INTI International University & Colleges

FINAL

Examination Paper

(COVER PAGE)

Session	: **August 2017**		
Programme	: Diploma in Mechanical Engineering (DMEN)		
Course	: **PHY1121 : Physics**		
Date of Examination	: December 14, 2017 (Thursday)		
Time	: 11:00 am – 1:00 pm	Reading Time :	Nil
Duration	: 2 Hours		
Special Instructions	:		

This paper consists of **FIVE (5)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Materials permitted : Non-programmable Scientific Calculator

Material provided : Physics Booklet

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Moderator : Dr Chong Tet Vui

This paper consists of 6 printed pages, including the cover page.

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME
PHY 1121 : PHYSICS
FINAL EXAMINATION: AUGUST 2017 SESSION

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Question 1

(a) State the number of significant digits in the following measurements.

(i) 3.01×10^7 m (1 mark)

(ii) 0.00060 m (1 mark)

(iii) 4.070 m (1 mark)

(b) A sports car burns fuel at a rate of 11.2 g/s. Convert the consumption rate to kg/hr. (3 marks)

(c) The position of an object as a function of time is given by $x(t) = at^3 - bt^2 + ct - d$, where $a = 3.6\ \text{m/s}^3$, $b = 4.0\ \text{m/s}^2$, $c = 60\ \text{m/s}$ and $d = 7.0$ m.

(i) Find the average acceleration over the first 2.4 seconds. (5 marks)

(ii) Find the instantaneous acceleration at $t = 2.4$ s. (3 marks)

(d) A student rides her bike on some rural roads. She begins her trip by riding due north for 3.0 km. Then, She turns east and travelling in a straight line for 2.0 km. On her last leg of trip, she rides northeast for a distance of 5.0 km.

(i) Sketch a vector diagram showing the graphical method in determining the total displacement vector ***D*** for the entire trip. (3 marks)

(ii) Determine the magnitude and direction of the total displacement vector ***D***. (8 marks)

Question 2

(a) A child throws a ball with an initial speed of 8.00 m/s at an angle of 40.0° above the horizontal. The ball leaves her hand 1.00 m above the ground and experience negligible air resistance.

(i) Determine the time of flight before the ball hits the ground. (2 marks)

(ii) Determine the distance from where the child is standing and the ball hits the ground. (2 marks)

(iii) Calculate the ball's velocity just before it hits the ground. (5 marks)

(b) Two blocks connected by a cord passing over a small and frictionless pulley are put and released from a frictionless incline as shown in **Figure Q2(b)**.

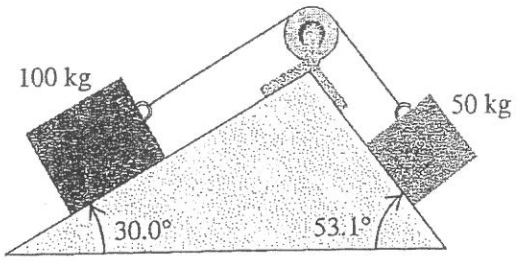

Figure Q2(b)

(i) Sketch a free body diagram for each of the blocks. (4 marks)

(ii) Determine the acceleration of the blocks. (5 marks)

(iii) Determine the tension in the cord. (2 marks)

(c) A crate of auto parts is sitting on a horizontal frictionless frozen lake. A worker applies a constant horizontal force of 750 N to the crate. Starting from rest, the crate moves 20 m in the first 4 s. Calculate the mass of the crate. (5 marks)

Question 3

(a) Two gliders collide on a frictionless horizontal air track. The first glider has a mass of 2.0 kg. Before the collision, it is moving rightward at 5.0 m/s. The second glider has a mass of 3.0 kg. Before the collision, it is at rest. After the collision, the second glider is moving rightward at 4.0 m/s. Assume this is perfectly elastic collision. Calculate the velocity of the first glider after the collision. (5 marks)

(b) A solid concrete wall 4.0 m by 2.4 m and 30 cm thick, with a thermal conductivity of 1.3 W/(m·K), separates a basement at 18°C from the ground outside at 6°C. Under steady state conditions, how much heat flows through the wall in one hour? (6 marks)

(c) A piece of iron of mass 0.12 kg is taken from an oven where its temperature is 336°C and quickly placed in an insulated copper can that contains 0.20 kg of water. The copper can has mass 0.50 kg, and it and the water in it are originally at a temperature of 20°C. Calculate the final temperature of the system, assuming no heat is lost to the surroundings. Use the following specific heats: water, $c = 4190\ \text{J/kg} \cdot {}^\circ\text{C}$; iron, $c = 470\ \text{J/kg} \cdot {}^\circ\text{C}$; and copper, $c = 390\ \text{J/kg} \cdot {}^\circ\text{C}$. (6 marks)

(d) 2.0 L of an ideal nitrogen gas (N_2) are at 0.00°C and 1.0 atm. The ideal gas constant is $R = 8.314$ J/mol·K, Avogadro's number is 6.022×10^{23} molecules/mol, the molecular mass of nitrogen is 28 g/mol and $1\ \text{L} = 1 \times 10^{-3}\ \text{m}^3$.

