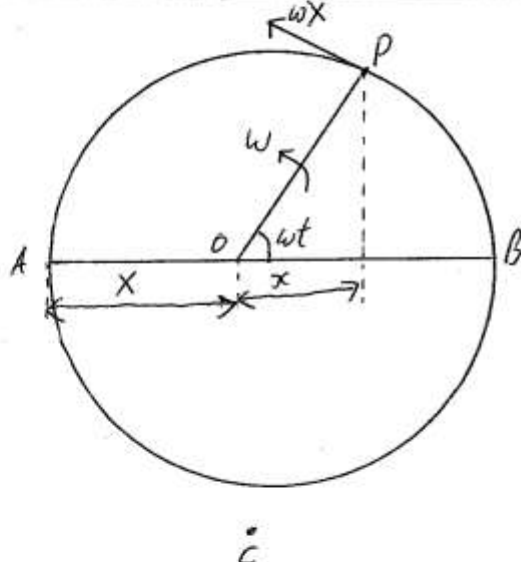




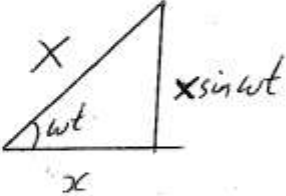
EXAMINATION SOLUTIONS: SESSION 2008/12

School:	LOGISTICS & MANUFACTURING ENGINEERING		
Programme:		Year:	
Module/Unit:	STRESS ANALYSIS & DYNAMICS		
Author:	KELVIN LAKE	Page:	1 of 10 (KL)

Question No	Question	Marks
①	 DISTANCE x: $x = X \cos \omega t$ $\therefore$ VELOCITY $v = \underline{wX \sin \omega t}$ ①	1½

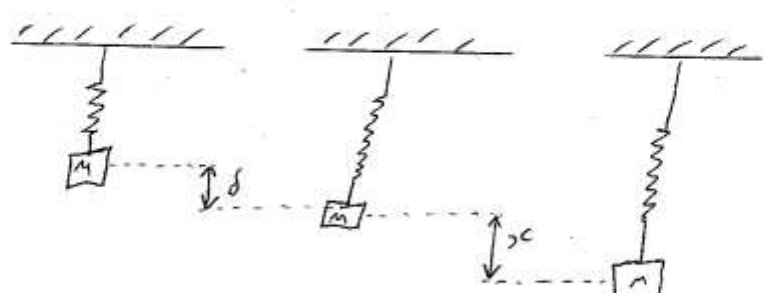
Continuation Sheet

Module/Unit:	STRESS ANALYSIS & DYNAMICS	Page:	2 of 10 (KL)
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Question No	Question	Marks
	 $\therefore (x \sin wt)^2 + x^2 = X^2$ $x \sin wt = \sqrt{X^2 - x^2} \quad (2)$ COMBINING (1) & (2) $v = \omega X \sin wt$ $\underline{\underline{v = \omega \sqrt{X^2 - x^2}}}$ v IS MAX WHEN $x=0$, i.e. WHEN p PASSES 0.	1½ 2

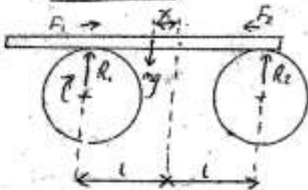
Continuation Sheet

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Question No	Question	Marks
16	 - IN EQUILIBRIUM $mg = k\delta$ - WHEN OSCILLATING RESTORING FORCE $F = kx$ - NEWTON'S 2ND LAW $F = ma$ $kx = ma$ $\underline{\underline{\frac{a}{x} = \frac{k}{m}}}$	

Continuation Sheet

Module/Unit: STATICS ANALYSIS & DYNAMICS Page: 4 of 10 (KL)

