INTI International University & Colleges

**FINAL**
Examination Paper

(COVER PAGE)

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| Session | : | **August 2019** |
| Programme | : | Diploma In Mechanical Engineering (DMEN) |
| Course | : | **PHY1121 : Physics** |
| Date of Examination | : | December 14, 2019 (Saturday) |
| Time | : | 5:00 pm – 7:00 pm Reading Time: Nil |
| Duration | : | 2 Hours |
| Special Instructions | : | |

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

Materials permitted :
Non-Programmable Scientific Calculator

Materials provided :
Physics Booklet

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| Examiner (s) | : | **Chong Mee Teng** and Manickampraslad Sambasivam |
| Moderator | : | Dr Chong Tet Vui |

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

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
PHY1121: PHYSICS
FINAL EXAMINATION: AUGUST 2019 SESSION

**Instructions:** This paper consists of **FIVE (5)** questions. Answer any **FOUR (4)** 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) $3.40 \times 10^3$ s (1 mark)

(ii) 4.280 s (1 mark)

(iii) 0.0060 s (1 mark)

(b) A rectangular building lot has a width of 75.0 ft and a length of 125 ft. Determine the area of this lot in square meters. Given that 1 m = 3.281 ft. (4 marks)

(c) A person walks 53.1° north of east for 2.50 km, then due east for 2.00 km and finally 5.20 km at 30.0° south of west.

(i) Show these displacements and the resultant by graphical method. (3 marks)

(ii) Find the resultant displacement of the person by component method. (6 marks)

(d) A baseball is hit so that it travels straight upward after being struck by the bat. A fan observes that it takes 3.00 s for the ball to reach its maximum height. Calculate:

(i) the ball's initial velocity, and (4 marks)

(ii) the height it reaches. (3 marks)

(e) Define the term "Instantaneous velocity". (2 marks)

**Question 2**

(a) A 100-g cube of ice at 0°C is dropped into 1.0 kg of water that was originally at 80°C. Determine the final temperature of the water after the ice has melted. Assume there is no heat exchange with the surroundings. For water, the specific heat is 4186 J/kg · C° and the heat of fusion is $3.33 \times 10^5$ J/kg. (5 marks)

(b) A stone is thrown horizontally outward with an initial velocity, $v_o = 4.96$ m/s from the top of a bridge. If the bridge is 19.6 m above the ground, determine the magnitude and direction of the velocity of a stone just before it strikes the ground. (7 marks)

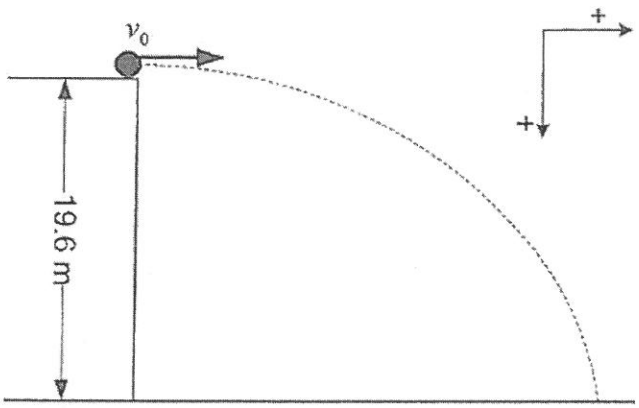


**Figure Q2 (b)**

(c) A block of mass, $m$ remains at rest on a frictionless surface after being acted by forces, $F_1 = 10$ N and $F_2$ of unknown magnitude, as illustrated in the **Figure Q2(c).**

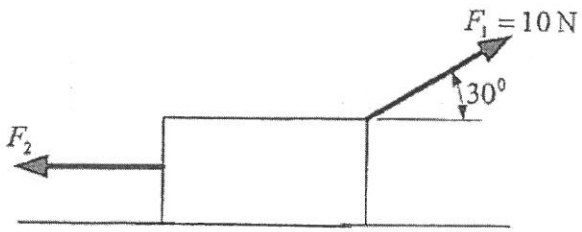


**Figure Q2 (c)**

(i) Determine the magnitude of force $F_2$. (3 marks)

(ii) If the normal force acting on the block is 4.8 N, calculate the mass, $m$ of the block. (5 marks)

(d) The acceleration due to gravity at the surface of a planet of mass, $M$ and radius, $R$ is given by the expression: $g = \frac{GM}{R^2}$. On Earth, this value of $g$ is 9.8 m/s$^2$. Suppose that a planet is discovered that has a mass 12 times that of Earth, and a radius 2.0 times that of Earth, determine the value of $g$ on this planet. (5 marks)

**Question 3**

(a) A 64.0 kg mass, $M$ initially at rest breaks into pieces of $m_1 = 16.0$ kg and $m_2 = 48.0$ kg, due to an explosion that produces $2.4 \times 10^3$ J of total kinetic energy in the pieces. Calculate the velocity of mass $m_1$ and $m_2$ right after the explosion. (10 marks)

(b) A spring exerts a force of 88 N when it is compressed by 0.16 m.

