UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF INDUSTRIAL TECHNOLOGY

FINAL EXAMINATION

JANUARY 2016 SEMESTER

COURSE CODE	:	JGB 10603
COURSE TITLE	:	ENGINEERING SCIENCE 2
PROGRAMME LEVEL	:	BACHELOR
DATE	:	30 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 5 PAGES OF QUESTIONS EXCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

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

Question 1

(a) Give a formula of capacitance and list **THREE (3)** factors that can affect the capacitance of a parallel-plate capacitor.

(4 marks)

(b) The plates of a parallel-plate capacitor separated by polyester are 2.50 mm apart and 3 cm^2 in area. A potential difference of 15 kV is applied across the capacitor. If the dielectric constant of polyester is 3.30, calculate

i. The capacitance.
ii. The charge on each plate.
iii. The magnitude of the electric field in the space between the plates.

(6 marks)

Question 2

(a) Define Ohm's law and give a formula to show a relationship between resistance and resistivity.

(4 marks)

(b) Suppose you want to connect your stereo to remote speakers. If the wire must be 15 m long, estimate the diameter of the copper wire you should use to keep its resistance less than 0.10 Ω. Given the resistivity of copper is 1.68×10^{-8} Ωm.

(6 marks)

Question 3

(a) Give **FOUR (4)** example of third class of lever.

(4 marks)

(b) A hammer is used to drive a wedge into a log to split it. When the wedge is driven 0.20 m into the log, the log is separated a distance of 5.0 cm. A force of 1.7×10^4 N is needed to split the log, and the hammer exerts a force of 1.1×10^4 N.

i. Determine the ideal and actual mechanical advantage of the wedge.

(4 marks)

ii. Calculate the efficiency of the wedge.

(2 marks)

Question 4

(a) Define a magnetic field.

(2 marks)

(b) Two identical bar magnets lie on a table along a straight line with their south poles facing each other. Sketch the bar magnets and direction of the magnetic field lines.

(2 marks)

(c) A long straight wire carrying a current of 3.50 A is located 9 cm from point P. Given the permeability of free space, μ_0 is $4 \pi \times 10^{-7}$ H m^{-1}. Calculate the magnetic field at the point P.

(3 marks)

(d) Determine the current in the wire if a magnetic field of 3×10^{-6} T is measured at a distance of 0.60 m from the wire.

(3 marks)

SECTION B (Total: 60 marks)

INSTRUCTION: Choose THREE (3) questions only

Please use the answer booklet provided

Question 1

(a) Three positive particles of equal charge, +11 μC, are located at the corners of an equilateral triangle of side 15.0 cm as shown in Figure 1. Calculate the magnitude and direction of the net force on each particle.

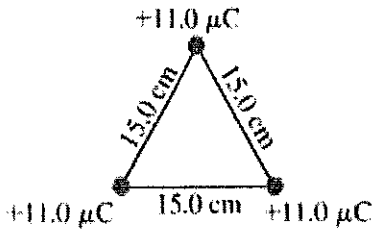

Figure 1: Three positive particles are located at the corners of triangle.

(12 marks)

(b) A glass object receives a positive charge by rubbing it with a silk cloth. In the rubbing process, explain does protons been added to the object or have electrons been removed from it.

(8 marks)

Question 2

(a) Determine the electric potential difference between two metal plates that separated by 0.5 m if electric field between them is 2.5×10^3 N/C.

(3 marks)

(b) Two charged particles are arranged in a line as shown in Figure 2. Calculate the electric potential at point A and at point B due to the two charges.

