DIPLOMA IN ELECTRICAL & ELECTRONIC ENGINEERING PROGRAMME (DEEI)
DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
PHY1131/PHY1121 : PHYSICS
FINAL EXAMINATION: JANUARY 2020 SESSION

Instructions: This paper consists of **FOUR (4)** questions. Answer **ALL** 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) 3080 kg (1 mark)

(ii) 9.210 kg (1 mark)

(b) Express the speed of light, $c = 2.9979 \times 10^8$ m/s in feet per nanosecond. It is given that 1 ft = 0.3048 m. (3 marks)

(c) In a baseball team, a player manages to throw a ball straight up and reaches a maximum altitude of 25 m above the launch point, before falling back down.

(i) Calculate the initial speed of the ball. (4 marks)

(ii) How long did it take for the ball to reach its maximum altitude? (3 marks)

(d) A girl exerts a force of 180 N, at 60.0° above the horizontal, on a box of mass 30.0 kg as shown in **Figure Q1 (d)**. Assume the box as a point-like object.

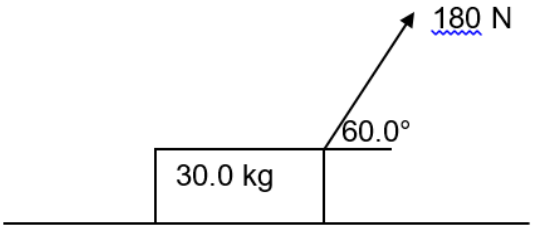

Figure Q1 (d)

(i) Calculate the horizontal component of the force exerted by the girl. (3 marks)

(ii) If the acceleration of the box is 2.50 m/s^2, determine the frictional force acting on the box. (4 marks)

(e) In **Figure Q1 (e)**, a rock is projected from the top of a building with a speed of 20 m/s at an angle of 37^o above the horizontal. The building is 50 m high.

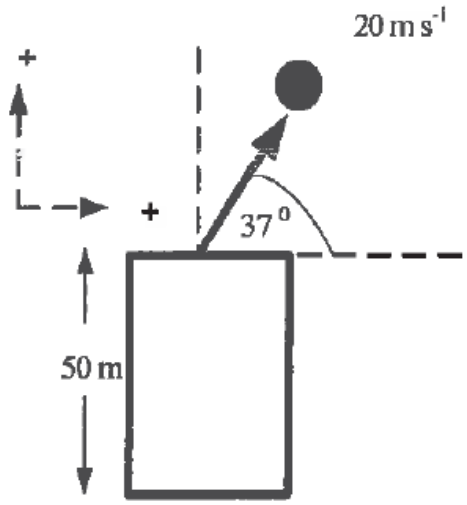

Figure Q1 (e)

(i) Calculate the final vertical velocity of the rock just before it hits the ground. (4 marks)

(ii) Find the time of flight of the rock. (2 marks)

Question 2

(a) The mass of the Moon is 7.3×10^{22} kg and its radius is 1785 km. Determine the strength of the gravitational force on the surface of the Moon. (4 marks)

(b) A rock climber wears a 7.5 kg backpack while scaling a cliff. After 30.0 min, the climber is 8.2 m above the starting point. Calculate,

(i) the work does the climber do on the backpack, (2 marks)

(ii) if the climber weighs 645 N, the work does she do lifting herself and the backpack, and (3 marks)

(iii) the average power developed by the climber. (2 marks)

(c) A cylinder of diameter 1.00 cm at 30 ^{o}C is to be slid into a hole in a steel plate. The hole has a diameter of 0.99970 cm at 30 ^{o}C. Determine to what temperature must the plate be heated to fit the cylinder. (for steel, $\alpha = 1.1 \times 10^{-5}$ /^{o}C) (3 marks)

(d) A 3.00 g bullet (c = 0.0305 cal/g.^{o}C =128 J/kg.^{o}C) moving at 180 m/s enters a bag of sand and stops. Determine the temperature of the bullet changes if 80% of its kinetic energy becomes thermal energy that is added to the bullet. (5 marks)

(e) In **Figure Q2 (e),** a 15 g bullet is fired horizontally into a 3000 kg block of wood suspended by a long cord. The bullet sticks in the block. Compute the speed of the bullet if the impact causes the block to swing 10 cm above its initial level. (6 marks)

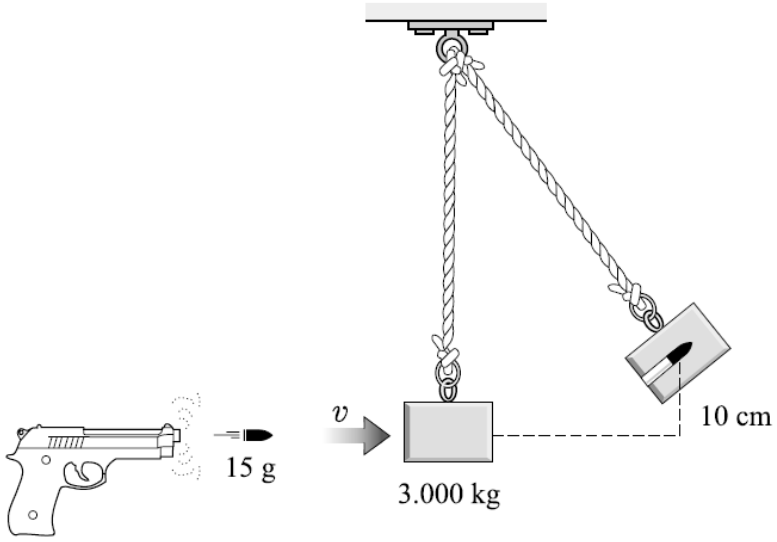

Figure Q2 (e)