(i) Calculate the potential energy stored in the spring when it is compressed by 0.16 m. (4 marks)

(ii) The spring with the compression of 0.16 m is now used to launch a 0.055 kg ball horizontally. Calculate the maximum speed with which the ball can be launched. (4 marks)

(c) The coefficient of thermal expansion for aluminium is $25 \times 10^{-6}$ /C°. What temperature change, $\Delta T$ is required to cause a 4.00 m long aluminium rod to expand by 0.01 m? (2 marks)

(d) A certain mass of hydrogen gas occupies 370 mL at 16 °C and 150 kPa. Calculate its volume at -21 °C and 420 kPa. (5 marks)

**Question 4**

(a) Two charged objects have a repulsive force of 0.0980 N. If the distance between the two charges is doubled, calculate the new force acting on these objects. (3 marks)

(b) A certain parallel-plate capacitor consists of two plates, each with area 0.02 $m^2$, separated 4.0 mm by air gap. Given that the permittivity of free space, $\varepsilon_o = 8.85 \times 10^{-12}$ F/m and dielectric constant of air is 1.0.

(i) Compute its capacitance. (3 marks)

(ii) If the capacitor is connected across a 500 V source, calculate the maximum charge and the maximum energy stored in the capacitor. (5 marks)

(c) Mary has RM 1.05 credit on her pre-paid electricity meter. Electricity cost 50 sen per unit of kilowatt-hour. She gets home, cooks supper before dark using 2000 W stove for 50 minutes, then studies, using the 100 W bulb. How long will she able to study with the supply of electricity? Show calculations to support your answer. (7 marks)

(d) In the Bohr model of hydrogen atom, an electron ($q = -e$) circles a proton ($q' = +e$) in an orbit with radius of $5.3 \times 10^{-11}$ m. The attraction of the proton for the electron furnishes the centripetal force needed to hold the electron in orbit. It is given that the Coulomb constant, $k = 9.0 \times 10^9$ Nm$^2$/C$^2$ and the electron mass, $m_e = 9.1 \times 10^{-31}$ kg. Calculate:

(i) the force of electrical attraction between the particles, and (3 marks)

(ii) the electron's linear speed. (4 marks)

**Question 5**

(a) Determine the current $I$ through the battery for **Figure Q5 (a)**. (7 marks)

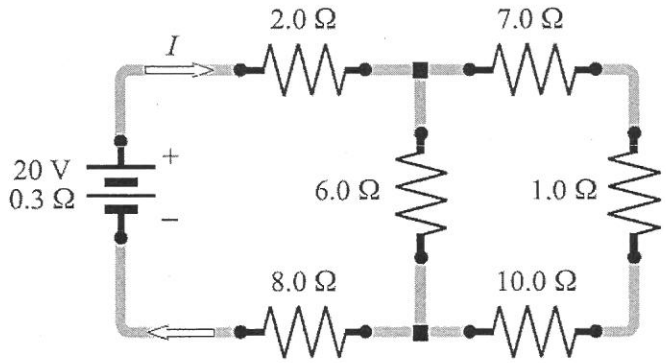


**Figure Q5 (a)**

(b) A proton travels with a speed of $3.0 \times 10^6$ m/s at an angle of 37° with the direction of a uniform magnetic field of 0.30 T in the $+y$ direction. Calculate:

(i) the magnitude of the magnetic force acts on the proton, and (3 marks)

(ii) the proton's acceleration. (3 marks)

(c) Describe the direction of the force acts on a proton that is moving through the magnetic fields as shown in the **Figure Q5 (c)(i)) and Figure Q5 (c)(ii))**. (4 marks)

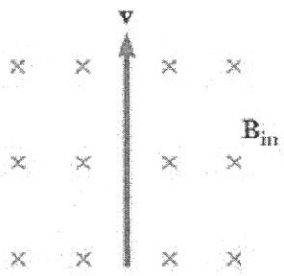


**Figure Q5 (c)(i)**

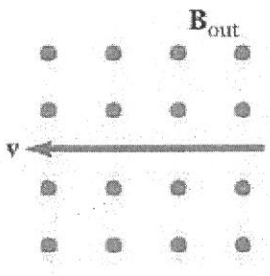


**Figure Q5 (c)(ii)**

(d) Define the following terms:

(i) Diode (2 marks)

(ii) Intrinsic Semiconductor (2 marks)

(iii) Depletion region (2 marks)

(iv) Barrier voltage (2 marks)

**-THE END-**

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