INTI International University & Colleges

FINAL
Examination Paper

(COVER PAGE)

Session	:	**August 2019**
Programme	:	Diploma In Mechanical Engineering (DMEN)
Course	:	**EGM1181 : Engineering Dynamics**
Date of Examination	:	December 13, 2019 (Friday)
Time	:	5:00 pm -7:00 pm Reading Time: Nil
Duration	:	2 Hours
Special Instructions	:	

This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Materials permitted :

Non-Programmable Calculator

Materials provided :

Formula Sheet

Examiner (s)	:	**Tham Chan Seng** and Phua Chin Lai
Moderator	:	Associate Professor Dr Seyed Amirmostafa Jourabchi

*This paper consists of **8** printed pages, including the cover page.*

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
EGM1181: ENGINEERING DYNAMICS
FINAL EXAMNINATION: AUGUST 2019 SESSION

Instructions: This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Question 1

(a) A freight train shown in Figure Q1(a) travels at $v = 60(1 - e^{-t})$ m/s, starts from rest.

(i) Determine the distance s_t traveled in time 3 s, and

(4 marks)

(ii) the acceleration at this time.

(3 marks)

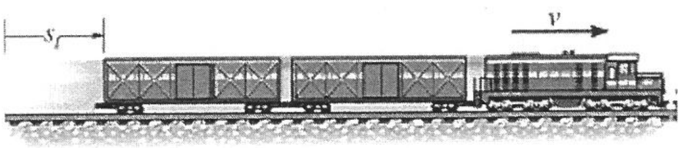

Figure Q1 (a)

(b) The *v-t* graph for the motion of a car as it moves along a straight road is shown in Figure Q1 (b). The car starts from rest at $s = 0$. For the time interval $0 < t < 30$ s.

(i) Draw the *s-t* graph,

(15 marks)

(ii) determine the distance traveled and the average speed.

(3 marks)

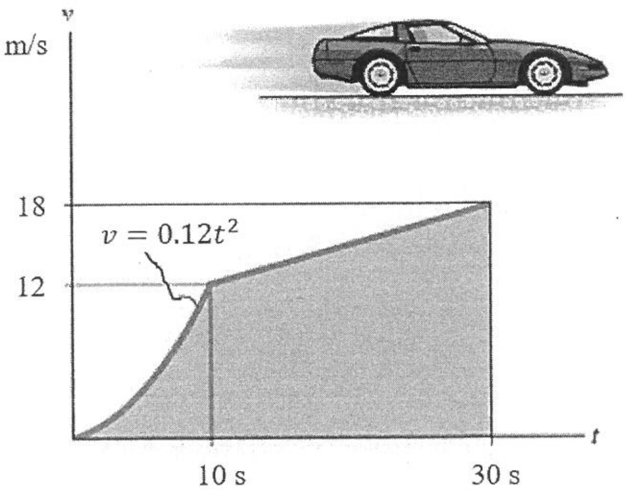

Figure Q1 (b)

Question 2

(a) The sled and rider have a total mass, 80 kg and start from rest at point $A(10\text{ m}, 0)$. If the sled descends the smooth slope, which is a parabola

$$y = 5\left(\frac{x}{10}\right)^2 - 5,$$

determine the normal force that the ground exerts on the sled at the instant it arrives at point B. Given the velocity at B is 9.9 m/s and neglect the size of the sled and rider.

(7 marks)

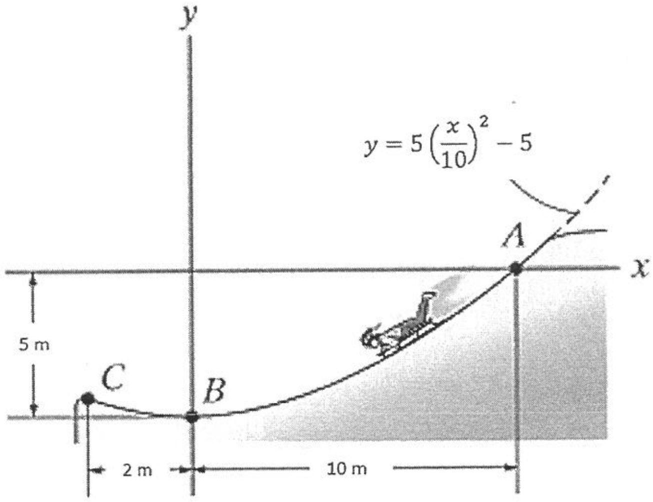

Figure Q2 (a)