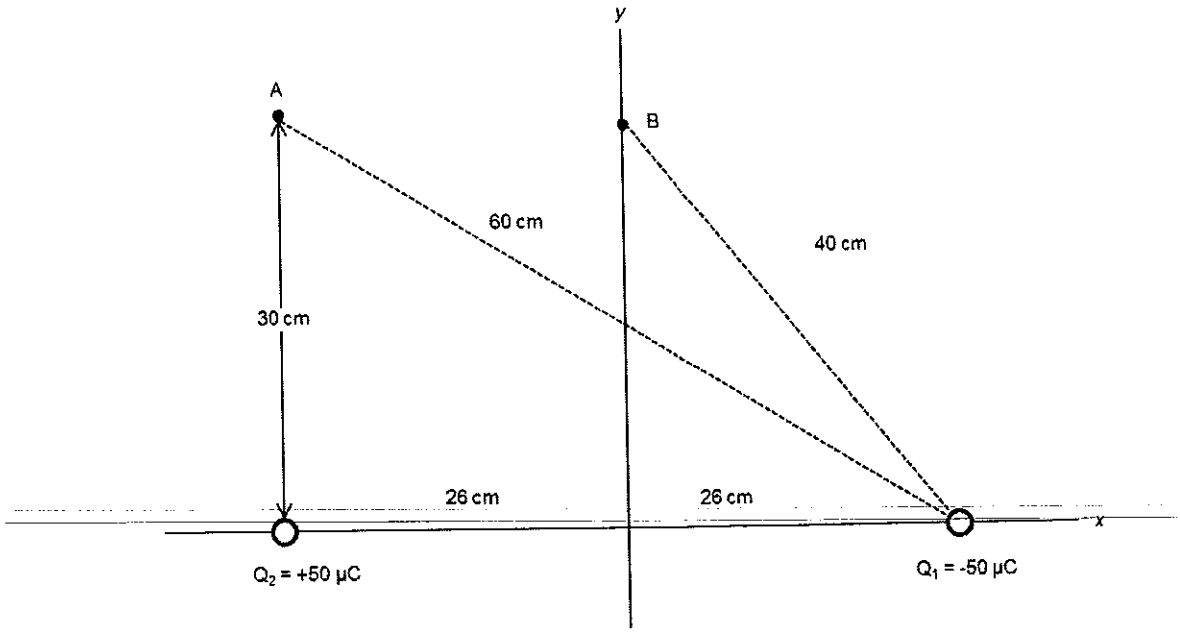

Figure 2. Two charges particle are arranged in a line.

(9 marks)

(c) When charged particles are separated by an infinite distance, the electric potential energy of the pair is zero. When the particles are brought close, the electric potential energy of a pair with the same sign is positive, whereas the electric potential energy of a pair with opposite signs is negative. Explain this statement.

(8 marks)

Question 3

(a) Figure 3 shows a complex circuit consist of resistors and batteries. Assume the internal resistance of each battery is r = 1 Ω.

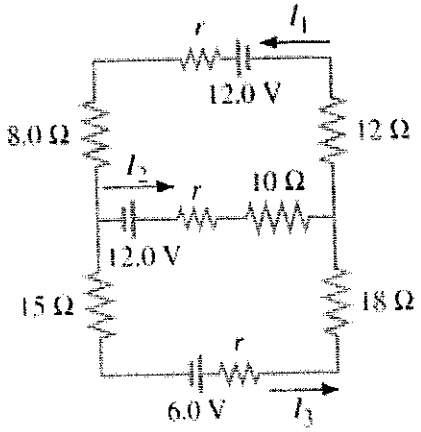

Figure 3: A complex circuit.

Determine

i. The currents I_1, I_2 and I_3.

(12 marks)

(b) A student claims that the second of two lightbulbs in series is less bright than the first because the first lightbulb uses up some of the current. Explain your respond to this statement.

(4 marks)

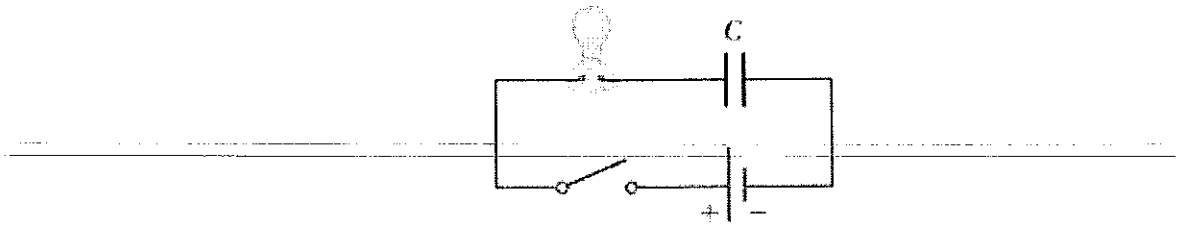

Figure 4. A lightbulb is connected in a circuit.