Question 3

(a) A 100 g cube of ice at 0 ^{o}C is dropped into 1.0 kg of water that was originally at 80 ^{o}C. Determine the final temperature of the water after the ice has melted. (It is given that the heat of fusion of water, L_F = 3.33 x 10^5 J/kg and the specific heat capacity of water, c_w = 4186 J/kg.^{o}C) (6 marks)

(b) The specific heat of water is 4184 J/kg.K. Calculate the energy in joules does the internal energy of 50 g of water change, as it is heated from 21 ^{o}C to 31 ^{o}C. (5 marks)

(c) Three charged particles arranged in a line as shown in **Figure Q3 (c)**. Charge **A** = −5 μC, charge **B** = +10 μC and charge **C** = −12 μC. Calculate the net electrostatic force on particle **B** due to the other two charges. (7 marks)

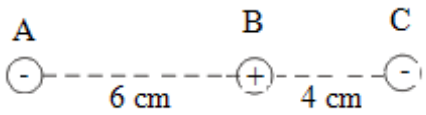

Figure Q3 (c)

(d) A certain parallel-plate capacitor consists of two plates, each with area 200 cm^2, separated by an air gap.

(i) Compute its capacitance. (2 marks)

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

Question 4

(a) It is given that there is a steady current of 150 μA in the vacuum between the cathode and the anode of a cathode-ray tube, calculate,

(i) the time taken for a charge of 3.0 C to be transferred, and (3 marks)

(ii) the number of electrons emitted per second from the cathode. (3 marks)

(b) Neglect internal resistance of the battery. In the circuit shown in **Figure Q4 (b),** calculate,

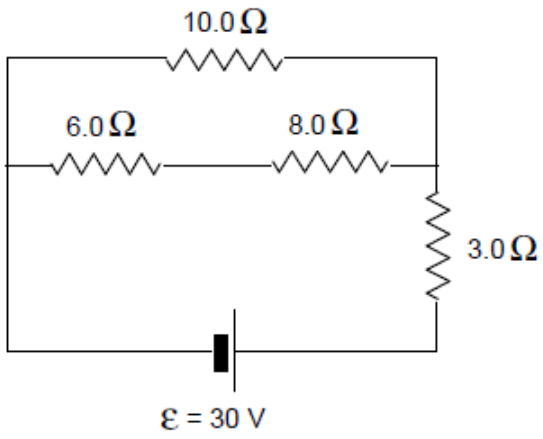

Figure Q4 (b)

(i) the total external resistance of the circuit, and (4 marks)

(ii) the current through the battery. (3 marks)

(c) (i) What is semiconductor? (2 marks)

(ii) How is a *p*-type semiconductor formed? (2 marks)

(iii) What is a *pn* junction? (2 marks)

(d) Two long straight parallel copper wires **A** and **B** are clamped vertically. The wires pass through holes in a horizontal sheet of card **PQRS**, are shown in **Figure Q4 (d).**

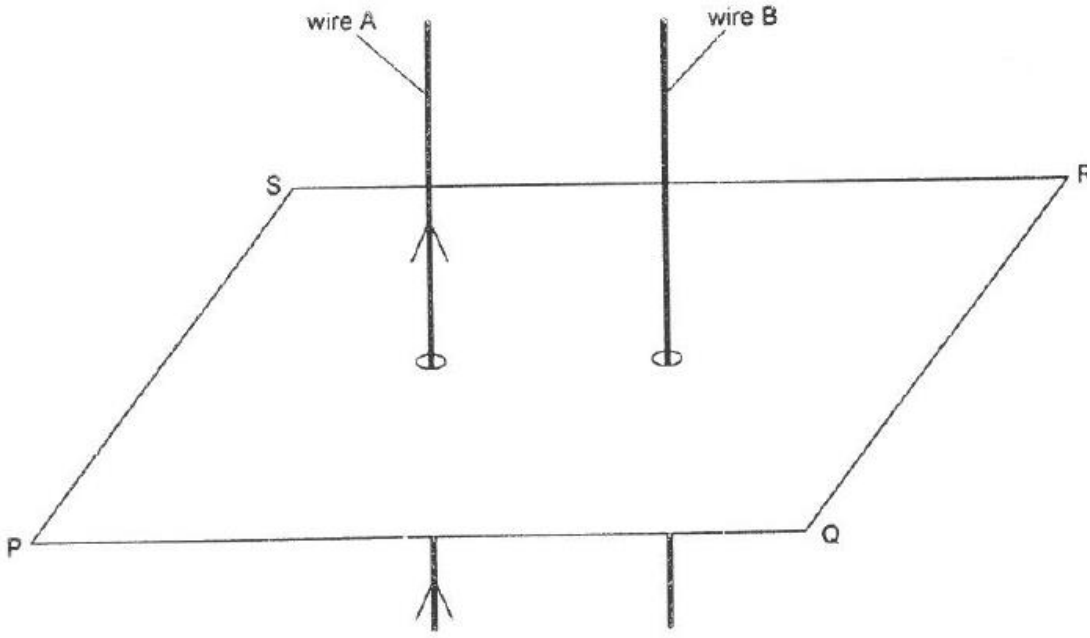

Figure Q4 (d)

(i) On **Figure Q4 (d)**, draw four field lines in the plane **PQRS** to represent the magnetic field due to the current in wire **A**. (3 marks)

(ii) Wire **A** also experiences a force. State and explain which wire, if any, will experience the larger force. (3 marks)

-THE END-