INTI International University & Colleges

FINAL

Examination Paper

(COVER PAGE)

Session	:	**April 2018**
Programme	:	Diploma in Mechanical Engineering (DMEN)
Course	:	**PHY1121 : Physics**
Date of Examination	:	August 1, 2018 (Wednesday)
Time	:	8:00 am – 10:00 am 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

Examiner : **Chong Mee Teng** & Manickampraslad M. Sambasivam

Moderator : Dr Chong Tet Vui

This paper consists of 7 printed pages, including the cover page.

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
PHY1121: PHYSICS
FINAL EXAMINATION: APRIL 2018 SESSION

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

Question 1

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

(i) 7.08×10^7 g (1 mark)

(ii) 0.00150 g (1 mark)

(b) Given that 1 m = 3.281 ft. Express the speed of light, 3.0×10^8 m/s in

(i) feet per nanosecond and, (3 marks)

(ii) milimeters per picosecond. (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 $a = 3.6$ m/s^3, $b = 4.0$ m/s^2, $c = 60$ m/s and $d = 7.0$ m.

(i) Find the instantaneous acceleration at t =2.4 s. (4 marks)

(ii) Find the average acceleration over the first 2.4 seconds. (4 marks)

(d) A rabbit trying to escape a fox runs north for 8.0 m, darts northwest for 1.0 m, then drops 1.0 m south a hole into its burrow.

(i) Sketch a vector diagram showing the graphical method in determining the total displacement of the rabbit. (3 marks)

(ii) By component method, compute the magnitude and direction of the total displacement. (6 marks)

Question 2

(a) A projectile is shot horizontally at 23.4 m/s from the roof of a building 55.0 m tall. Determine

(i) the time necessary for the projectile to reach the ground, (2 marks)

(ii) the distance from the base of the building that the projectile lands and, (2 marks)

(iii) the horizontal and vertical components of the velocity just before the projectile reaches the ground. (3 marks)

(b) A block of mass, m = 2 kg moves along a horizontal frictional table under the action of forces as shown in **Figure 2 (b)**, assuming the coefficient of kinetic friction between the tabletop and block is $\mu_k = 0.20$.

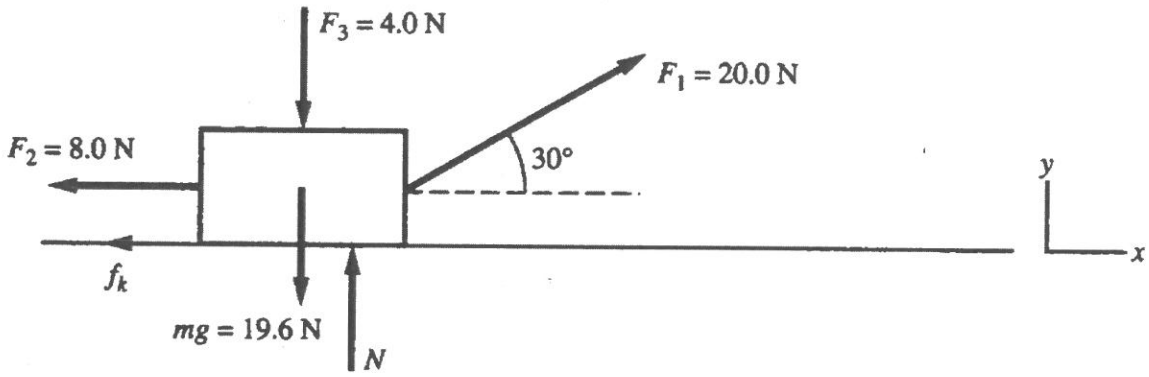

Figure 2 (b)

(i) Find the normal force due to the table. (3 marks)

(ii) Find the acceleration of the block. (4 marks)

(c) (i) State the Newton's law of gravity. (1 mark)

(ii) Find the mass of the Earth, given that the radius of the Earth, $R_E = 6.38 \times 10^6$ m. (2 marks)

(iii) Determine the speed of the Hubble space telescope that orbits the Earth at the altitude of 600 km. (3 marks)

(d) An aluminium pot of volume 600 cm^3 is filled to the top with water at 20 °C. The pot and contents are heated up to 60 °C. Determine the volume of water spills over the top of the pot during the heating. (Given the coefficient of volume expansion of water, $\beta_{water} = 30 \times 10^{-5}$ /C° and the coefficient of volume expansion of aluminium, $\beta_{aluminum} = 7.65 \times 10^{-5}$ /C°) (5 marks)

Question 3

(a) Two blocks of masses, m_1 of 2.0 kg and m_2 of 4.0 kg are each released from rest at a height of 5.0 m on a frictionless track as shown in **Figure 3 (a)**. Subsequently, they undergo an elastic head-on collision. (treat the blocks as point-like particles)

