Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	TECHNICAL SCIENCE II
COURSE CODE	:	DAS 12703
PROGRAMME	:	1 DAB / 1 DAJ / 1 DAR / 1 DAK
EXAMINATION DATE	:	JUNE 2014
DURATION	:	3 HOURS
INSTRUCTION	:	A) ANSWER **ALL** QUESTIONS IN **SECTION A** B) ANSWER **ONE (1)** QUESTION ONLY IN **SECTION B** C) ANSWER **ONE (1)** QUESTION ONLY IN **SECTION C**

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

PART A

Q1 (a) Explain the types of collision.

(4 marks)

(b) An aeroplane accelerates 5 ms^{-2} and travels for 40 s before it takes off. Find:

(i) The minimum length of the runway.

(3 marks)

(ii) The velocity of the aeroplane at take off.

(2 marks)

(c) A goal keeper kicks a ball from the ground with a velocity of $u_x = 48$ m s^{-1} and $u_y = 36$ ms^{-1}.

(i) Determine the initial velocity.

(3 marks)

(ii) Calculate the time of the ball is in the air.

(6 marks)

(iii) Determine how far will the ball landed.

(3 marks)

(iv) Determine the maximum height reached by the ball.

(4 marks)

Q2 (a) (i) Describe completely the galvanic cell as shown in **FIGURE Q2 (a)** based on the following half – reactions under standard conditions:

$$Ag^+ + e^- \longrightarrow Ag \qquad E^o = 0.80\ V$$

$$Fe^{3+} + e^- \longrightarrow Fe^{2+} \qquad E^o = 0.77\ V$$

(6 marks)

(ii) Show the cell diagram for the above galvanic cell.

(5 marks)

(b)

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

(i) Write the half-cell reaction, for anode and cathode for the given electrochemical cell.

(4 marks)

(ii) Predict whether the above reaction would proceed spontaneously as written at 298 K.
Given: $[Fe^{2+}] = 0.68$ M, $[Co^{2+}] = 0.15$ M,
$E^\circ_{Co^{2+}/Co} = -0.28V$ $E^\circ_{Fe^{2+}/Fe} = -0.44V$

(10 marks)

PART B

Q3 (a) State **four (4)** factors that affect the resistance in a wire.

(4 marks)

(b) **Three (3)** resistors with 1 Ω, 2 Ω and 5 Ω respectively are connected in series to a battery of 24 V.

(i) Draw the ciruit diagram.

(3 marks)

(ii) Calculate the total resistance.

(2 marks)

(iii) Calculate the total amount of current in the circuit.

(2 marks)

(iv) Determine the potential difference across the 2 Ω resistor.

(2 marks)

(c) Based on the circuit shown in **FIGURE Q3 (c),** determine

(i) The current through the 6 Ω resistor.

(3 marks)

(ii) The terminal voltage of the battery.

(6 marks)

(iii) The electrical power supplied by the battery to the external circuit.

(3 marks)

Q4 (a) Solve the following situation using Hooke's law

(i) A spring has a spring constant of 0.1 N/m. Determine the force necessary to stretch the spring by 200 mm.

(2 marks)

(ii) A car of mass 1250 kg is placed on four identical springs. Each spring is seen to be compressed by a distance of 8 cm. Determine the spring constant of each spring
Given: gravity acceleration, $g = 9.81\ ms^{-2}$

(4 marks)

(b) A circular steel wire with length 20 cm must stretch not more than 0.25 cm when the tensile force of 400 N is applied to one end of the wire. Calculate the minimum diameter of the wire (Young's Modulus of steel = 20×10^{10} Pa).

(7 marks)

(c) (i) Name two methods for solving problem related to system of forces acting on a particle which are in equilibrium.

(2 marks)

(ii) A particle is in equilibrium under the action of forces T and P as shown in **FIGURE Q4 (c) (ii).** Solve for the values of magnitudes of T and P.

(10 marks)

PART C

Q5 (a) The reaction between solid sodium and iron (III) oxide is given by the equation:

$$6\ Na(s) + Fe_2O_3(s) \rightarrow 3\ Na_2O(s) + 2\ Fe(s)$$

If 100.0 g Na and 100 g Fe_2O_3 react :

(i) Find the number of moles of Na and Fe_2O_3.

(3 marks)

(ii) Determine the limiting and excess reactant.

(5 marks)

(iii) Calculate the theoretical yield of solid Fe produced.

(4 marks)

(iv) Calculate the percent yield if the actual yield of Fe is 50.0 g.

(2 marks)

(v) Calculate the mass of the excess reactant.

