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$$V = \frac{V_0}{r^2 - 1}$$

$$\sqrt{r^2 - 1} V = V_0$$

$$(r^2 - 1) V^2 = V_0^2$$

$$r^2 = \frac{V_0^2}{V^2} + 1$$

$$r = \sqrt{\frac{V_0^2}{V^2} + 1}$$

x
x

74/12 Agreed

① ✓

Second Marker
SDP

2.

a) $5(3x - 2) - 2(4x - 3) + 25 = 0$

$$15x - 10 - 8x + 6 + 25 = 0 \quad \checkmark$$

$$7x + 21 = 0 \quad \checkmark$$

$$x = \frac{-21}{7} \quad \checkmark$$

$$x = -3 \quad \checkmark$$

b) $6x^2 + 13x - 5 = 0$

$$x + 13x - 30$$

$$x - 3x + 10x - 30$$

$$x = \frac{-13 \pm \sqrt{13^2 - 4 \times 6 \times -5}}{2 \times 6} \quad \checkmark$$

$$x = -0.5 \quad \times$$

$$x = -1.66 \quad \times$$

④ ✓

② ✓

SDP

$$C. 5 \times 10^{3x+2} = 215$$

$$10^{3x+2} = \frac{215}{5} \quad \checkmark$$

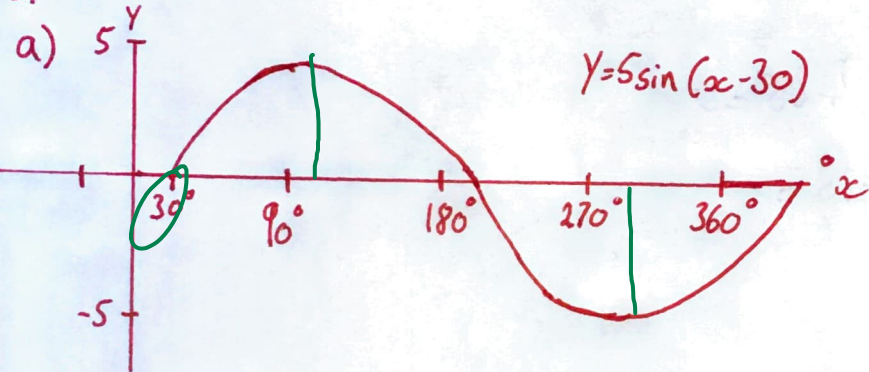
$$\log_{10} 43 = 3x+2 \quad \checkmark$$

$$x = \frac{\log_{10} 43 - 2}{3} \quad \checkmark$$

$$x = -0.12 \quad \checkmark$$

⑥ $\checkmark$

3.



② $\checkmark$

shift not
clear and
not full cycle

$$\sin(x - 30) = 0$$

$$x - 30 = 0$$

$$x = 30^\circ$$

wave starts at 30° $\checkmark$

B.)

$$\sin 2x = -0.5$$

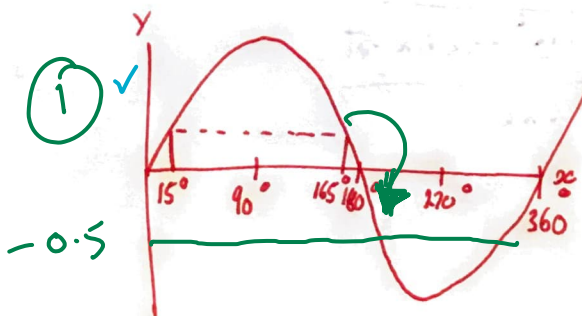
$$2x = \sin^{-1}(-0.5)$$

$$2x = 30^\circ \quad \times$$

$$x = 15^\circ \quad \times$$

$$180 - 15 = 165^\circ$$

$$x = 30^\circ / 165^\circ \quad x = 15^\circ, 165^\circ \quad \times$$



-0.5 is negative
region of wave

JDP

$$4. \quad z_1 = 3 - j5 \quad z_2 = -2 + j4$$

$$a) \quad (3 - j5)(-2 + j4)$$

$$5 - 9j \quad \checkmark$$

(2) ✓

$$b) \quad (3 - j5)(-2 + j4)$$

$$-6 + 12j + 10j - 20j^2 \quad \checkmark$$

$$-6 + 22j + 20 \quad \checkmark$$

$$22j + 14 \quad \checkmark$$

format is $x + jy$ - put real part first

(3) ✓

$$c) \quad \frac{(3 - j5)(-2 - j4)}{(-2 + j4)(-2 - j4)} \quad \checkmark$$

$$\frac{-6 - 12j + 10j + 20j^2}{4 + 8j - 8j + 16j^2} \quad \checkmark$$

$$\frac{-6 - 2j - 20}{4 - 16} \quad \checkmark$$

$$\frac{-26 - 2j}{-12} \quad \checkmark$$

$$\frac{-26 - 2j}{-12} = \frac{-13 - j}{6} \quad \checkmark$$

(6) ✓

split into real and imaginary parts

5. $A = \begin{pmatrix} 4 & -1 \\ 2 & -3 \end{pmatrix}$ $B = \begin{pmatrix} 5 & 0 \\ -2 & 6 \end{pmatrix}$

