Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	TECHNICAL SCIENCE II
COURSE CODE	:	DAS 12703
PROGRAMME	:	1 DAB / 1 DAJ / 1 DAR / 1 DAK
EXAMINATION DATE	:	JUNE 2015/ JULY 2015
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	A) ANSWER **ALL** QUESTIONS IN **PART A** B) ANSWER **ONE (1)** QUESTION ONLY IN **PART B** C) ANSWER **ONE (1)** QUESTION ONLY IN **PART C**

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

PART A

Q1 (a) Three charged particles with q_1 is – 50.0 μC, q_2 is + 50.0 μC and q_3 is + 30.0 μC are placed on the corner of the 5.0 cm X 10.0 rectangle as shown in **FIGURE Q1 (a).**

(i) Calculate the magnitude of the net force on charge q_3 due to the other two charges.

(11 marks)

(ii) Calculate the direction of the net force on q_3.

(2 marks)

(b) **FIGURE Q1 (b)** shows an electric circuit with 6 resistors. The circuits connect with the *emf* equal to 100.0 V.

(i) Compute the equivalent resistance, R_{eq} on the circuit.

(10 marks)

(ii) Compute the magnitude of the current of the circuit.

(2 marks)

Q2 (a) Explain the following electrochemical cells.

(i) Galvanic (voltaic cell).

(2 marks)

(ii) Electrolytic cell.

(2 marks)

(b) Given the voltaic cell reaction of

$$2Al(s) + 3Mn^{2+}(aq) \rightarrow 2Al^{3+}(aq) + 3Mn(s)$$

(i) Write the anode and cathode reactions.

(2 marks)

(ii) Name the anode and cathode.

(2 marks)

(iii) Calculate E°_{cell}.

Given $E^{\circ}_{Al^{3+}/Al} = -1.66$ V and $E^{\circ}_{Mn^{2+}/Mn} = -1.18$ V

(5 marks)

(c)

$$Co(s) + Fe^{2+}(aq) \longrightarrow Co^{2+}(aq) + Fe(s)$$

Given: $[Co^{2+}] = 0.15$ M and $[Fe^{2+}] = 0.68$ M.

$E^{\circ}_{Fe^{2+}/Fe} = -0.44V$; $E^{\circ}_{Co^{2+}/Co} = -0.28V$

(i) Identify the half – cell reactions at anode and cathode.

(4 marks)

(ii) Analyze the cell potential, E for the given cell.

(6 marks)

(iii) Predict whether the above reaction would proceed spontaneously as written at 298 K.

(2 mark)

PART B

Q3 (a) Typical blood serum is about 0.14 M NaCl. Calculate volume (in mL) of blood contains 1.0 mg of NaCl.
(Relative atomic mass: Ni = 14.01, H = 1.01, Cu = 63.56, O = 15.99)

(8 marks)

(b) Write the meaning of chemical equation.

(2 marks)

(c) Nitrogen gas can be prepared by passing gaseous ammonia over solid copper (II) oxide at high temperatures. The other products of the reaction are solid copper and water vapour. A sample containing 18.1 g of NH_3 and reacted with 90.4 g of CuO.

$$NH_3(g) + CuO(s) \rightarrow N_2(g) + Cu(s) + H_2O(g)$$

(Relative atomic mass: Ni = 14.01, H = 1.01, Cu = 63.56, O = 15.99)

(i) Write the balanced equation for the reaction.

(4 marks)

(ii) Compute the amounts of reactants in moles.

(5 marks)

(iii) Define the term limiting reactant.

(2 marks)

(iv) Identify the limiting reactant in the above reaction

(4 marks)

Q4 (a) Write the rate expression for the following reaction.

$$CO_2(g) + 2H_2O(g) \rightarrow CH_4(g) + 2O_2(g)$$

(4 marks)

(b) Consider the following reaction:

$$2NO(g) + H_2(g) \rightarrow N_2O(g) + H_2O(g)$$

A rate study of this reaction was conducted at 298 K. The data that were obtained are shown in the **Table Q4 (b).**

Table Q4 (b)

Experiment	[NO]/M	[H_2]/M	Initial Rate/Ms^{-1}
1	0.30	0.35	2.835×10^{-3}
2	0.60	0.35	11.340×10^{-3}
3	0.60	0.70	22.680×10^{-3}

(i) Find the reaction order of NO and H_2.

(9 marks)

(ii) Write the rate law of the reaction.

(1 mark)

(iii) Find the value of rate constant, *k*.

(2 marks)

(c) (i) Explain the effects of increasing temperature on the reaction rate.

(3 marks)

(ii) Define a catalyst.

(2 marks)

(iii) Draw an energy diagram showing the path of a reaction with and without a catalyst.