(5 marks)

(Relative atomic mass : O = 16, Na = 23, Fe = 56)

(b) The reaction between nitric acid, HNO_3 and potassium hydroxide, KOH is given by the following equation :

$$HNO_3(aq) + KOH(aq) \rightarrow KNO_3(aq) + H_2O)(l)$$

In a titration, 43.33 mL of 0.10 M KOH is required to neutralize 20.00 mL of the acid.

(i) Find the number of moles of KOH.

(2 marks)

(ii) Calculate the molarity of HNO_3.

(4 marks)

Q6 (a) Consider the reaction

$$X + Y \rightarrow Z$$

Initial Rate of Disappearance of X (M/s)	**[X] (M)**	**[Y] (M)**
0.053	0.10	0.50
0.127	0.20	0.30
1.020	0.40	0.60
0.254	0.20	0.60
0.509	0.40	0.30

From the given data, obtained at 360 K,

(i) Determine the rate law and rate constant, *k* of the reaction.

(9 marks)

(ii) Calculate the initial rate of disappearance of X when the concentration of X is 0.30 M and that of Y is 0.40 M

(5 marks)

(b) Ethyl iodide (C_2H_5I) decomposes at a certain temperature in the gas phase as follows:

$$C_2H_5I\ (g) \longrightarrow C_2H_4\ (g) + HI\ (g)$$

Time (min)	**[C_2H_5I] (M)**
0	0.36
15	0.30
30	0.25
48	0.19
75	0.13

(i) From the given data:
Plot a graph of ln [C_2H_5I] against time. Prove that the reaction is first – order kinetics.

(7 marks)

(ii) Calculate the rate constant, *k*.

(4 marks)

~ END OF QUESTION ~

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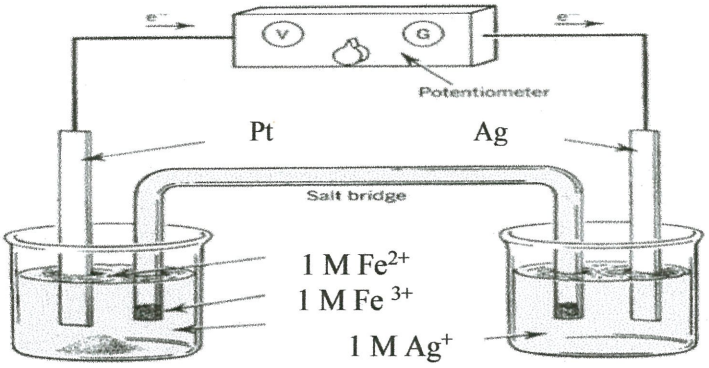

FIGURE Q2 (a)

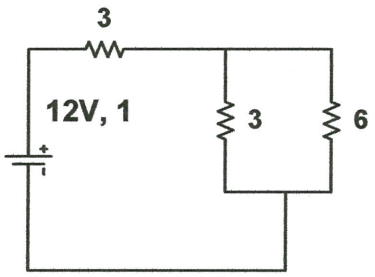

FIGURE Q3 (c)

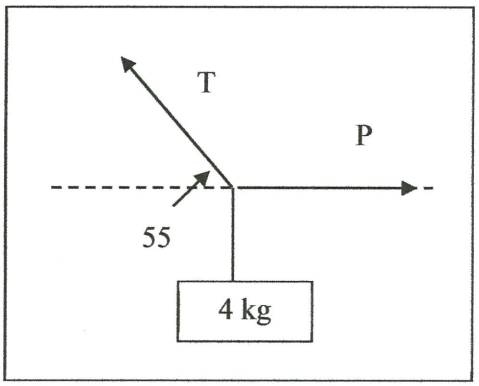

FIGURE Q4 (c)

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Appendix

$\mathrm{E} = \frac{\sigma}{\varepsilon}$	$\sigma = \frac{F}{A}$	$\varepsilon = \frac{\Delta L}{L}$
$A = \pi r^2$	$\mathrm{d} = \frac{v_i + v_i}{2} t$	$\mathrm{d} = v_i t + \frac{1}{2} a\, t^2$
$\mathrm{y} = v_{iy} t + 0.5 g\, t^2$	$\mathrm{E} = \frac{1}{2} k\, e^2$	$\mathrm{F} = k\, e$
$\mathrm{P} = \frac{F}{A}$	$\mathrm{v}_f = v_i + a\, t$	$v_f^2 = v_i^2 + 2a\, d$
$\mathrm{v}_f = g\, t$	$\mathrm{x} = v_{ix}\, t$	$\mathrm{y} = 0.5 g\, t^2$