UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF INDUSTRIAL TECHNOLOGY

FINAL EXAMINATION
JANUARY 2016 SEMESTER

COURSE CODE	:	JGB 10503
COURSE TITLE	:	ENGINEERING SCIENCE 1
PROGRAMME LEVEL	:	BACHELOR
DATE	:	24 MAY 2016
TIME	:	9.00 AM - 12.00 PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consists of TWO (2) sections.
4. Answer ALL questions in Section A. Choose THREE (3) questions in section B.
5. Please write your answers on the answer booklet provided.
6. Table and formula are enclosed as reference.
7. Please answer all questions in English only.

THERE ARE 8 PAGES OF QUESTIONS EXCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided

Question 1

(a) i. Define physical quantity.

(1 mark)

ii. Convert 7.60 $g.cm^{-3}$ to S.I units.

(2 marks)

(b) Figure 1 shows two vector A and B are in the x-y plane.

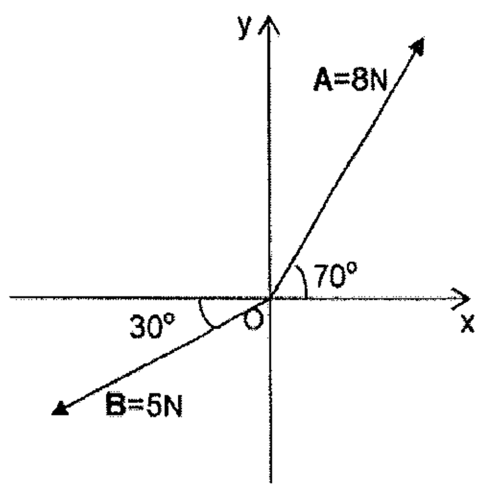

Figure 1 : Vector A and B

i. Express vectors A and B in x and y-components.

(3 marks)

ii. Compute the magnitude and direction of vector A + B.

(4 marks)

Question 2

A baseball is seen to pass upward by a window 28 m above the street with a vertical speed of 13 ms^{-1}. If the ball was thrown from the street, compute

(a) The initial speed of the baseball.

(3 marks)

(b) The highest point the baseball could reach

(3 marks)

(c) The time taken by the baseball to reach the street again

(4 marks)

Question 3

(a) Give **TWO (2)** examples of real object that undergo a rotational motion.

(2 marks)

(b) A 0.15 kg ball on the end of a 1.10 m long cord (negligible mass) is swung in a verticle circle.

i. Determine the minimum speed the ball must have at the top of its arc so that the ball continues moving in a circle.

(4 marks)

ii. Calculate the tension in the cord at the bottom of the arc, assuming the ball is moving at twice the speed of part (i).

(4 marks)

Question 4

(a) Define work-energy theorem.

(2 marks)

(b)

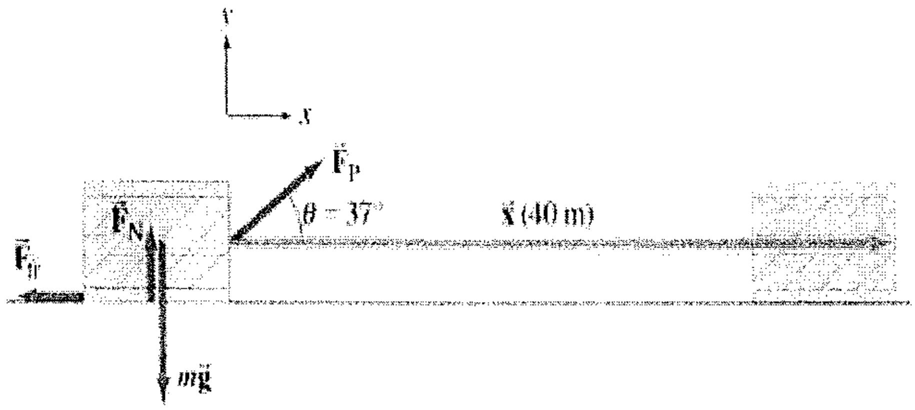

Figure 2 : A 50 kg crate is pulled along a floor.