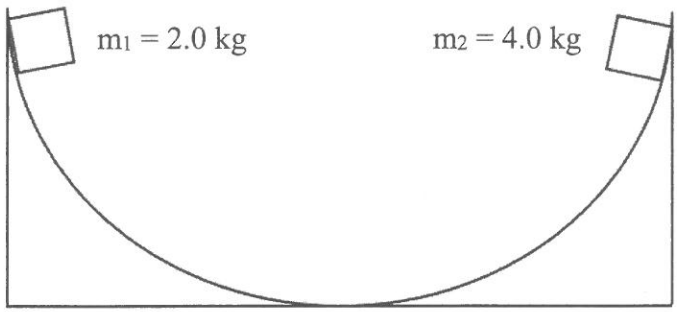

Figure 3 (a)

(i) Show that the velocity of both the blocks just before collision is 9.9 m/s, assuming no air resistance. (2 marks)

(ii) Determine the total kinetic energy of the blocks just after the collision. (2 marks)

(iii) Given that m_1 has a kinetic energy of 272 J after collision, determine the maximum height that m_2 can rise after the collision using your answer in part (ii). (4 marks)

(b) In the gas, a hydrogen molecule of mass 2.00 u and velocity 1.88×10^3 m/s, collides elastically and head on with an oxygen molecule of mass 32.0 u and velocity 405 m/s, as illustrated in **Figure 3 (b).**

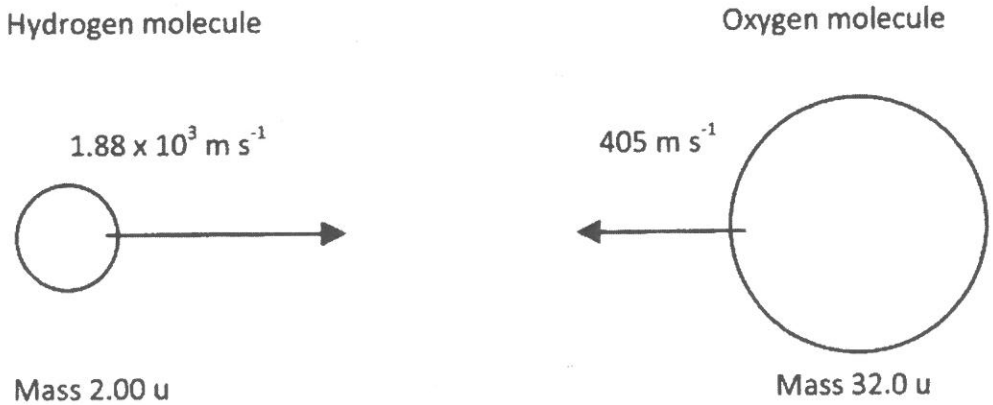

Figure 3 (b)

(i) Explain what is meant by an elastic collision between the two molecules. (1 mark)

(ii) Determine the velocity of the oxygen molecule just after collision. (6 marks)

(c) A calorimeter has a shell of negligible heat capacity and contains 0.5 kg of ice and 0.5 kg of water in equilibrium (T_i = 0 °C). A 2.0 kg of steel at 500 °C is placed in the calorimeter, and the system is allowed to come to equilibrium. Calculate the final equilibrium temperature. (Given the specific heat capacity of steel, c_{steel} = 460 J/kg·C°, specific heat capacity of water, c_{water} = 4186.0 J/kg·C° and heat of fusion of ice, L_{ice} = 335000 J/kg) (6 marks)

(d) A container holds 2×10^{-3} m^3 of air at 27 °C with an atmospheric pressure of 100 kPa. If the percentage of nitrogen in the air is 70%, find the number of nitrogen molecules in the container. (Given that Avogadro constant, $N_A = 6.02 \times 10^{23}$) (4 marks)

Question 4

(a) In **Figure 4 (a)**, a positive charge of 3.0 C is pulled by two negative charges. One negative charge of −2.0 C is 0.05 m to the west and the other negative charge of −4.0 C is 0.03 m to the east. Calculate the total force that exerted on the positive charge. (6 marks)

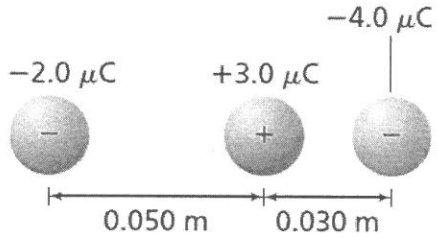

Figure 4 (a)

(b) If 120 J of work is performed to move 2.4 C of charge from the positive plate to the negative plate as shown in **Figure 4 (b),** calculate the potential difference exists between the plates. (3 marks)

