UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF MARINE ENGINEERING TECHNOLOGY

FINAL EXAMINATION
JANUARY 2017 SEMESTER

COURSE CODE	:	LGB10203
COURSE NAME	:	ENGINEERING SCIENCE
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	BACHELOR OF ENGINEERING TECHNOLOGY (HONS) IN MARINE ENGINEERING
DATE	:	03/07/2017 MON
TIME	:	2.00 PM - 05.00 PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read CAREFULLY the instructions given in the question paper.
2. This question paper has information printed on both sides.
3. This question paper consists of FIVE (5) questions. Answer FOUR (4) questions only.
4. Please write yours answers on the answer booklet provided.
5. Write your answers only in BLACK or BLUE ink.
6. Answer all questions in English.

THERE ARE 8 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

INSTRUCTION: Answer only FOUR (4) questions.

Please use the answer booklet provided.

Question 1

Figure 1 shows a graph of velocity versus time for an object that is moving in a straight line.

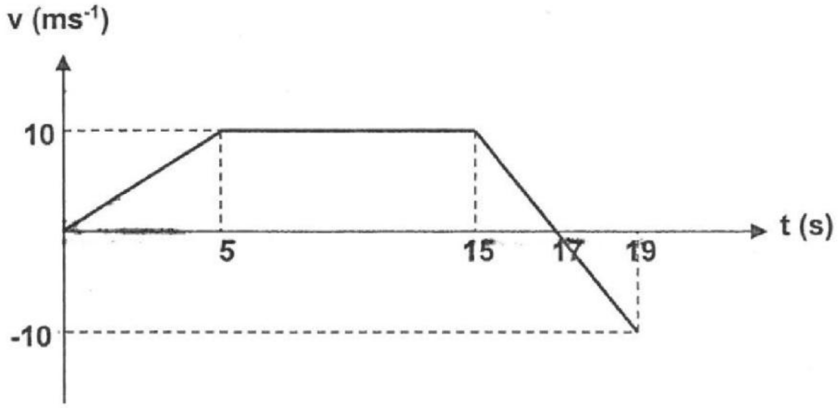


Figure 1 : Velocity – time graph

(a) Sketch a displacement – time graph for the object from $t = 0$ to $t = 19$ s.
*(**Show all the calculation involved)*

(10 marks)

(b) Sketch a graph of acceleration versus time for the entire motion.
*(**Show all the calculation involved)*

(9 marks)

(c) Determine the total distance the object moved between $t = 0$ to $t = 19$ s.

(3 marks)

(d) Calculate the average speed of the object.

(3 marks)

Question 2

(a) Explain Newton's First Law and Newton's Second Law of motion.

(8 marks)

(b) A 10 kg block is placed on a rough table. A 4 kg mass is attached to the block by a string that passes over a smooth pulley as shown in Figure 2. A force of 50 N is applied to the system so that the 10 kg object accelerates to the left and 4 kg object moves upwards.

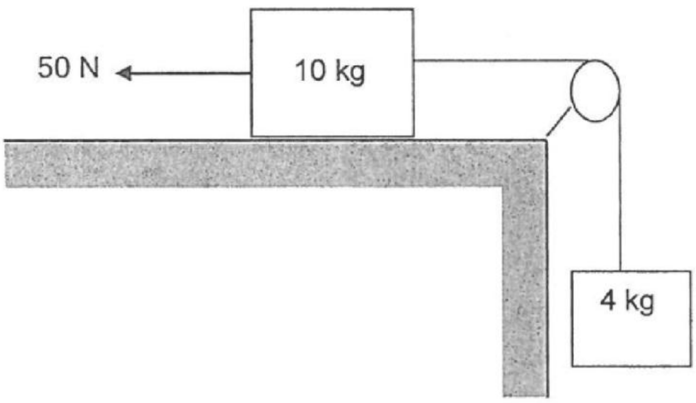


Figure 2: Pulley system

i. Calculate the frictional force between the 10 kg block and the table if the coefficient of friction is 0.12.

(5 marks)

ii. Compute the acceleration of the system.

(12 marks)

Question 3

(a) A turbine rotates with a uniform angular acceleration and takes 25 s to complete one revolution. If the windmill starts rotating from rest, calculate :

i. the angular velocity after 25 s

(4 marks)

ii. the angular acceleration

(3 marks)

iii. the angular velocity after 2 revolutions and

(5 marks)

iv. the time taken for the second revolution.