Question No	Question	Marker
	<u>Ans</u> $f = \frac{1}{T} = \frac{1}{2\pi} \omega$ <u>Also</u> $a = \omega^2 x \therefore \omega = \sqrt{\frac{a}{x}}$ $\therefore f = \frac{1}{2\pi} \sqrt{\frac{a}{x}}$ $\therefore$ From * $f = \frac{1}{2\pi} \sqrt{\frac{k}{m}}$  Taking moments about R_2 $mg(l+x) = R_1 \times 2l$ $\therefore R_1 = \frac{mg(l+x)}{2l}$ Taking moments about R_1 $mg(1-x) = R_2 \times 2l$ $\therefore R_2 = \frac{mg(1-x)}{2l}$	① ① ② ②

Continuation Sheet

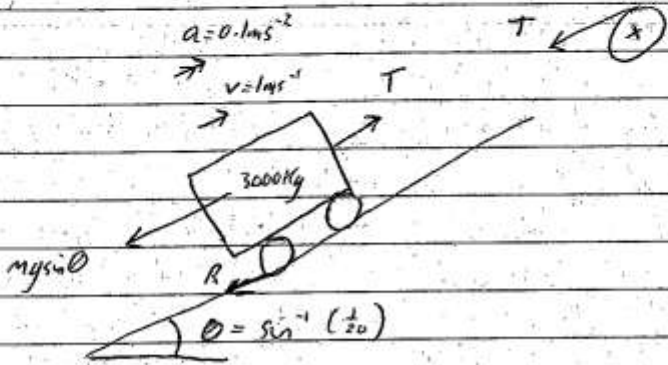
Module/Unit: STRUCTURAL ANALYSIS & DYNAMICS Page: 5 of 10 (KL)

Question No.	Question	Marks
	$F_1 = \mu R_1$ $= \frac{\mu mg}{2l} (1+x)$ $F_2 = \mu R_2$ $= \frac{\mu mg}{2l} (1-x)$ $\therefore \text{RESULTANT FORCE } F = F_1 - F_2$ $= \frac{\mu mg}{2l} (1+x) - \frac{\mu mg}{2l} (1-x)$ $= \frac{\mu mg}{2l} (1+x - (1-x))$ $F = \frac{\mu mgx}{l}$ $\therefore a = \frac{F}{m} = \frac{\mu g x}{l}$ $T = \frac{1}{f} = \frac{2\pi}{\omega} = 2\pi \times \frac{1}{\omega}$ $\text{SINCE } a = \omega^2 x, \omega = \sqrt{\frac{a}{x}}$ $\therefore T = 2\pi \sqrt{\frac{\text{DISPLACEMENT}}{\text{ACCELERATION}}}$ $= 2\pi \sqrt{\frac{x}{\mu g x}}$ $\therefore T = 2\pi \sqrt{\frac{l}{\mu g}}$	(2) (2) (2)

Continuation Sheet

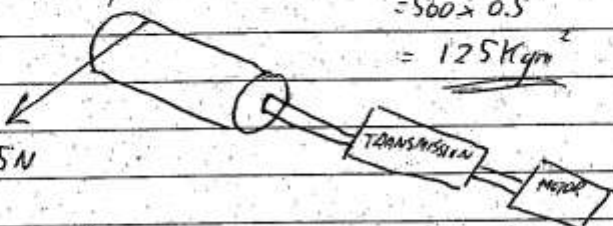
Module/Unit: STRESS ANALYSIS & DYNAMICS

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Question No.	Question	Marks
2	 $a = 0.1 \text{ ms}^{-2}$ $v = 1 \text{ ms}^{-1}$ 3000 kg $m g \sin \theta$ R $\theta = \sin^{-1} \left(\frac{1}{20} \right)$ NET ACCELERATING FORCE, $F_{\text{NET}} = T - (R + m g \sin \theta)$ $\therefore m a = T - (R + m g \sin \theta)$ $3000 \times 0.1 = T - (1000 + 3000 \times 9.81 \left(\frac{1}{20} \right))$ $300 = T - (1000 + 1471.5)$ $T = 300 + 2471.5$ $\therefore T = \underline{\underline{2771.5 \text{ N}}}$	1