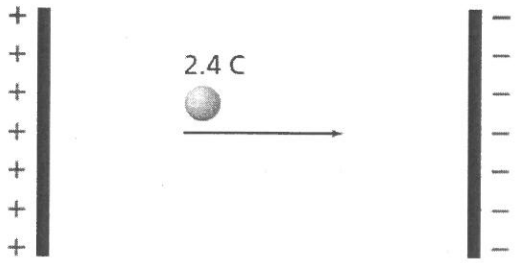

Figure 4 (b)

(c) After a comb is rubbed on a wool sweater, it is able to pick up small pieces of paper. Explain why the comb loses that ability after a few minutes. (3 marks)

(d) Two capacitors of 3.3 μF and 6.8 μF are connected across a 24 V electric potential difference. Identify which capacitor has a greater charge by calculation. (5 marks)

(e) Refer to **Figure 4 (e)**, calculate

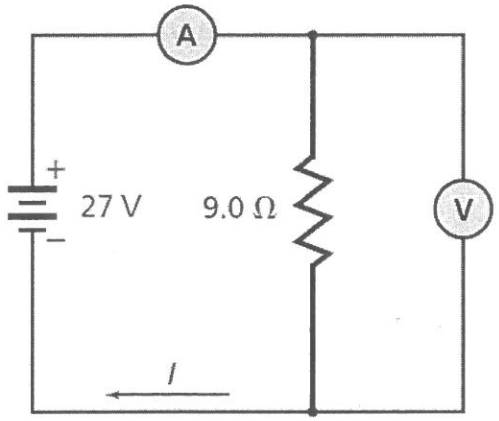

Figure 4 (e)

(i) the ammeter (A) reading, (2 marks)

(ii) the voltmeter (V) reading, (2 marks)

(iii) the amount of power delivered to the resistor and, (2 marks)

(iv) the amount of energy is delivered to the resistor per hour. (2 marks)

Question 5

(a) Refer to the circuit shown in **Figure 5 (a)**, calculate

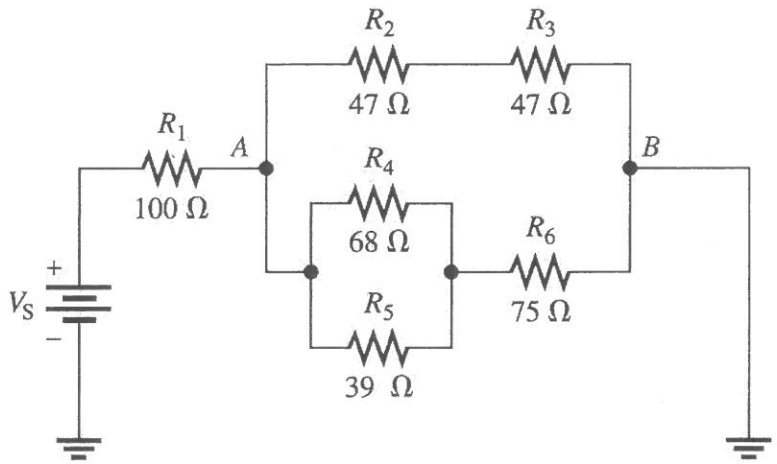

Figure 5 (a)

(i) the total resistance from point ***A*** to point ***B*** and, (8 marks)

(ii) the total current flows in the combinational circuit if $Vs = 30$ V. (3 marks)

(b) In **Figure 5 (b),** an electron travelling with a speed of 6.5×10^7 m/s enters a region of uniform magnetics field of flux density 0.316 T. It then emerges from the field at ***P***.

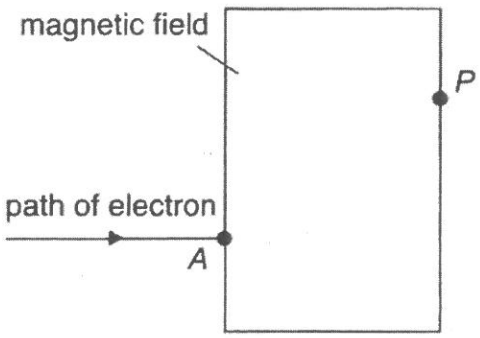

Figure 5 (b)

(i) Draw the path of the electron from ***A*** to ***P***. (2 marks)

(ii) Draw the path of the electron after emerging from the field. (2 marks)

(iii) State the direction of the magnetic field. (1 mark)

(iv) Determine the speed of the electron after emerging from the field. (1 mark)

(c) Explain the following terms:

(i) Semiconductor (2 marks)

(ii) Diode (2 marks)

(iii) Transistor (2 marks)

(iv) Doping (2 marks)

-THE END-

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