(c) Referring to Figure 4, describe what happens to the lightbulb after the switch is closed. Assume the capacitor has a large capacitance and is initially uncharged. Also assume the light illuminates when connected directly across the battery terminals.

(4 marks)

Question 4

(a) The specific heat of liquid mercury is 140 J/kg. When 1.0 kg of solid mercury at its melting point of -39°C is placed in a 0.5 kg aluminum calorimeter filled with 1.2 kg of water at 20°C, the final temperature of the combination is found to be 16.5°C. Determine the heat of fusion of mercury in J/kg.

(12 marks)

(b) Rub the palm of your hand on a metal surface for about 30 seconds. Place the palm of your other hand on an unrubbed portion of the surface and then on the rubbed portion. The rubbed portion will feel warmer. Now repeat this process on a wood surface. Explain why does the temperature difference between the rubbed and unrubbed portions of the wood surface seem larger than for the metal surface.

(8 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	$\sigma = 5.670 \times 10^{-8}\ W\ m^{-2}\ K^{-4}$

MECHANICS		ELECTRICITY	
motion with uniform acceleration	$v^2 = u^2 + 2as$	charge and current	$I = \frac{\Delta Q}{\Delta t}$
	$s = ut + 1/2\ at^2$		$I = n\ A\ Q\ v$
	$s = [(u + v) / 2]\ t$	Electric energy	$\Delta W = I\ V\ \Delta t$
	$v = u + at$	Electric power	$P = I^2R$
resultant force and acceleration	$F = ma$	Terminal potential difference	$V = \varepsilon - Ir$
Conservation of momentum	$mu_1 + mu_2 = mv_1 + mv_2$	Resistance in series	$R_T = R_1+R_2+R_3+..$
weight	$W = mg$	Resistance in parallel	$1/R_T = 1/R_1 + 1/R_2 + 1/R_3 +...$
work and power	$W = Fs$	Resistivity	$R = \frac{\rho L}{A}$
	$P = W / t = E / t = Fv$	Electric force	$F = k\left\|\frac{q_1 q_2}{r^2}\right\|$
Mechanical advantage	$M_A = F_o / F_i$	**ELECTROMAGNETISM**	
	$M_I = S_i / S_o$	Electric field strength	$E = -(\Delta V / d)$
kinetic energy	$KE = (1/2)\ mv^2$	Field of a point charge	$E = \frac{Q}{4\pi\varepsilon_o r^2}$
gravitational PE	$PE = mgh$	Potential at a point charge	$V = \frac{Q}{4\pi\varepsilon_o r}$
angular speed	$\omega = \Delta\theta / \Delta t$	Magnetic Force	$F = B\ q\ v$
radial acceleration	$a = \omega^2 x$	Force on a carrying current wire	$F = B\ I\ L$
Elasticity	$Y = (F/A) / (\Delta L/L)$	Field inside a long solenoid	$B = \mu_o n\ I$
newton's law of gravity	$F = (GM_1M_2) / r^2$		

See next page

SIMPLE HARMONIC MOTION		Field surrounding a long wire	$B = \frac{\mu_0 I}{2\pi r}$
displacement	$x = x_o \sin(\omega t)$		
maximum speed	$v_{max} = \omega x_o$	Flux	$\phi = BA$
acceleration	$a = \omega^2 x$	**THERMODYNAMICS**	
period of simple pendulum	$T = 2\pi \sqrt{\frac{l}{g}}$	Specific heat capacity	$Q = mc\Delta T$
Wavelength	$\lambda = \frac{v}{f}$	Latent heat	$Q = mL$