(i) Determine the number of moles of N_2. (4 marks)

(ii) How many molecules of N_2 are present? (2 marks)

(iii) Calculate the mass of this gas. (2 marks)

Question 4

(a) Two positive point charges +4.00 μC and +2.00 μC are placed at the opposite corners of a rectangle as shown in the **Figure Q4(a)**. (It is given that the Coulomb constant, $k = 8.99 \times 10^9\ \text{N·m}^2/\text{C}^2$)

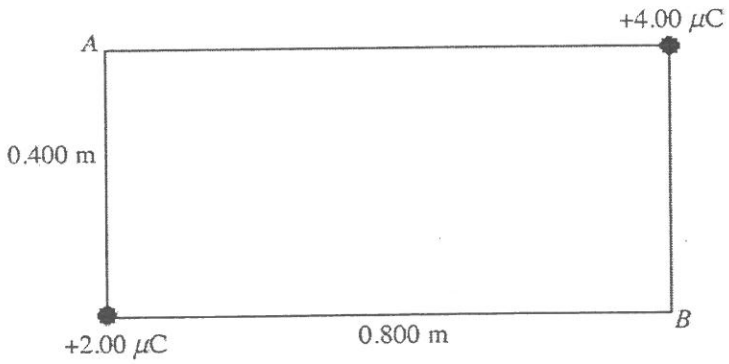

Figure Q4(a)

(i) Determine the potential at point *A* (relative to infinity) due to these charges? (3 marks)

(ii) Determine the potential at point *B* (relative to infinity) due to these charges? (3 marks)

(b) A parallel–plate capacitor has circular plates of 8.2 cm radius and 1.3 mm separation. (It is given that the permittivity of vacuum, $\varepsilon_o = 8.85 \times 10^{-12}$ F.m^{-1})

(i) Calculate the capacitance. (5 marks)

(ii) Determine the amount of charge on the plates if a potential difference of 120V is applied. Define your answer in appropriate prefixes. (3 marks)

(c) **Figure Q4(c)** shows an electron is fired perpendicular into a 3.5 mT uniform magnetic field with a speed of 2.0×10^7 ms^{-1}. The magnetic field is directed into the plane of the page.

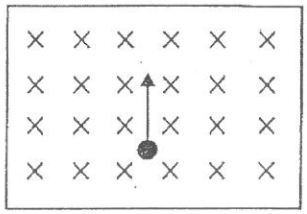

Figure Q4(c)

(i) Make a copy of the diagram and mark the direction of the magnetic force on the electron. (2 marks)

(ii) Calculate the magnetic force acting on the electron. (2 marks)

(iii) Explain why the electron will move in a circle with constant speed. (2 marks)

(iv) Calculate the radius of the electron's circular path. (3 marks)

(v) How long will it take for the electron to complete one circular orbit? (2 marks)

Question 5

(a) If the electrical energy costs 25 cents per kilowatt-hour, how much does it cost to operate an electric oven for 5.0 hour if it carries a current of 20.0 A at 220 V? (5 marks)

(b) (i) How are covalent bonds formed? (2 marks)

(ii) Define doping. (2 marks)

(iii) How is an *n*-type semiconductor formed? What is the majority carrier in a *n*-type semiconductor? (3 marks)

(iv) What is the difference between intrinsic and extrinsic semiconductor? (2 marks)

(c) Four capacitors are connected across a 90-V voltage source as shown in the **Figure Q5(c)**. Determine

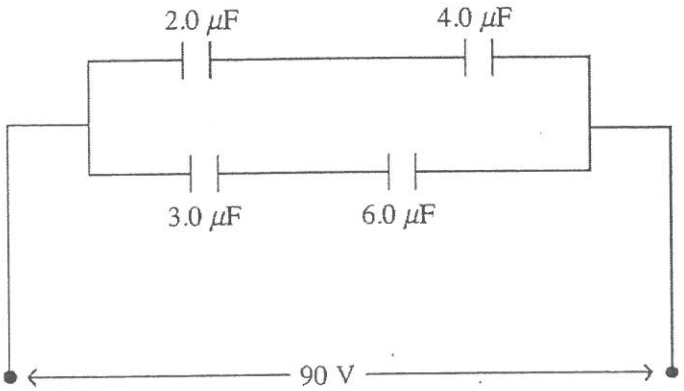

Figure Q5 (c)

(i) the equivalent capacitance for the circuit, (5 marks)

(ii) the charge on a 4.0-μF capacitor, (2 marks)

(iii) the charge on the 3.0-μF capacitor, and (2 marks)

(iv) the potential difference across the 6.0-μF capacitor. (2 marks)

-THE END-