(4 marks)

PART C

Q5 (a) In **FIGURE Q5 (a)** shows a rescue plane flies at 55.0 ms^{-1} and constant height h = 500 m toward a point directly over a victim, where a rescue capsule is to land.

(i) Calculate the time taken by a rescue capsule is to land.

(3 marks)

(ii) Determine the angle of the pilot's line of sight to the victim when the rescue capsule release is made.

(5 marks)

(iii) Determine the velocity before it reaches the water.

(4 marks)

(b) Sakura drag a suitcase with a rope along the floor of an airport terminal. The rope makes a angle with the horizontal. If the coefficient of kinetic friction between the suitcase and the floor is 0.13, the suitcase has a mass of 30.0 kg and she pulls on the rope with a force of 75.0 N as shown in **FIGURE 5 (b).**

(i) Draw Free Body Diagram on the suitcase.

(4 marks)

(ii) Find the magnitude of the normal force, frictional force and the net force.

(9 marks)

Q6 (a) In a two-dimensional tug of war, Alex, Betty and Charles pull horizontally on an automobile tire at the angles shown in the overhead view of **FIGURE Q6 (a)**. The tire remains stationary in spite of the three pulls. Alex pulls with force, F_A = 220 N and Charles pulls with force, Fc = 170 N.

(i) Draw Free Body Diagram (FBD) for this situation.

(3 marks)

(ii) Determine the magnitude of Betty's force, F_B.

(10 marks)

(b) A circular steel wire with length 4.0 m must stretch no more than 0.25 cm when a tensile force of 400 N is applied to one end of the wire.

(i) Define Young Modulus.

(4 marks)

(ii) Find the minimum diameter is required for the wire.

(8 marks)

~ END OF QUESTION ~

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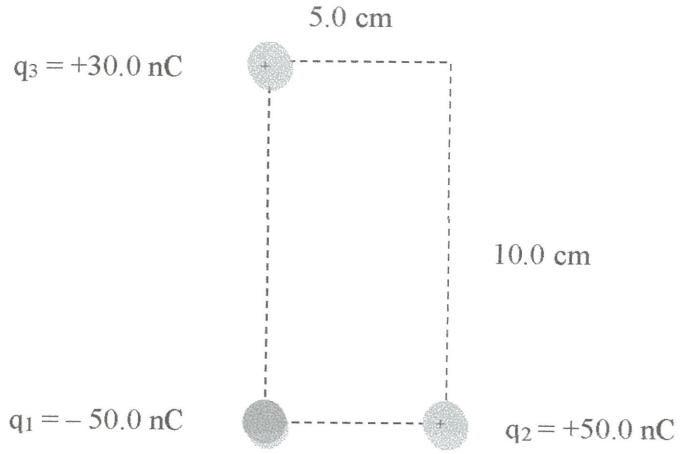

FIGURE Q1 (a)

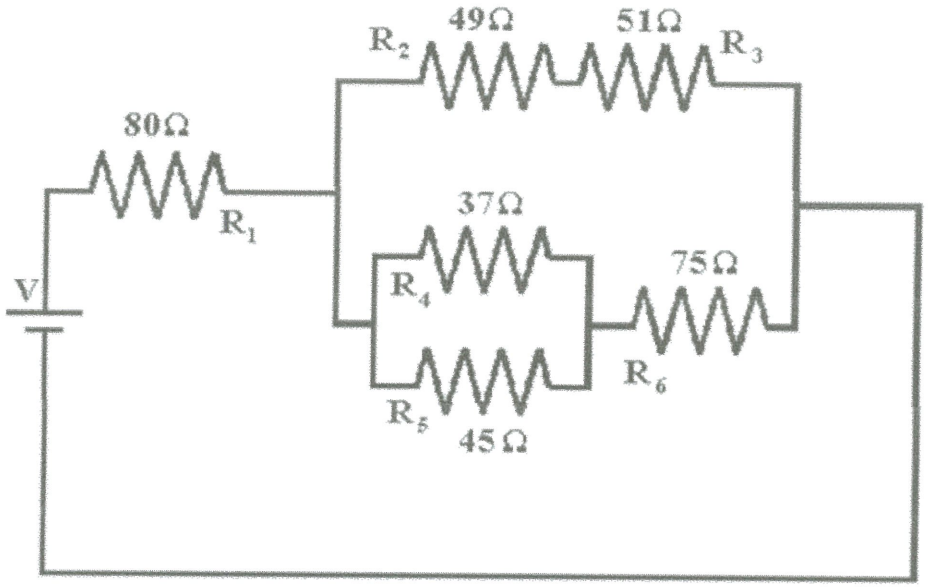

FIGURE Q1 (b)

