

FINAL  
Examination Paper  
(COVER PAGE)

Session : January 2018

Programme : Diploma in Mechanical Engineering (DMEN)

Course : PHY1121 : Physics

Date of Examination : March 5, 2018 (Monday)

Time : 2:00 pm – 4:00 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

Examiner : Manickampraslad M. Sambasivam & Chong Mee Teng

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: JANUARY 2018 SESSION

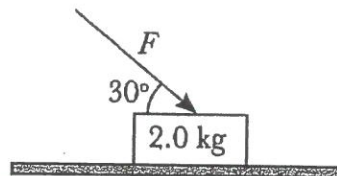
**Instructions:** This paper consists of **FIVE (5)** questions. Answer any **FOUR** questions in the answer booklet provided. All questions carry equal marks.

**Question 1**

- (a) State the number of significant digits in the following measurements.
- (i)  $2.05 \times 10^7$  g (1 mark)
  - (ii) 0.00090 g (1 mark)
  - (iii) 107010 g (1 mark)
- (b) A runner makes one complete lap of a 200 m track in a total time of 25 s. Calculate the runners:
- (i) average speed, and (2 marks)
  - (ii) average velocity. (2 marks)
- (c) A car is stopped at a traffic light. It then travels along a straight road so that its distance from the light is given by  $x = bt^2 + ct^3$ , where  $b = 1.10$  m/s<sup>2</sup> and  $c = 0.150$  m/s<sup>3</sup>. Calculate
- (i) the average velocity of the car for the time interval  $t = 0$  to  $t = 10.0$  s, and (4 marks)
  - (ii) the instantaneous velocity of the car at  $t = 3.0$  s. (3 marks)
- (d) An airplane undergoes the following displacements, all at the same altitude: First, it flies 59.0 km in a direction 30.0° east of north. Next, it flies 58.0 km due south. Finally, it flies 100.0 km in a direction 30.0° north of west.
- (i) Sketch a vector diagram showing the graphical method in determining the total displacement vector  $D$  for the entire trip. (3 marks)
  - (ii) Calculate the magnitude and direction of the total displacement vector  $D$ . (8 marks)

**Question 2**

- (a) A baseball is thrown straight upward on moon with the gravitational acceleration of  $-1.6 \text{ m/s}^2$  and an initial speed of  $35 \text{ m/s}$ . Calculate
- (i) the maximum height reached by the ball, (2 marks)
  - (ii) the time taken to reach maximum height, and (2 marks)
  - (iii) the velocity  $30 \text{ s}$  after it is thrown. (3 marks)
- (b) When a body is moving at constant velocity, explain whether it needs a force to maintain its state of motion. (3 marks)
- (c) **Figure Q2 (c)** shows the  $2.0 \text{ kg}$  block is being pushed along a rough horizontal plane by a force  $F = 10 \text{ N}$  at an angle  $30^\circ$  from the horizontal.



