CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF INDUSTRIAL TECHNOLOGY

FINAL EXAMINATION
JANUARY 2016 SEMESTER

COURSE CODE	:	JGD 10302
COURSE TITLE	:	FUNDAMENTALS OF ENGINEERING SCIENCE 1
PROGRAMME LEVEL	:	DIPLOMA
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 TWO (2) 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 6 PAGES OF QUESTIONS EXCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

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

Question 1

(a) Express the following quantities using the prefixes.

i. 3×10^{-4} m
ii. 5×10^{-5} s
iii. 72×10^{2} g
iv. 1000 m

(7 marks)

(b) An airplane flies to the north at 235 km/h with respect to the air. There is a wind blowing at 65 km/h, 45° North of East. Determine the magnitude of plane's speed and direction with respect to the ground.

(8 marks)

Question 2

(a) Two students hold a large bed sheet vertically between them. A third student, who happen to be the star pitcher on the school baseball team, throws a raw egg at the center of the sheet. Explain why the egg does not break when it hit the sheet, regardless of its initial speed.

(5 marks)

(b) A 35 g bullet strikes a 5 kg stationary piece of lumber and embeds itself in the wood. The piece of lumber and bullet fly off together at 8.6 m/s. Determine the original speed of the bullet.

(5 marks)

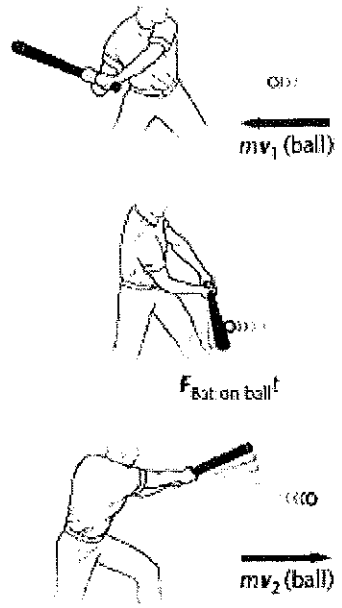

Figure 1: A baseball is pitched horizontally after being hit by the bat.

(c) Figure 1 shows a 0.144 kg baseball is pitched horizontally at 38.0 m/s after it is hit by the bat, it moves at the same speed, but in opposite direction.

i. Calculate the change in momentum of the ball.

ii. Determine the impulse delivered by the bat.

(5 marks)

Question 3

(a) State **THREE (3)** conditions of static equilibrium.

(3 marks)

(b) A 7.3 kg ladder, 1.92 m long, rest on two sawhorses, as shown in Figure 2. Sawhorse A on the left is located 0.3 m from the end and sawhorse B on the right is located 0.45 m from the other end.

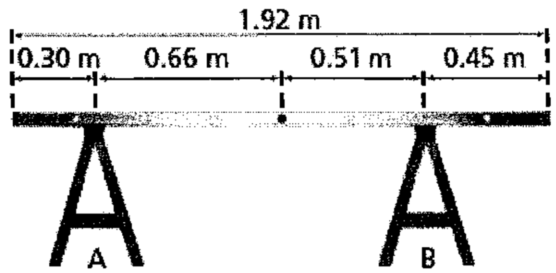

Figure 2: A ladder rest on sawhorse A and B.

i. Draw a free-body diagram of the system.

(3 marks)

ii. Determine the force exerted by the sawhorse A and B on the ladder.

(7 marks)

iii. If the sawhorse A were moved very close to the center of mass, explain what will happen to the value of the forces exerted by the two sawhorses.

(2 marks)

Question 4

(a) State the differences between tangential acceleration and radial acceleration for a point on a rotating body.

(2 marks)

(b) A flywheel rotates with constant angular velocity. Sketch the following quantities at a point on its rim;

i. Tangential acceleration.

ii. Centripetal acceleration.

iii. Resultant acceleration.

(3 marks)

(c) A wheel starts from rest and rotates with constant angular acceleration to reach an angular velocity of 12 rad/s in 3 s. Determine

i. initial angular velocity of the wheel.

(1 marks)

ii. magnitude of the angular acceleration of the wheel.

(3 marks)

iii. angle (in radians) through which it rotates in this time interval.