a) $3A - 2B$

$$\begin{pmatrix} 12 & -3 \\ 6 & -6 \end{pmatrix} - \begin{pmatrix} 10 & 0 \\ -4 & 12 \end{pmatrix} = 2 \begin{pmatrix} 2 & -3 \\ 10 & -21 \end{pmatrix} \checkmark$$

b) AB

$$\begin{pmatrix} 4 & -1 \\ 2 & -3 \end{pmatrix} \begin{pmatrix} 5 & 0 \\ -2 & 6 \end{pmatrix}$$

$$\begin{pmatrix} 4 \times 5 + -1 \times -2 & 4 \times 0 + -1 \times 6 \\ 2 \times 5 + -3 \times -2 & 2 \times 0 + -3 \times 6 \end{pmatrix}$$

~~$4 \times 5 + -1 \times -2$~~

$$\begin{pmatrix} 20 + 2 & 0 + -6 \\ 10 + 6 & 0 + -18 \end{pmatrix} \checkmark$$

$$\begin{pmatrix} 22 & -6 \\ 16 & -18 \end{pmatrix} \checkmark$$

c) BA

$$\begin{pmatrix} 5 & 0 \\ -2 & 6 \end{pmatrix} \begin{pmatrix} 4 & -1 \\ 2 & -3 \end{pmatrix}$$

$$\begin{pmatrix} 5 \times 4 + 0 \times 2 & 5 \times -1 + 0 \times -3 \\ -2 \times 4 + 6 \times 2 & -2 \times -1 + 6 \times -3 \end{pmatrix}$$

$$\begin{pmatrix} 20 + 0 \\ -8 + 12 \end{pmatrix}$$

$$\begin{pmatrix} -5 + 0 \\ 2 + -18 \end{pmatrix} = \begin{pmatrix} -5 & -16 \end{pmatrix} \checkmark$$

BA

$$\begin{pmatrix} 5 & 0 \\ -2 & 6 \end{pmatrix} \begin{pmatrix} 4 & -1 \\ 2 & -3 \end{pmatrix}$$

$$\begin{pmatrix} 5 \times 4 + 0 \times 2 & 5 \times -1 + 0 \times -3 \\ -2 \times 4 + 6 \times 2 & -2 \times -1 + 6 \times -3 \end{pmatrix}$$

$$\begin{pmatrix} 20 + 0 & -5 + 0 \\ -8 + 12 & 2 + -18 \end{pmatrix} = \begin{pmatrix} 20 & -5 \\ 4 & -16 \end{pmatrix} \checkmark$$

$AB \neq BA$ $\checkmark$

3

4

(did not need to repeat this!)

5

JDP

d.

$$A = \begin{pmatrix} 4 & -1 \\ 2 & -3 \end{pmatrix}$$

$$4 \times 3 - 2 \times -1 = 12 - 10 \checkmark$$

rearrange

$$\begin{pmatrix} -3 & 1 \\ 2 & -4 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix}$$

$$-\frac{1}{12} \begin{pmatrix} -3 & 1 \\ 2 & -4 \end{pmatrix} = \begin{pmatrix} \frac{3}{12} & -\frac{1}{12} \\ -\frac{2}{12} & \frac{4}{12} \end{pmatrix} = \begin{pmatrix} \frac{1}{4} & -\frac{1}{12} \\ -\frac{1}{6} & \frac{1}{3} \end{pmatrix}$$

$$\begin{pmatrix} \frac{3}{12} & \frac{1}{12} \\ \frac{2}{12} & \frac{4}{12} \end{pmatrix} = \begin{pmatrix} \frac{1}{4} & \frac{1}{12} \\ \frac{1}{6} & \frac{1}{3} \end{pmatrix}$$

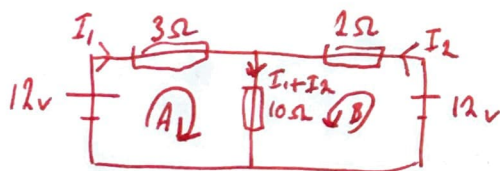
rearrange

$$\begin{pmatrix} -3 & 1 \\ -2 & 4 \end{pmatrix}$$

$$+\frac{1}{10} \begin{pmatrix} -3 & 1 \\ -2 & 4 \end{pmatrix} = \begin{pmatrix} -\frac{3}{10} & \frac{1}{10} \\ -\frac{2}{10} & \frac{4}{10} \end{pmatrix} = \begin{pmatrix} -\frac{3}{10} & \frac{1}{10} \\ -\frac{1}{5} & \frac{2}{5} \end{pmatrix}$$

3

6.



