UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF MARINE ENGINEERING TECHNOLOGY

FINAL EXAMINATION
JANUARY 2016 SEMESTER

COURSE CODE	: LGB 10203
COURSE NAME	: ENGINEERING SCIENCE
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	: BACHELOR
DATE	: 23 MAY 2016
TIME	: 2.00 pm – 5.00 pm
DURATION	: 3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please CAREFULLY read the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. Answer only FOUR (4) questions.
4. Please write your answers in the answer booklet provided.
5. Answer all questions in English language ONLY.
6. Table of formulae has been appended for your reference.

THERE ARE 7 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

INSTRUCTION: Answer only FOUR (4) questions.
Please use the answer booklet provided.

Question 1

A locomotive takes 4 s to accelerate from 10 m/s to a velocity of 20 m/s. It then moves with a constant velocity for 10 s, before it is made to stop in 5 s.

(a) Sketch a velocity – time graph for the whole motion.

(4 marks)

(b) Draw a displacement – time graph to describe this motion.
*(**Please show all the calculation involved)*

(9 marks)

(c) Calculate the average velocity of the motion.

(3 marks)

(d) Calculate the acceleration for each segment during the whole motion.

(6 marks)

(e) From (d), sketch a graph of acceleration versus time for the entire motion.

(3 marks)

Question 2

Figure 1 shows object A of mass 4 kg on a rough inclined plane while the second object, B is hanging to the side. B has a mass of 1 kg. When the objects are released from rest, A slides down the inclined plane with 6 N force oppose the motion. The pulley can be considered frictionless and the inclination angle is 30°.

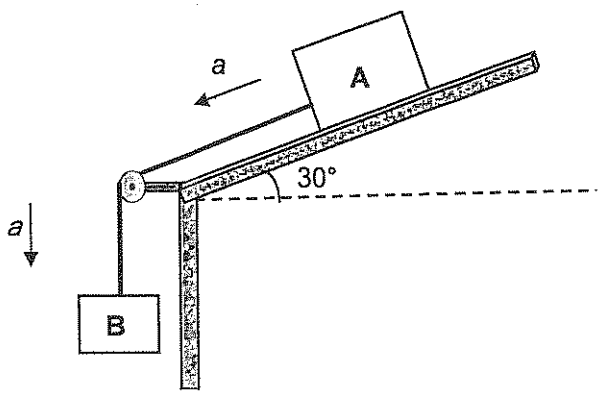

Figure 1 : A pulley system

(a) Sketch the free body diagram for both objects.

(4 marks)

(b) Determine the coefficient of friction, μ between the plane and object A.

(7 marks)

(c) Compute the acceleration of both objects.

(10 marks)

(d) Determine the distance travelled by object A, if it has a velocity of 3 m/s after being released.

(4 marks)

Question 3

(a) i. Define the moment of inertia of a rigid body.

(3 marks)

ii. State two (2) factors that determine the moment of inertia a rigid body.

(4 marks)

(b) A potter's wheel as shown in Figure 2 is a thick stone disc of radius 0.5 m and mass 100 kg is freely rotating at 50 rev/min. The potter can stop the wheel in 6 s by pressing a wet rag against the rim and exerting radial inward force of 70 N.
(For a disc, moment of inertia = ½ mr^2)

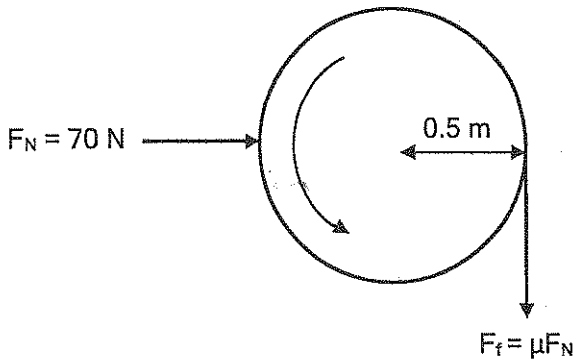

Figure 2 : A potter's wheel

i. Calculate the angular acceleration of the potter.

(6 marks)

ii. Determine the torque of the wheel.

(6 marks)

iii. Find the coefficient of friction between the wheel and the rag.

(6 marks)

Question 4

(a) Damped harmonic motion is a phenomenon in which an object oscillates with a decrease in amplitude. Describe the three (3) types of damping.

*(**You may include the displacement – time graph in your explanation.)*

(12 marks)

(b) A 0.6 kg mass at the end of a spring vibrates three times in one second with an amplitude of 0.13 m. Compute :

i. the velocity when it passes the equilibrium position,

(7 marks)

ii. the velocity when it is 0.1 m from equilibrium position,

(3 marks)

iii. the total energy of the system.

(3 marks)

Question 5

(a) i. Describe the concept of buoyancy.

(2 marks)

ii. State the Archimedes' Principle and explain why a big ship that made up from steel can float on the ocean.

(7 marks)

(b) A raft with dimension 2.4 m x 1.8 m x 0.2 m has a mass of 560 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) i. Describe Isothermal process using P–V diagram.

(4 marks)

ii. During isothermal compression, the internal energy of the gas does not change although work is done on the gas. Explain why.

(3 marks)

(b) Two (2) moles of an ideal gas expands isothermally from a volume of 200 cm^3 to 500 cm^3 at 400 K.

i. Calculate the work done by the gas.

(4 marks)

ii. Determine the total heat required for this expansion.

(4 marks)

(c) With the aid of diagram, explain the working principle of a heat engine.

(10 marks)

END OF EXAMINATION PAPER

APPENDIX

1. TABLE OF FORMULAE

$v = u + at$	$s = ut + \frac{1}{2}at^2$	$v^2 = u^2 + 2as$
$F = ma$	$F_f = \mu F_N$	$W = mg$
$\omega = \omega_0 + \alpha t$	$\omega^2 = \omega_0^{\ 2} + 2\alpha\theta$	$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$
$\tau = F\,x\,d$	$\tau = I\alpha$	$f = \frac{1}{T}$
$\omega = 2\pi f$	$v_{max} = \omega x_o$	$v = \omega\sqrt{x_o^2 - x^2}$
$E = \frac{1}{2}m\omega^2 x_o^2$	$\rho = \frac{m}{V}$	$F_B = \rho_f V_f g$
$\Delta U = Q - W$	$W = nRT\ln(\frac{V_f}{V_i})$	$\Delta U = \frac{3}{2}nR(T_f - T_i)$

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

V = 22.4 x 10^{-3} m^3

T = 273 K