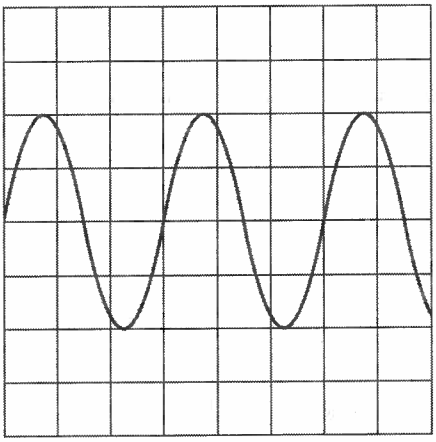
Tutorial Questions

1.	(a)	A sinusoidal alternating voltage has a peak value of 12 V and a frequency of 50 Hz. Calculate its time period.		*2*
	$T = \frac{1}{f} = \frac{1}{50} = 0.02\ s = 20\ ms$			
	(b)	Write an equation that would allow you to work out the instantaneous voltages for a time, *t*, after the voltage went through the 0 point. Include numerical values in the terms.		*2*
	$v = 12 \sin(100\pi t)$			
	(c)	Use your equation to work out instantaneous values for the voltage at these times. Show your working out.		
		(i)	4 ms	*2*
	$v = 12 \sin(100\pi \times 4 \times 10^{-3})$			
	$v = 11.4\ V$			
		(ii)	7 ms	*2*
	$v = 12 \sin(100\pi \times 7 \times 10^{-3})$			
	$v = 9.71\ V$			
		(iii)	18 ms	*2*
	$v = 12 \sin(100\pi \times 18 \times 10^{-3})$			
	$v = -7.05\ V$			

2. The diagram shows a CRO screen:



The voltage gain is set at 0.2 V cm^{-1} and the time base is set at 10 μs cm^{-1}.

(a) Calculate:

(i) The peak to peak voltage; *2*

$4 \times 0.2 = 0.8\ V$

$V_{pk\ to\ pk} = 0.8\ V$

(ii) The RMS voltage; *2*

$V_{RMS} = \frac{0.4}{\sqrt{2}}$

$V_{RMS} = 0.28\ V$

(iii) The frequency. *2*

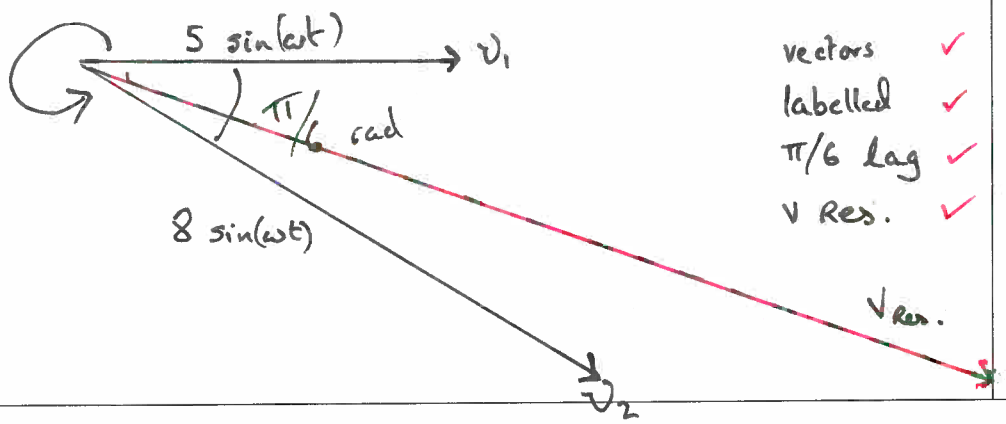
$T = 3 \times 10 \times 10^{-6} = 30 \times 10^{-6}\ s$

$f = \frac{1}{T} = \frac{1}{30 \times 10^{-6}} = 33 \times 10^{3}\ Hz = 33\ kHz.$

(b) The signal generator producing the sinusoidal wave is now adjusted so that it makes a triangular wave of exactly the same peak voltage and frequency. *2*

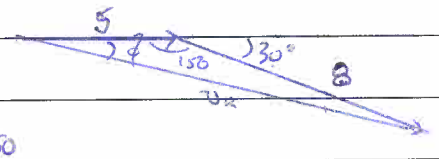
(i) Work out the new RMS voltage.