Continuation Sheet

Module/Unit	STRESS ANALYSIS & DYNAMICS	Page	7 of 10 (KL)
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Question No.	Question	Marks
2	CONSIDER WINDING DRUM	
cont.	 $I_0 = M_0 \times k_0^2$ $= 500 \times 0.5^2$ $= 125 \text{ Kg m}^2$	1
	$T = 2771.5 \text{ N}$	
	$\text{TORQUE FROM ROPE} = T \times r_0$ $= 2771.5 \times 0.6$ $= 1662.9 \text{ Nm}$	1
	$\text{ANGULAR ACC}^n \text{ OF DRUM } \alpha = \frac{a}{r_0} = \frac{0.1}{0.6} = 0.167 \text{ rad/s}^2$	1
	$\text{TORQUE TO ACC DRUM} = I_0 \alpha = 125 \times 0.167 = 20.8 \text{ Nm}$	1
	$\text{TOTAL TORQUE} = 1662.9 + 20.8 = 1683.7 \text{ Nm}$	1
	$\text{ANGULAR SPEED OF DRUM } \omega_0 = \frac{v}{r_0} = \frac{1}{0.6} = 1.67 \text{ rad/s}$	1
	$\text{POWER AT DRUM} = \text{TORQUE} \times \omega_0$ $= 1683.7 \times 1.67$ $= 2811.8 \text{ W}$	1
	$\text{TRANSMISSION IS } 85\% \text{ EFFICIENT } \therefore$ $\text{WAT MTR} = \frac{2811.8}{0.85} = 3308 \text{ W}$	1

Continuation Sheet

Module/Unit:	STRESS ANALYSIS & DYNAMICS	Page:	8 of 10 (KL)
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Question No.	Question	Marks
2b		
①	Velocity-Time graph showing acceleration, constant velocity, and deceleration phases. $t_0 = 0$ $t_1 = 15$ $t_2 = 30$ $t_3 = 31.8$	2
	$t_1: v = u + at$ $\therefore t_1 = \frac{v-u}{a} = \frac{1.5-0}{0.1} = \underline{\underline{15 \text{ sec}}}$	1
	$t_2: t_2 = t_1 + 15 = \underline{\underline{30 \text{ sec}}}$	1
	$t_3: \text{DECELERATING FORCE: } F = 1000 + mg \sin \theta$ $= 1000 + 3000 \times 9.81 \left(\frac{1}{20} \right)$ $= \underline{\underline{2471.5 \text{ N}}}$	1
	$\therefore F = ma \therefore a = \frac{F}{m} = \frac{2471.5}{3000} = 0.82 \text{ ms}^{-2}$	
	$t = \frac{v-u}{a} = \frac{0-1.5}{-0.82} = \underline{\underline{1.82 \text{ seconds}}}$	
	$\therefore t_3 = t_2 + 1.8 = \underline{\underline{31.8 \text{ sec}}}$	1

Continuation Sheet

Module/Unit	STRESS ANALYSIS & DYNAMICS	Page	9 of 10 (KL)
Question No	Question	Marks	
4b ii	= AREA UNDER GRAPH TOTAL DISTANCE = $\frac{15 \times 1.5}{2} + 15 \times 1.5 + \frac{1.8 \times 1.5}{2}$ = $11.25 + 22.5 + 1.35$ = <u>35.1m</u>	21	
(10)	$v = 1$ $a = 0.1$ $t = \frac{v-u}{a} = \frac{1-0}{0.1} = \underline{10 \text{ sec}}$ (X MARKED ON GRAPH)	1	
(10)	~~QUESTION~~ ~~ANSWER~~		

Continuation Sheet

Module/Unit:

STRIPS ANALYSIS & DYNAMICS

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