A person pulls a 50 kg crate 40 m along a horizontal floor by a constant force, F_P = 100 N, which acts at a 37° angle as shown in Figure 2. The floor is rough and exerts a friction force F_{fr} = 50 N. Determine

i. the work done by frictional force, F_{fr} acting on the crate

(4 marks)

ii. the net work done on the crate

(4 marks)

SECTION B (Total: 60 marks)

INSTRUCTION: Choose THREE (3) questions only
Please use the answer booklet provided

Question 1

(a) A 5 kg block is pulled along a horizontal surface by a 28 N force to the right. Compute the acceleration if the surface is

i. Smooth

ii. Rough with a coefficient of kinetic friction of 0.23 between the block and the surface

(8 marks)

(b) A Boy Scout troop tried to improvise a scheme to pull an old ore car up out of a sloping mine shaft. They are going to divert a stream so that water ran into a bucket attached to the ore car. When enough water filled the car, it was supposed to move up the track. If the ore car had mass of 80 kg, and the track is inclined at 15° above horizontal,

i. Determine the mass of water that is required to start the car moving if friction is negligible.

(4 marks)

ii. If the friciton coefficient between the car and the track was 0.20, calculate the mass of water that would be needed to start the car moving.

(4 marks)

iii. With friction present, suppose water is added until the car is just about to move. Now an additional 4 kg of water is added to the bucket with the wheels of the car locked. Calculate the time taken for the car to move 34 m up the track when the wheels are unlocked.

(4 marks)

Question 2

(a) A 15.0 kg object moving in the +x direction at 5.5 ms^{-1} collides head-on with an 10.0 kg object moving in the -x direction at 4.0 ms^{-1}. Find the final velocity of each mass if:

i. the objects stick together.

ii. the collision is elastic.

iii. the 6.0 kg object is at rest after the collision.

iv. the 8.0 kg object is at rest after the collision.

v. the 6.0 kg object has a velocity of 4.0 ms^{-1} in the -x direction after the collision.

vi. determine if the results in iii, iv, and v "reasonable". Explain your answer.

(12 marks)

(b) A golf ball of mass 0.045 kg is hit off the tee at a speed of 45 ms^{-1}. The golf club was in contact with the ball for 3.5 x 10^{-3}s. Find

i. The impulse imparted to the golf ball

ii. The average force exerted on the ball by the golf club

(8 marks)

Question 3

(a) Calculate the depth of a

i. Water (density 1000 kgm^{-3}) and of a

ii. Mercury (density 13,600 kgm^{-3})

that is required to produce a pressure of 1 atm (1.01×10^5 Nm^{-2}).

(4 marks)

(b) You inset a straw of length L into a tall glass of water. You place your finger over the top of the straw, capturing some air above the water but preventing any additional air from getting in or out, and then you lift the straw from the water. You find that the straw retains most of the water as shown in Figure 3.

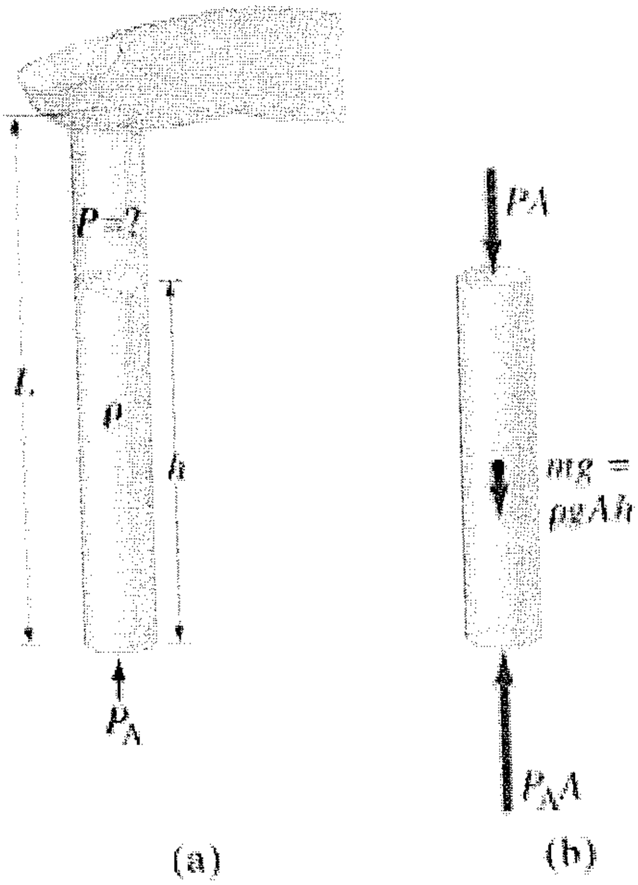

Figure 3 : (a) finger placed on top of a straw and (b) Forces acted upon a column of water

Explain wether the air in the space between your finger and the top of the water have a pressure, P that is greater than, equal to, or less than, the atmospheric pressure, P_A outside the straw.