(3 marks)

(b) Figure 3 shows a load, ***m*** suspended by a light string from a rim of a wheel. The mass of the load is 500 g and diameter of a wheel is 30 cm. When released from rest, the load falls 1.2 m in 3 s. Calculate the tension in the string and the moment of inertia of the wheel.

(10 marks)

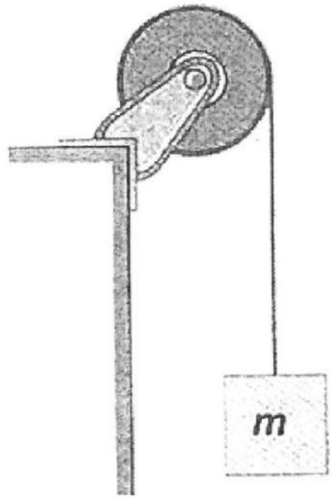


Figure 3 : A load suspended from a disc

Question 4

(a) Explain the following terms :

i. Period

ii. Frequency

(4 marks)

(b) Using x – t graph, discuss under damping, critical damping and over damping.

(12 marks)

(c) The expression for the displacement, *x* of an object undergoing linear Simple Harmonic Motion is given by : $\boldsymbol{x = 8\,sin\ (20\pi t + 0.4\pi)}$. *x* is in the unit of centimeter and *t* is in second. Determine:

i. the period of the oscillation

(3 marks)

ii. the displacement of the object at t = 0 s.

(3 marks)

iii. the velocity of the object at t = 0 s.

(3 marks)

Question 5

(a) Hydraulic lift works according to Pascal's Principle. Describe Pascal's Principle using hydraulic lift as an example.

(5 marks)

(b) Explain the concept of the Archimedes' Principle.

(4 marks)

(c) A raft with dimension 1.2 m x 0.9 m x 0.1 m has a mass of 280 kg. The raft is partly submerged when it is put on the water of density 1000 kg/m^3.

i. Calculate the buoyant force of the raft.

(3 marks)

ii. Determine the volume of water displaced by the raft.

(4 marks)

iii. Determine the mass of the load that would cause the raft to sink in the water.

(9 marks)

Question 6

a) The first law of thermodynamics is a version of conservation of energy principles, adapted for thermodynamic systems. Describe isobaric, isochoric and isothermal process using the P-V diagram.

(12 marks)

b) Figure 4 shows one mole of monatomic gas at an initial temperature of 45°C and a pressure of 2.02 x 10^5 Pa. The gas is expanding from 1.5 x 10^{-3} m^3 to 4 x 10^{-3} m^3. It is then cooled down at constant volume at a pressure of 1.01 x 10^5 Pa. The gas is finally compressed isothermally back to its initial state.

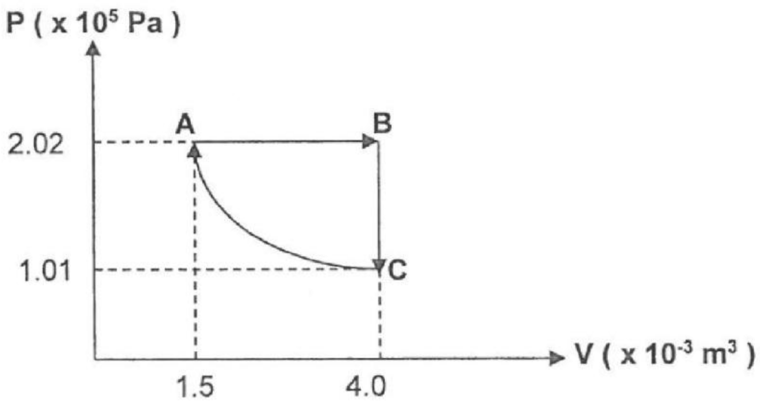


Figure 4 : P-V graphs of thermodynamics processes

Determine:

i) the work done in process **AB**, (4 marks)

ii) the amount of heat absorbed from **A** to **B** if the temperature at **B** is 500 °C, and (6 marks)

iii) the work done on the gas from **C** to **A**. (3 marks)