(3 marks)

iv. number of revolution within the same time interval.

(3 marks)

SECTION B (Total: 40 marks)

INSTRUCTION: Choose TWO (2) questions only
Please use the answer booklet provided

Question 1

(a) Assume that you throw a ball straight up into the air and drop back to you hand. Illustrate the changes in the velocity and acceleration of the ball.

(4 marks)

(b) A race car can be slowed with a constant acceleration of -11 m/s^2.

i. If the car is going 55 m/s, determine the displacement of the car before it stops.

(3 marks)

ii. Estimate the car's displacement before it stops if the car going twice as fast.

(4 marks)

(c) A tennis ball is thrown straight up with an initial speed of 22.5 m/s. it is caught at the same distance above the ground.

i. Calculate the maximum height does the ball rise.

(4 marks)

ii. Estimate the time taken for the ball remain in the air.

(5 marks)

Question 2

(a) Interpret action-reaction pairs in the following situations:

i. A man takes a step.
ii. A snowball hits a girl in the back.
iii. A baseball player catches a ball.
iv. A gust of wind strikes a window.

(4 marks)

(b) Two blocks, one of mass 5 kg and the other of mass 3 kg are tied together with a massless rope as in Figure 3. This rope is strung over a massless, resistance-free pulley. The blocks are released from rest.

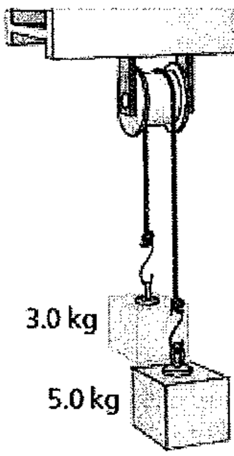

Figure 3: Two blocks are connected by a massless rope.

i. Draw free-body diagrams of both block.

(4 marks)

ii. Determine the magnitude of acceleration of the system.

(8 marks)

iii. Calculate the tension in the rope.

(4 marks)

Question 3

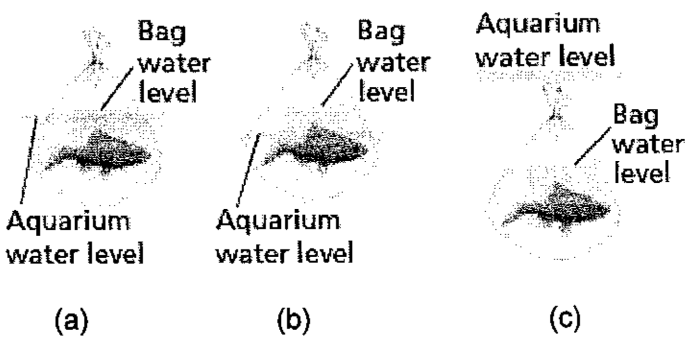

Figure 4: (a) Water level of aquarium and bag is same; (b) water level of aquarium is below than bag water level; (c) water level of aquarium is higher than bag water level.

(a) Tropical fish for aquariums are often transported home from pet shops in transparent plastic bags filled mostly with water. If you placed a fish in its unopened transport bag in a home aquarium, choose which of the cases in Figure 4 (a), (b), or (c) best represents what would happen. Justify your reason.

(4 marks)

(b) A 10 kg block of metal measuring 12 cm by 10 cm by 10 cm is suspended from a scale immersed in water as shown in Figure 5. The 12 cm dimension is vertical, and top of the block is 5 cm below the surface of water.

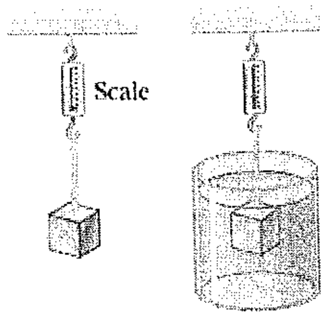

Figure 5: A metal block is suspended from a scale and then immersed in water.

i. Draw a free-body diagram of the metal block when it was immersed in water. (3 marks)

ii. Determine the magnitudes of the force acting on the top of the block due to the surrounding water (Given the atmospheric pressure is 1.013×10^5 N/m^2, density of water is 1000 kg/m^3). (4 marks)

iii. Estimate the reading of the spring scale when the block is immersed in water. (9 marks)