$V_{RMS} = \frac{0.4}{\sqrt{3}} = 0.231\ V$

3	An alternating voltage is represented by the equation $v = 20\sin(157.1t)$. Work out:		
	(a)	The maximum value of the voltage:	*1*
		$V_0 = 20$ V	
	(b)	The frequency	*2*
		$f = \frac{\omega}{2\pi} = \frac{157.1}{2\pi} = 25$ Hz.	
	(c)	The periodic time	*1*
		$T = \frac{1}{25} = 0.04$ s $= 40$ ms.	
	(d)	What is the angular velocity of the phasor representing this waveform?	*2*
		157.1 rad/s or 50π rad/s.	
4.	The instantaneous voltage of two alternating voltages are given by these two equations: $v_1 = 5\sin(\omega t)$ $v_2 = 8\sin\left(\omega t - \frac{\pi}{6}\right)$		
	(a)	Sketch a phasor diagram for the two voltage vectors.	*4*
			

	(b)	By accurate drawing or resolution of vectors, obtain expressions for:		7
		(i)	$v_1 + v_2$	
		(ii)	$v_1 - v_2$	

(i) $\pi/6$ rad $= 30°$.



Use cosine rule

$v_R^2 = 5^2 + 8^2 - 2 \times 5 \times 8 \times \cos 150$

$= 25 + 64 - 80 \times -0.866$

$= 89 + 69.28 = 158.28$

$V_R = 12.6\,V$

Now use sine rule to get ϕ between v_1 and v_R.

$\frac{\sin 150}{12.6} = \frac{\sin\theta}{8} \Rightarrow \sin\theta = \frac{8 \times 0.5}{12.6} = 0.318$

$\Rightarrow \theta = 18.5° = 0.324$ rad.

$v_1 + v_2 = 12.6 \sin(\omega t - 0.324)$

(ii) $-v_2$ is drawn in opposite direction. *

Resolve the horizontal and vertical components.

$8 \cos 150 + 5 \cos\theta = -1.928$

$8 \sin 150 + 5 \sin\theta = 4$

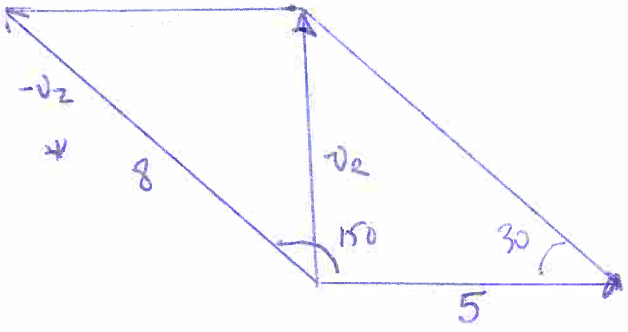
$v_R^2 = -1.928^2 + 4^2 = 19.72 \quad V_R = 4.44\,V.$

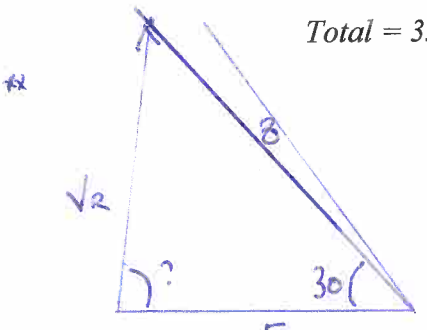
$\tan\phi' = \frac{4}{1.928} = 2.075 \Rightarrow \phi = 64.3°$

$\phi = 90 - \phi' = 90 - 64.3° = 25.7°.$

Phase angle is $90 + 25.7° = 115.7° = 2.02$ rad

$v_1 - v_2 = 4.44 \sin(\omega t + 2.02)$





Total = 35 marks