(b) The particle A has a mass of 0.5 kg and is confined to move along the smooth horizontal slot due to the rotation of the arm OA. The rod is rotating with angular velocity $\dot{\theta} = 2$ rad/s and angular acceleration $\ddot{\theta} = 3$ rad/s². Assume the particle contacts only one side of the slot at any instant. Determine

(i) the radial and transverse acceleration the particle when $\theta = 30°$,

(12 marks)

(ii) the force of the rod on the particle and normal force of the slot on the particle when $\theta = 30°$.

(6 marks)

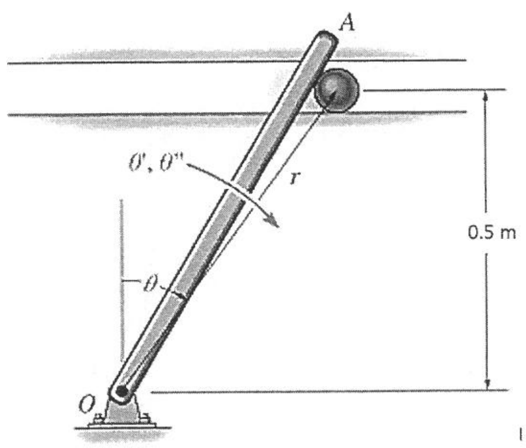

Figure Q2 (b)

Question 3

(a) The block has mass, 150 kg and rests on a surface for which the coefficients of static and kinetic friction are $\mu_s = 0.5$ and $\mu_k = 0.4$ respectively. If a force $F = 60t^2$ N is applied to the cable,

(i) Determine the time needed for the force to cause motion. (3 marks)

(ii) Determine the power developed by the force at $t = 5$ s. (Hint: the acceleration is not a constant) (8 marks)

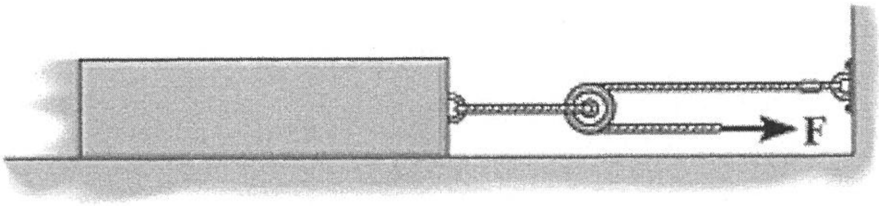

Figure Q3 (a)

(b) The collar D with weight of $W = 25$ N, is released from rest at A and travels along the smooth guide. The spring has an unstretched length L = 30 cm, and point C is located just before the end of the curved portion of the rod.

(i) Determine its speed when its center reaches point C and (6 marks)

(ii) the normal force it exerts on the rod at this point C. (8 marks)

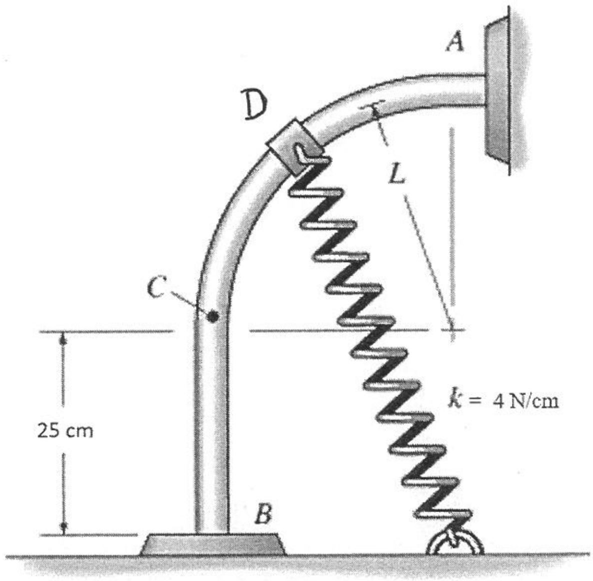

Figure Q3 (b)

Question 4

(a) Block A has a mass $M_A = 3$ kg and is sliding on a rough horizontal surface with a velocity 2 m/s when it makes a direct collision with block B, which has a mass $M_B = 2$ kg and is originally at rest. The coefficient of kinetic friction between the blocks and the plane is $\mu_k = 0.3$. If the collision is perfectly elastic ($e = 1$),

(i) determine the velocity of each block just after collision and

(7 marks)

(ii) the distance between the blocks when they stop sliding.