END OF EXAMINATION PAPER

TABLE OF CONSTANT AND FORMULA

CONSTANT OF NATURE	SYMBOL AND VALUE
speed of light in a vacuum	$c = 2.998 \times 10^{8}\ ms^{-1}$
Coulomb's law constant	$k = 9 \times 10^{9}\ N\ m^2/C^2$
gravitational constant	$G = 6.67 \times 10^{-11}\ N\ m^2\ kg^{-2}$
Planck constant	h = 6.626 x 10-34 Js
permittivity of free space	$\varepsilon_o = 8.854 \times 10^{-12}\ Fm^{-1}$
permeability of free space	$\mu_o = 4\pi \times 10^{-7}\ Hm^{-1}$
electron charge	$e = 1.602 \times 10^{-19}\ C$
electron mass	$m_e = 9.110 \times 10^{-31}\ kg$
proton mass	$m_p = 1.673 \times 10^{-27}\ kg$
neutron mass	$m_n = 1.675 \times 10^{-27}\ kg$
Bohr radius	$a_o = 5.292 \times 10^{-11}\ m$
Avogadro constant	$N_A = 6.022 \times 10^{23}\ mol^{-1}$
Boltzmann constant	$k = 1.381 \times 10^{-23}\ JK^{-1}$
molar gas constant	$R = 8.314\ JK^{-1}mol^{-1}$
Stefan constant	$\sigma = 5.670 \times 10^{-8}\ W\ m^{-2}\ K^{-4}$

Magnitude of vector	$\lvert V\rvert = \sqrt{V_X^2 + V_Y^2}$	Resultant force and acceleration	F = ma	Rotational kinetic energy	$KE = ½ I\omega^2$
Direction of vector	$\tan\theta = \lvert \frac{V_y}{V_x} \rvert$	Resultant force and momentum	F = p / t	Rotational work	$W = \tau\theta$
Unit vector	$\hat{a} = \frac{\vec{A}}{\lvert\vec{A}\rvert}$	Weight	W = mg		$W = \Delta KE$
Dot product	$\vec{A}.\vec{B} = \lvert\vec{A}\rvert\lvert\vec{B}\rvert\cos\phi$	Work done by a constant force	$W = Fs\cos\theta$	Rotational power	$P = \tau\omega$
Cross product	$\vec{A}.\vec{B} = \lvert\vec{A}\rvert\lvert\vec{B}\rvert\sin\phi$	Kinetic energy	$KE = ½ mv^2$	Angular momentum	$L = I\omega$
Motion with uniform acceleration	v = u + at	Gravitational potential energy	PE = mgh	Moment of inertia	$I = \sum mr^2$
	s = ½ (u + v)t	Elastic energy	$PE = ½ kx^2$	Torque	$\tau = I\alpha$
	$s = ut + ½ at^2$	Work-Energy theorem	$W = \Delta KE$ or $W = \Delta PE$	Torque	$\tau = Fr$
	$v^2 = u^2 + 2as$	Principle of conservation energy	$\sum E_i = \sum E_f$	Hoole's law	F = ks
Momentum	p = mv	Angular displacement	$s = r\theta$		Stress = $\frac{F}{A}$
Principle of conservation of momentum	$\sum p_i = \sum p_f$	Angular velocity	$\omega = \frac{\theta}{t}$	Pressure	$P = \frac{F}{A}$, $P = \rho gh$
Conservation of momentum		Angular quantities	$f = \frac{\omega}{2\pi}$, $T = \frac{1}{f}$	Buoyant force	$F_B = \rho gV$
$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$		Linear velocity	$v = \omega r$	Pascal's law	$\frac{F_{in}}{A_{in}} = \frac{F_{out}}{A_{out}}$
$m_1u_1 + m_2u_2 = (m_1 + m_2)v_2$		Tangential acceleration	$a_T = \alpha r$	Rate of flow	V = Avt
		Centripetal acceleration	$a_c = \frac{v^2}{r}$	Net work done on fluid	$W = (P_1 - P_2)V$