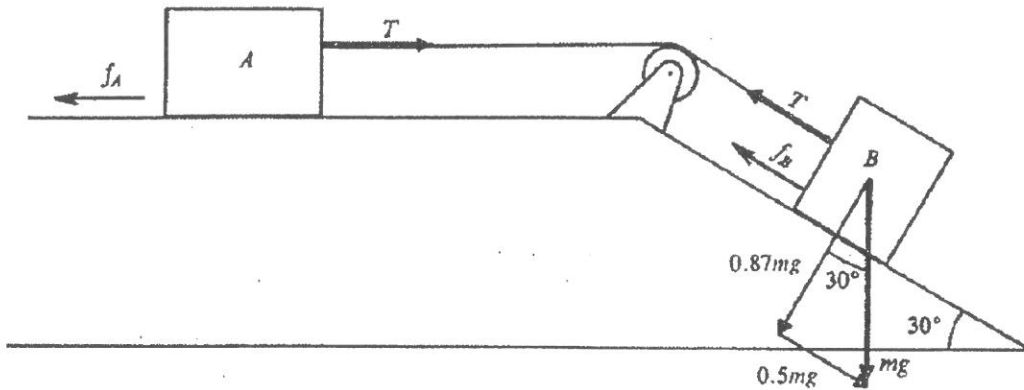
**Figure Q2 (c)**

- (i) Sketch a free body diagram for the block. (3 marks)
  - (ii) The block moves horizontally at a constant acceleration of  $0.8 \text{ m/s}^2$ , calculate the kinetic coefficient of friction. (6 marks)
- (d) An aluminum cup of  $300.0 \text{ cm}^3$  capacity is completely filled with glycerin at  $24.0 \text{ }^\circ\text{C}$ . Calculate the amount of glycerin, will spill out of the cup if the temperature of both the cup and the glycerin is increased to  $30.0 \text{ }^\circ\text{C}$ .  
(Given,  $\beta_{\text{glycerin}} = 5.1 \times 10^{-4} / \text{C}^\circ$  and  $\alpha_{\text{aluminum}} = 23.0 \times 10^{-6} / \text{C}^\circ$ ) (6 marks)

**Question 3**

(a) **Figure Q3 (a)** shows two boxes have an identical masses of 40 kg. Both experience a sliding friction force with  $\mu = 0.15$ . Calculate

- (i) the acceleration of the boxes, and (2 marks)
- (ii) the tension in the tie cord. (3 marks)

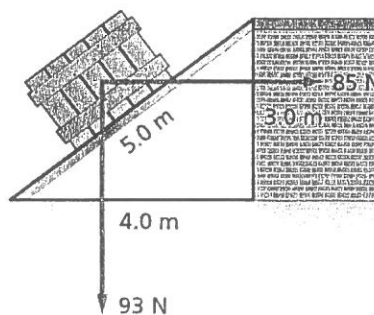


**Figure Q3 (a)**

(b) A 0.145 kg baseball is pitched at 42 m/s. The batter hits it horizontally to the pitcher at 58 m/s.

- (i) Determine the change in momentum of the ball. (2 marks)
- (ii) If the ball and the bat are in contact for  $4.6 \times 10^{-4}$  s, calculate the average force during contact. (3 marks)

(c) A worker pushes a crate weighing 93 N up an inclined plane for 5.0 m. The worker pushes the crate horizontally and parallel to the ground as illustrated in **Figure Q3 (c)**.



**Figure Q3 (c)**

- (i) If the worker exerts a force of 85 N, calculate work he does. (2 marks)
- (ii) Determine the work done by gravity. (2 marks)
- (iii) If the coefficient of friction is  $\mu = 0.20$ , determine the work done by friction. (3 marks)
- (d) A gas confined in a cylinder with a tight-fitting piston is initially in the state  $P_1 = 2000$  Pa,  $V_1 = 2.0 \times 10^{-3}$  m<sup>3</sup> and  $T_1 = 300$  K. Given gas constant,  $R = 8.31$  J/mol.K.
- (i) Calculate the moles of gas were in the cylinder. (2 marks)
- (ii) If the volume is decreased to  $0.50 \times 10^{-3}$  m<sup>3</sup> while the temperature is held fixed, determine the new pressure. (2 marks)
- (iii) Suppose that the gas is heated to 700 K while the volume is changed to a new value. But, there is 20% of the gas leaked out while the changes were being brought about. If the final pressure is measured to be 6000 Pa, calculate the new volume. (4 marks)

#### Question 4

- (a) In the **Figure Q4 (a)**, a proton is projected horizontally midway between two parallel plates that are separated by 0.50 cm. The electrical field due to the plates has magnitude 610000 N/C between the plates away from the edges. If the plates are 5.60 cm long, find the minimum speed of the proton if it just misses the lower plate as it emerges from the field. (Given,  $e = 1.60 \times 10^{-19}$  C,  $\epsilon_0 = 8.85 \times 10^{-12}$  C<sup>2</sup>/N · m<sup>2</sup> and  $m_p = 1.67 \times 10^{-27}$  kg) (9 marks)