(7 marks)

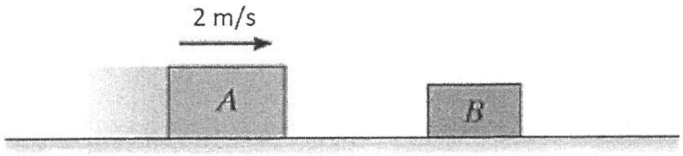

Figure Q4 (a)

(b) The crankshaft AB is rotating at constant angular velocity ω =150 rad/s. Determine the velocity of the piston P for the given $\theta = 30°$.

(11 marks)

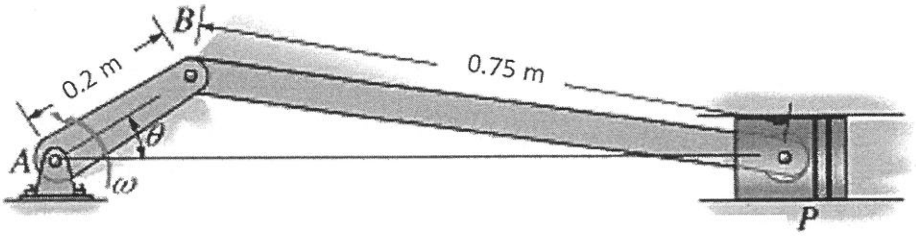

Figure Q4 (b)

Question 5

(a) The forklift shown in Figure Q5(a) and operator have combined weight $W = 50$ kN and center of mass at G. If the forklift is used to lift the concrete pipe of weight $Wp = 10$ kN, determine the normal reactions on each of its four wheels if the pipe is given upward acceleration $a = 1.2$ m/s^2.

(13 marks)

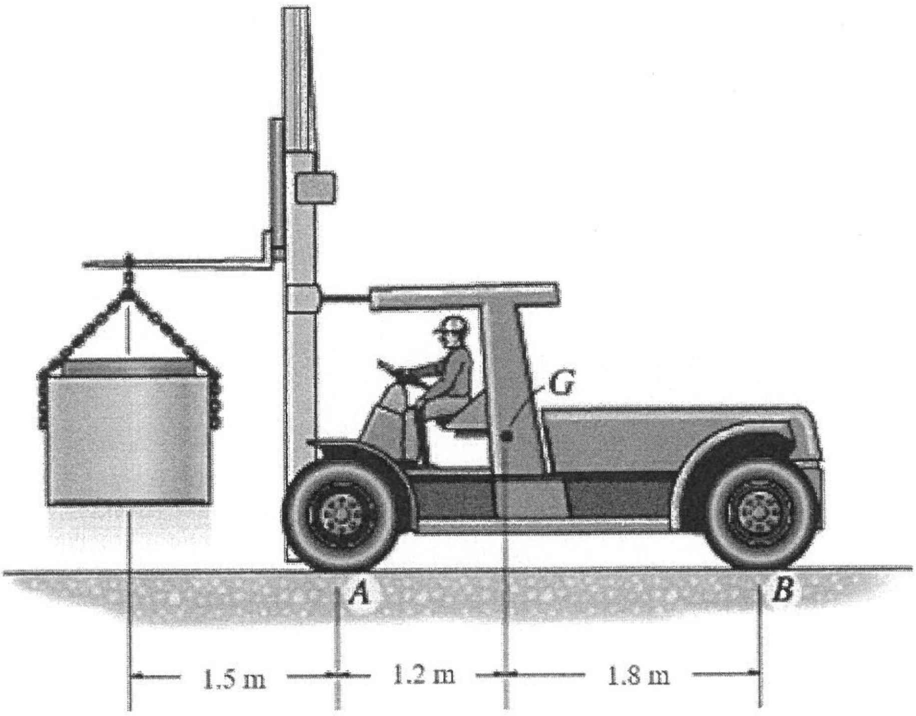

Figure Q5(a)

(b) A cord is wrapped around the outer surface of the 8 kg disk shown in Figure Q5(b). If a force $F = (\frac{1}{4}\theta^2)$ N, where θ is in radians, is applied to the cord, determine the disk's angular acceleration when it has turned 5 resolutions. The disk has an initial angular velocity of $\omega_0 = 1\frac{rad}{s}$.