(4 marks)

(c) Fireman use a hose of inside diameter 6.0 cm to deliver 1000 L of water per minute. A nozzle is attached to the hose, and they want to squirt the water up to a window 30 m above the nozzle.

i. the speed of the water when it leaves the nozzle

ii. the inside diameter of the nozzle

iii. the pressure that is required in the hose

(12 marks)

Question 4

(a) State

i. Zeroth law of thermodynamics

ii. First law of thermodynamics

iii. Second law of thermodynamics

(6 marks)

(b) In an engine, 0.25 moles of an ideal monatomic gas in the cylinder epands rapidly and adiabatically against the piston. In the process, the temperature of the gas drops from 1150 K to 400 K. Calculate the work done by the gas.

(7 marks)

(c) Determine the change in internal energy of 1.0 liter of water (mass 1.0 kg) at 100°C when it is fully boiled from liquid to gas, which results in 1671 liters of steam at 100°C. Assume the process is done at atmospheric pressure. Given $L_v = 22.6 \times 10^5$ Jkg^{-1}.

(7 marks)

END OF EXAMINATION PAPER

LIST OF FORMULAE

$v = v_0 + at$

$x = x_0 + v_0 t + \frac{1}{2} at^2$

$v^2 = v_0^2 + 2a(x - x_0)$

$\sum \mathbf{F} = \mathbf{F}_{net} = m\mathbf{a}$

$\mathbf{F} = \frac{d\mathbf{p}}{dt}$

$\mathbf{J} = \int \mathbf{F}\, dt = \Delta\mathbf{p}$

$\mathbf{p} = m\mathbf{v}$

$F_{fric} \leq \mu N$

$W = \int \mathbf{F} \cdot d\mathbf{r}$

$K = \frac{1}{2} mv^2$

$P = \frac{dW}{dt}$

$P = \mathbf{F} \cdot \mathbf{v}$

$\Delta U_g = mgh$

$a_c = \frac{v^2}{r} = \omega^2 r$

$\tau = \mathbf{r} \times \mathbf{F}$

$\sum \tau = \tau_{net} = I\alpha$

$I = \int r^2 dm = \sum mr^2$

$\mathbf{r}_{cm} = \sum m\mathbf{r} / \sum m$

$v = r\omega$

$\mathbf{L} = \mathbf{r} \times \mathbf{p} = I\omega$

$K = \frac{1}{2} I\omega^2$

$\omega = \omega_0 + \alpha t$

$\theta = \theta_0 + \omega_0 t + \frac{1}{2} \alpha t^2$

$\mathbf{F}_s = -k\mathbf{x}$

$U_s = \frac{1}{2} kx^2$

$T = \frac{2\pi}{\omega} = \frac{1}{f}$

$T_s = 2\pi\sqrt{\frac{m}{k}}$

$T_p = 2\pi\sqrt{\frac{\ell}{g}}$

$\mathbf{F}_G = -\frac{Gm_1m_2}{r^2}\hat{\mathbf{r}}$

$U_G = -\frac{Gm_1m_2}{r}$

$p = p_0 + \rho gh$

$F_{buoy} = \rho Vg$

$A_1 v_1 = A_2 v_2$

$p + \rho gy + \frac{1}{2}\rho v^2 = \text{const.}$

$\Delta\ell = \alpha\ell_0\Delta T$

$Q = mL$

$Q = mc\Delta T$

$p = \frac{F}{A}$

$pV = nRT$

$K_{avg} = \frac{3}{2} k_B T$

$v_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3k_BT}{\mu}}$

$W = -p\Delta V$

$Q = nc\Delta T$

$\Delta U = Q + W$

$\Delta U = nc_V\Delta T$

$e = \left|\frac{W}{Q_H}\right|$

$e_c = \frac{T_H - T_C}{T_H}$