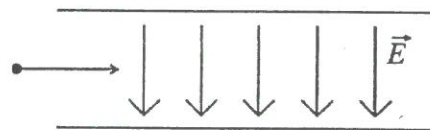


Figure Q4 (a)

- (b) (i) Describe the difference between *P*-type and *N*-type semiconductor materials. (2 marks)
- (ii) Explain the term “*pn* junction”. (2 marks)
- (iii) Explain majority carrier in a *n*-type semiconductor and also by what process are the majority carriers produced. (2 marks)

- (c) The **Figure Q4 (c)** shows two charged particles  $P$  and  $Q$  entering a uniform magnetic field, with flux density of  $0.85\text{ T}$  with the same velocity of  $v$ . The magnitude of the charges on the particles is  $1.60 \times 10^{-19}\text{ C}$ . The radius of curvature of the path of  $Q$  is  $15.0\text{ cm}$  and is twice that of  $P$ .

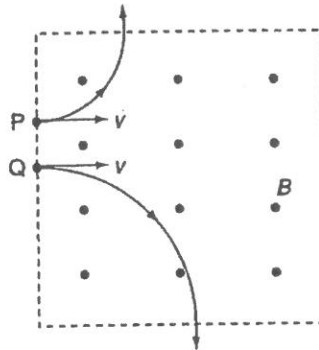


Figure Q4 (c)

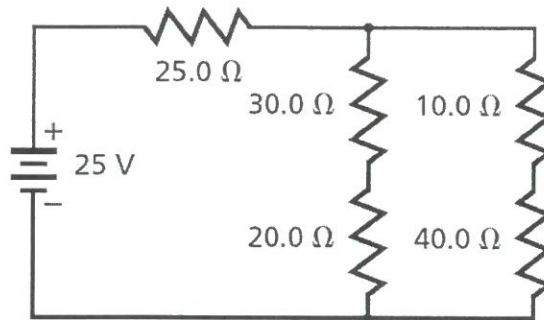
- (i) State two differences in the paths of particles  $P$  and  $Q$ . (2 marks)
- (ii) Identify the sign of the charges on the particles. Give a reason for your answer. (3 marks)
- (iii) The mass of  $Q$  is  $3.32 \times 10^{-27}\text{ kg}$ . Calculate the speed,  $v$  and the time taken by  $P$  to move through the region of magnetic field as illustrated in Figure Q4 (c). (5 marks)

### Question 5

- (a) A bulb is connected in series with a variable resistor and an  $18\text{ V}$  battery of negligible internal resistance. The variable resistor is adjusted until the bulb operates at its normal rating of  $12\text{ V}$  and  $24\text{ W}$ .
  - (i) Calculate the current in the bulb and its resistance. (3 marks)
  - (ii) How much is the electrical energy dissipated by the bulb in an hour. (2 marks)
  - (iii) Calculate the potential difference and the power dissipation in the variable resistor. (3 marks)
- (b) A parallel plate capacitor consists of two plates, each with area  $200\text{ cm}^2$ , separated by a  $0.40\text{ cm}$  air gap. (Given the permittivity of free space,  $\epsilon_0 = 8.85 \times 10^{-12}\text{ Fm}^{-1}$ )
  - (i) Compute its capacitance. (2 marks)
  - (ii) If the capacitor is connected across a  $500\text{ V}$  source, calculate the energy stored. (4 marks)

(iii) Calculate the electric field,  $E$  between the plates. (2 marks)

(c) From **Figure Q5 (c)**, find:



**Figure Q5 (c)**

(i) the total resistance in the circuit. (7 marks)

(ii) the current  $I$  through the 25 Ω resistor. (2 marks)

**-THE END-**