(12 marks)

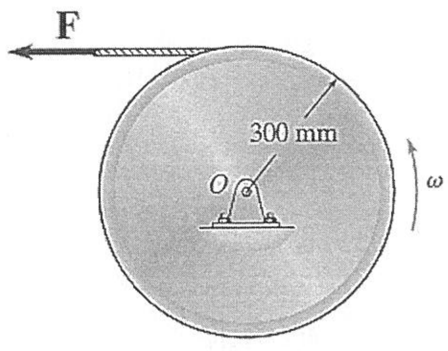

Figure Q5(b)

Question 6

(a) The mechanism in Figure Q6 (a) consists of two rods, *AB* and *BC*, which have weights 100 N and 200 N respectively, and a block at *C* with mass of 4 kg. Determine the kinetic energy of the system at the instant shown, when the block is moving at speed $v_C = 1$ m/s.

(15 marks)

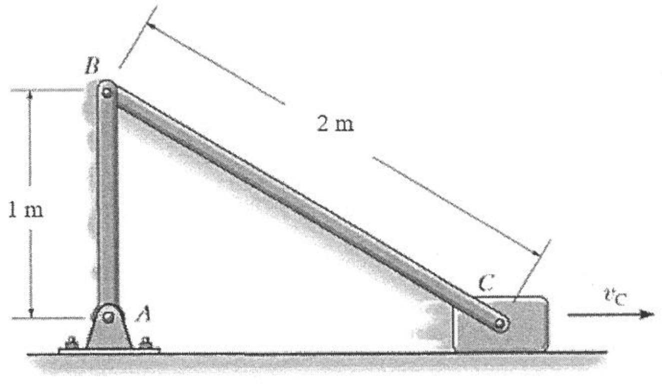

Figure Q6 (a)

(b) When slender bar *AB* of mass, 10 kg is horizontal it is at rest and the spring is unstretched. Determine the stiffness *k* of the spring so that the motion of the bar AB is momentarily stopped when it has rotated downward 90°.

(10 marks)

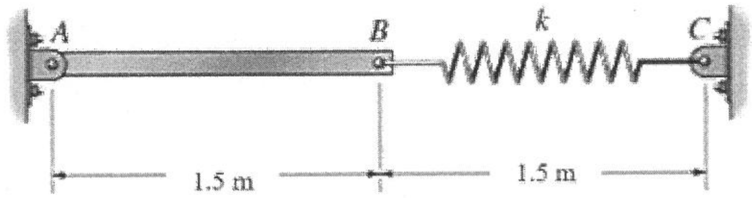

Figure Q6 (b)

Formula Sheet:

Curvilinear motion:

$a_n = \frac{v^2}{\rho}$

$a_t = \frac{dv}{dt}$

Polar Coordinate System or r-θ

$v_r = \dot{r} = \frac{dr}{dt}$ v_r =radial component of velocity

$a_r = \ddot{r} - r\left(\dot{\theta}\right)^2$ a_r =Radial acceleration

$v_\theta = r\dot{\theta} = r\frac{d\theta}{dt}$ v_θ = transverse component

$a_\theta = r\ddot{\theta} + 2\left(\dot{r}\right)\left(\dot{\theta}\right)$ a_θ = transverse acceleration

Work-Energy Equation:

$$W = \frac{1}{2}m(v^2 - u^2)$$

Work done by spring force $W_s = \frac{1}{2}kx^2$

Impulse-Momentum Equation:

$Ft = mv - mu$

$\int_{t1}^{t2} F dt = m(v - u)$

Kinetic Energy (Rotation)

For Disc: $E_k = \frac{1}{2}I_m\omega^2$ $I_m = \frac{1}{2}mr^2$

Moment of Inertia

$M = I_m\alpha$ Where M = moment

$V = \omega r$ $a = \alpha r$

Radius of Curvature $\rho = \frac{\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{3/2}}{\left|\frac{d^2y}{dx^2}\right|}$

-THE END –