2025 P3 V1 Q3

3 (a) Express $3\sqrt{2}\sin(x+45^\circ) + \cos x$ in the form $R\cos(x-\alpha)$, where $R > 0$ and $0^\circ < \alpha < 90^\circ$. [4]

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Topical questions | 91 questions

[illegible]

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Topical questions | 91 questions

89. Question part 1/2 | 9709 Oct-Nov 2025 P3 V2 Q8

8 (a) Prove the identity $\sin 4x \equiv 4 \sin x (2 \cos^3 x - \cos x)$. [3]

This image shows a full page of a worksheet designed for handwriting practice. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for writing. The entire page is otherwise blank, with no text or other markings.

Topical questions | 91 questions

[illegible]

9709 Mathematics Paper 3 - Trigonometry

Topical questions | 91 questions

90. Question part 1/3 | 9709 Oct-Nov 2025 P3 V3 Q5

5 (a) Show that $\cos 4x + 2 \sin^2 x - 1 \equiv 8 \sin^4 x - 6 \sin^2 x$. [4]

[illegible]

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This image shows a full page of white paper with horizontal dotted lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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90. Question part 3/3 | 9709 Oct-Nov 2025 P3 V3 Q5



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Topical questions | 91 questions

8 (a) Express $3\sqrt{3}\sin\left(\theta + \frac{1}{6}\pi\right) - 2\sin\theta$ in the form $R\sin(\theta + \alpha)$, where $R > 0$ and $0 < \alpha < \frac{1}{2}\pi$. Give the exact value of R and state the value of α correct to 3 decimal places. [5]

[illegible]

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91. Question part 2/2 | 9709 Oct-Nov 2025 P3 V5 Q8



(b) Hence, solve the equation $3\sqrt{3}\sin\left(2x + \frac{1}{6}\pi\right) - 2\sin 2x = \sqrt{6}$ for $0 < x < \pi$. [4]

[illegible]