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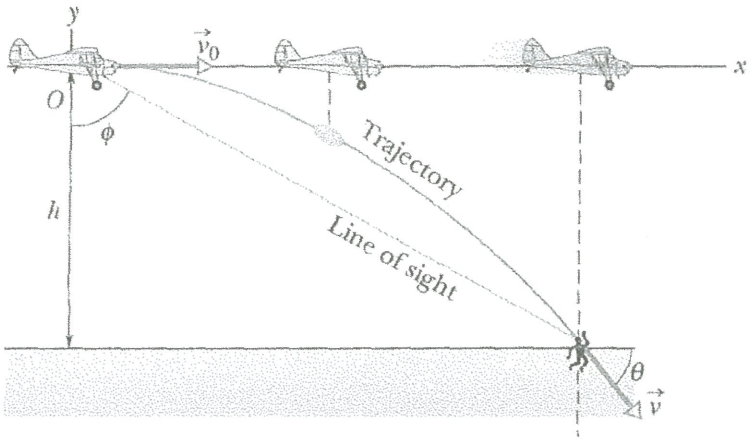

FIGURE Q5 (a)

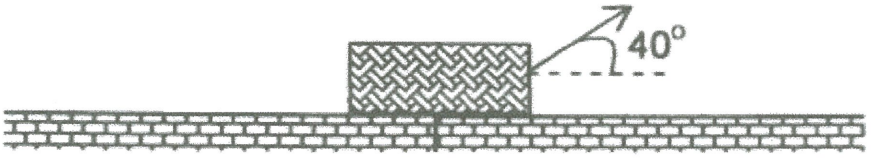

FIGURE Q5 (b)

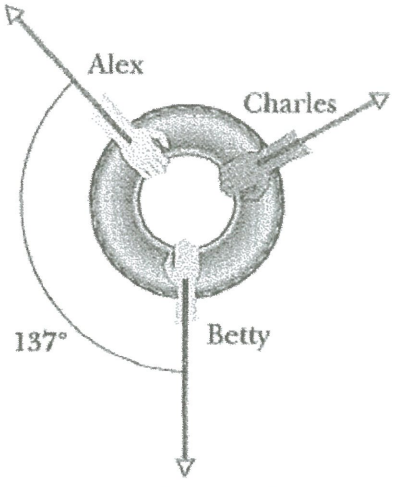

FIGURE Q6 (b)

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Appendix

$V = \frac{1}{4\pi\varepsilon_o}(\frac{q_1}{r})$	$A = \frac{\pi D^2}{4}$	$E = \frac{1}{4\pi\varepsilon_o}(\frac{q_1}{r^2})$
$B = \frac{\mu_0 I}{2\pi r}$	$x = v_{ox}\, t$	$F = \frac{\mu_0}{2\pi}(\frac{I_1 I_2}{d})$
$F = k\, e$	$F = k\frac{q_1 q_2}{r^2}$	$F = \frac{1}{4\pi\varepsilon_o}(\frac{q_1 q_2}{r^2})$
$E = \frac{1}{2} k\, e^2$	$y = v_o t + \frac{1}{2} g\, t^2$	$A = \pi r^2$
$v^2 = v_o^2 + 2as$	$s = v_o t + \frac{1}{2} a\, t^2$	$s = \frac{v_o + v_f}{2} t$
$P = \frac{F}{A}$	$B = -\frac{\sigma}{\varepsilon}$	$v = v_o + a\, t$
$\sigma = \frac{F}{A}$	$E = \frac{\sigma}{\varepsilon}$	$\varepsilon = \frac{\Delta l}{lo}$
$E = \frac{Q}{\varepsilon_o A}$		
$\varepsilon = \frac{\Delta V}{Vo}$	$\varepsilon = \frac{\Delta x}{L}$	$Y = \frac{\sigma}{\varepsilon}$

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List Of Constants

1. Gravity acceleration, $g = 9.81$ m/s^2
2. Atmospheric pressure, $P_{atm} = 1.0 \times 10^5$ Pa
3. Density of seawater, $\rho_{seawater} = 1030$ kg/m^3
4. Density of water, $\rho_{water} = 1000$ kg/m^3
5. Young Modulus of steel, $Y_{steel} = 20 \times 10^{10}$ Pa
6. Permeability of free space, $\mu_o = 4\pi \times 10^{-7} Nm^{-1}$
7. Planck constant, $h = 6.63 \times 10^{-34} Js$
8. Speed of light in air, $c = 3 \times 10^8$ m/s
9. Charge of electron, $e = 1.602 \times 10^{-19} C$
10. Permittivity of free space, $\varepsilon_o = 8.854 \times 10^{-12} (Nm)^{-2} C^2$
11. Coulomb constant, $k = 9 \times 10^9 Nm^2 C^{-2}$
12. Mass of electron, $e = 9.1 \times 10^{-31} kg$
13. Mass of proton, $p = 1.673 \times 10^{-27} kg$