$$12 = I_1 \times 3 + (I_1 + I_2) \times 10$$

$$12 = 13I_1 + 10I_2 \checkmark$$

$$12 = I_2 \times 2 + (I_1 + I_2) \times 10$$

$$12 = 12I_2 + 10I_1 \checkmark$$

$$\begin{bmatrix} 13 & 10 \\ 10 & 12 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 12 \\ 12 \end{bmatrix} \checkmark$$

$$\frac{1}{56} \begin{bmatrix} 12 & -10 \\ -10 & 13 \end{bmatrix} \begin{bmatrix} 13 & 10 \\ 10 & 12 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \frac{1}{56} \begin{bmatrix} 12 & -10 \\ -10 & 13 \end{bmatrix} \begin{bmatrix} 12 \\ 12 \end{bmatrix}$$

$$13 \times 12 - 10 \times 10 = 56$$

$$\frac{1}{56} \begin{bmatrix} 12 & -10 \\ -10 & 13 \end{bmatrix} \begin{bmatrix} 12 \times 13 + -10 \times 10 & 12 \times 10 + -10 \times 12 \\ -10 \times 13 + 13 \times 10 & -10 \times 10 + 13 \times 12 \end{bmatrix}$$

$$\frac{1}{56} \begin{bmatrix} 156 + -100 & 120 + -120 \\ -130 + 130 & -100 + 156 \end{bmatrix}$$

$$\frac{1}{56} \begin{bmatrix} 56 & 0 \\ 0 & 56 \end{bmatrix}$$

$$\frac{1}{56} \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \frac{1}{56} \begin{bmatrix} 12 & -10 \\ -10 & 13 \end{bmatrix} \begin{bmatrix} 12 \\ 12 \end{bmatrix} \checkmark$$

JOP

$$\begin{Bmatrix} I_1 \\ I_2 \end{Bmatrix} = \frac{1}{56} \begin{bmatrix} 12 & -10 \\ -10 & 13 \end{bmatrix} \begin{Bmatrix} 12 \\ 12 \end{Bmatrix}$$

$$\frac{1}{56} \begin{bmatrix} 12 \times 12 + -10 \times 12 \\ -10 \times 12 + 13 \times 12 \end{bmatrix} \quad \checkmark$$

$$\begin{bmatrix} \frac{144}{56} + \frac{-120}{56} \\ \frac{-120}{56} + \frac{156}{56} \end{bmatrix} \quad \checkmark$$

$$\begin{Bmatrix} I_1 \\ I_2 \end{Bmatrix} = \begin{Bmatrix} 24 \\ 36 \end{Bmatrix} \quad \checkmark$$

(16) $\checkmark$

$$I_1 = 24A \quad I_1 + I_2 = 60A \quad \times$$

$$I_2 = 36A$$

7.

a. $(x_1, y_1) (x_2, y_2)$
 $(-2, 3) (4, 5)$

$$\text{gradient} = \frac{5-3}{4-(-2)} = \frac{2}{6} = \frac{1}{3} \quad \checkmark$$

$$y = mx + c$$

$$3 = \frac{1}{3}x - 2 + c \quad \checkmark$$

$$y = mx + c$$

$$3 = 0.5x - 2 + c$$

$$3 + 2 = c$$

$$c = 5$$

$$x = 4$$

$$y = \frac{1}{2}x + 4$$

$$3 + \frac{2}{3} = c$$

$$c = \frac{11}{3} \quad \checkmark$$

$$y = \frac{11}{3}x + \frac{11}{3}$$

$$y = \frac{1}{3}x + \frac{11}{3} \quad \checkmark$$

(5)

b. -reciprocal = -2

$$\text{gradient} = -2$$

$$y = mx + c$$

$$3 = -2 \times 2 + c$$

$$3 - 4 = c$$

$$c = -1$$

$$\text{reciprocal} = -3 \quad \checkmark$$

$$\text{gradient} = -3$$

$$y = mx + c$$

$$3 = -\frac{1}{3} \times 2 + c$$

$$3 = -3 \times 2 + c \quad \checkmark$$

$$c = 3 + 6$$

$$c = 9 \quad \checkmark$$

$$y = -3x + 9 \quad \checkmark$$

(5)

JDP

$$8. a + (n-1)d$$

$$a = 1.5 \quad d = 0.7 \quad n = 50$$

$$1.5 + (50-1)0.7 = \text{£}35.80 \quad \checkmark$$

④ ✓

$$9. a = 10$$

$$\text{if } n = 5$$

$$ar^{n-1} = 700$$

$$10r^{5-1} = 700 \quad \checkmark$$

$$r^4 = \frac{700}{10} \quad \checkmark$$

$$r = \sqrt[4]{70} \quad \checkmark$$

$$r = 2.89$$

1st speed is 10 rpm

2nd speed is $n = 2 \quad a = 10 \quad r = 2.89$

$$ar^{n-1} = 10 \times 2.89^{2-1} = 29 \text{ Rpm} \quad \checkmark$$

3rd speed $n = 3 \quad a = 10 \quad r = 2.89$

$$ar^{n-1} = 10 \times 2.89^{3-1} = 84 \text{ Rpm} \quad \checkmark$$

4th speed $n = 4 \quad a = 10 \quad r = 2.89$

$$ar^{n-1} = 10 \times 2.89^{4-1} = 242 \text{ Rpm} \quad \checkmark$$

5th speed is 700 Rpm

⑧ ✓