END OF EXAMINATION PAPER

APPENDIX

1. TABLE OF FORMULAE

$v = u + at$	$s = ut + \frac{1}{2}at^2$	$v^2 = u^2 + 2as$
$F = ma$	$F_f = \mu F_N$	$W = mg$
$\omega = \omega_0 + \alpha t$	$\omega^2 = \omega_0^2 + 2\alpha\theta$	$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$
$s = r\theta$	$v = r\omega$	$a = r\alpha$
$\tau = F x d$	$\tau = I\alpha$	$PE = mgh$
$KE_T = \frac{1}{2}mv^2$	$KE_R = \frac{1}{2}I\omega^2$	$f = \frac{1}{T}$
$\omega = 2\pi f$	$v = \omega\sqrt{x_o^2 - x^2}$	$a = \omega^2 x$
$\rho = \frac{m}{V}$	$F_B = \rho_f V_f g$	$Q = mc\Delta T$
$\Delta U = Q - W$	$W = P\Delta V$	$W = nRT\ln(\frac{V_f}{V_i})$
$\Delta U = \frac{3}{2}nR(T_f - T_i)$	$Q_H = W + Q_L$	$e = \frac{W}{Q_H}$

2. CONSTANT VALUES:

Gravitational acceleration, g = 9.81 m/s^2

Universal gas constant, R = 8.314 J/mol.K

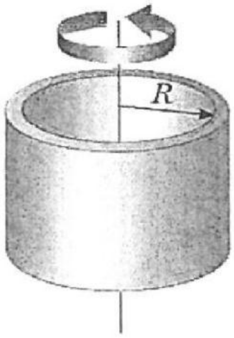
Standard Temperature Pressure, STP conditions: P = 1 atm = 1.013 x 10^5 Pa

T = 273 K

3. MOMENT OF INERTIA OF HOMOGENEOUS RIGID OBJECT

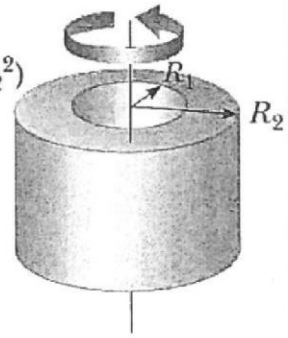
Hoop or thin cylindrical shell

$I_{CM} = MR^2$



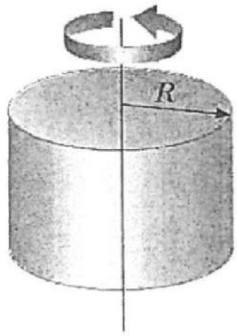
Hollow cylinder

$I_{CM} = \frac{1}{2}M(R_1^2 + R_2^2)$



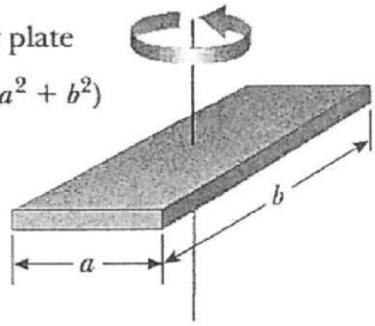
Solid cylinder or disk

$I_{CM} = \frac{1}{2}MR^2$



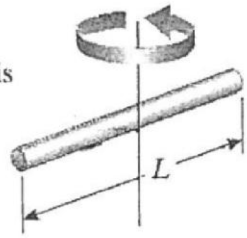
Rectangular plate

$I_{CM} = \frac{1}{12}M(a^2 + b^2)$



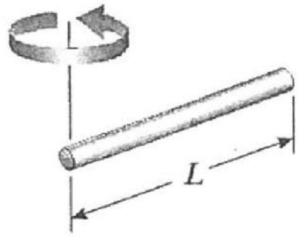
Long, thin rod with rotation axis through center

$I_{CM} = \frac{1}{12}ML^2$



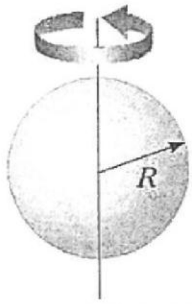
Long, thin rod with rotation axis through end

$I = \frac{1}{3}ML^2$



Solid sphere

$I_{CM} = \frac{2}{5}MR^2$



Thin spherical shell

$I_{CM} = \frac{2}{3}MR^2$