INTI
International College Penang

FINAL
Examination Paper

(COVER PAGE)

Session	:	**April 2019**
Programme	:	Diploma in Electrical & Electronic Engineering (DEEI)
Course	:	**PHY1131: Physics**
Date of Examination	:	27 July 2019 (Saturday)
Time	:	2:00pm – 4:00pm 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 Calculator

Materials provided :

Physics Formula Booklet

Examiner(s)	:	**Chong Mee Teng**
Moderator	:	Assoc. Prof. Dr. Khoo Bee Ee

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

INTI INTERNATIONAL COLLEGE PENANG

DIPLOMA IN ELECTRICAL & ELECTRONIC ENGINEERING PROGRAMME (DEEI)
PHY 1131: PHYSICS
FINAL EXAMINATION: APRIL 2019 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) 1060 kg (1 mark)

(ii) 7.780 kg (1 mark)

(b) Nick buys a farm in Mexico, and he is told that the area is 745 hectares. A hectare is 1×10^4 m^2 and a mile is 1609 m.

(i) How large is the area of the farm, in square meters? (2 marks)

(ii) How large is the area of the farm, in square miles? (2 marks)

(c) Suppose that the displacement of an object is related to time according to the expression $x = Bt^2$. What are the dimensions of B? (3 marks)

(d) An airplane undergoes the following displacements: First, it flies 66 km in a direction 30° east of north. Next, it flies 49 km due south. Finally, it flies 100 km 30° north of west. Using vector components, determine how far the airplane ends up from its starting point.

(i) Show these displacements and the resultant by graphical method. (2 marks)

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

(e) A cricket ball is thrown vertically upwards with a velocity of 20 m/s. Neglect the air resistance, calculate:

(i) The maximum height reached, (4 marks)

(ii) The time taken to return to Earth. (4 marks)

Question 2

(a) A 200-g metal container, insulated on the outside, holds 100 g of water in thermal equilibrium at 22.0 °C. A 21.0 g ice cube, at the melting point, is dropped into the water. When thermal equilibrium is reached, the temperature is 15.0 °C. Assume there is no heat exchange with the surroundings. For water, the specific heat is 4190 J/kg · K and the heat of fusion is 3.34×10^5 J/kg. Find the specific heat for the metal. (5 marks)

(b) In physics lab, students are to launch a projectile from a point 245 m in front of a building 325 m high. The projectile is to just barely land on the top near corner of the building. Its launch velocity has unknown components. Ignore air resistance.

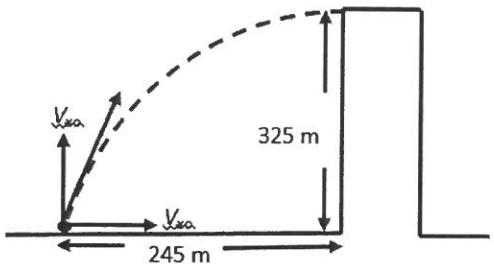

Figure (Q2b)

(i) What is the minimum vertical component of initial velocity needed to reach the top of the building? (3 marks)

(ii) What is the horizontal component of initial velocity needed to go along with your result from part (i)? (4 marks)

(c) A 32 kg filled grocery cart is to be pushed up a frictionless ramp by a pushing force, P acting along the ramp, tilted at an angle of 6.0 ° above horizontal.

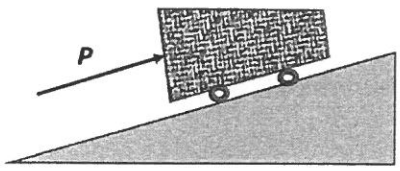

Figure (Q2c)

(i) What magnitude force, P is needed to push the cart at constant speed? (3 marks)

(ii) What magnitude P is needed to push the cart up the ramp with an acceleration of 2.0 m/s^2? (3 marks)

(d) Tarzan with mass of 85 kg is swinging back and forth while hanging on a vine 5.0 m long. Suppose friction is negligible and he keeps swinging easily for a long time. When he passes the lowest point, his speed is 8.0 m/s.

(i) How large is the vine tension when he is at the lowest point? (4 marks)

(ii) To what maximum height does he swing up above the lowest point? (3 marks)

Question 3

(a) Mass, $m_A = 2.50$ kg travelling at 25.0 m/s crashes head-on inti mass, $m_B = 7.50$ kg which is originally at rest. The masses can slide without friction on the level surface. After the collision, m_A reverses direction, recoiling with a speed of 5.00 m/s in the opposite direction.

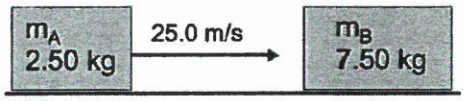

Figure (Q3a)

(i) Find the velocity of m_B after the collision. (4 marks)

(ii) Determine whether the collision is elastic or inelastic. (3 marks)

(b) A 1850 kg car is set in motion on a level road by a spring with spring constant, $k = 2.40 \times 10^6$ N/m that has been compressed 1.50 m. The car leaves the spring as it passes point ***A***, and the driver slams on the brakes at point ***B***. The wheels lock and the car skids to a stop at point ***C***, due to kinetic friction with coefficient, $\mu_k = 0.700$.

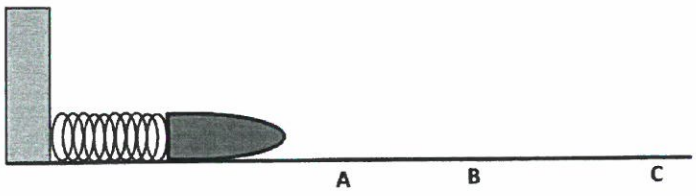

Figure (Q3b)

(i) What is the initial mechanical energy of the system, with the spring compressed 1.50 m before the car has released? (3 marks)

(ii) What speed will the car have when it leaves the spring at point ***A***? (3 marks)

(iii) Over what distance, ***BC*** will the car skid to a stop after the brakes have applied? (4 marks)

(c) The concrete sections of a certain superhighway are designed to have a length of 25.0 m. The sections are poured and cured at 10.0°C. What minimum spacing should the engineer leave between the sections to eliminate buckling if the concrete is to reach a temperature of 50.0°C? (2 marks)

(d) A bottle has a fixed 5.00 L volume. It is filled with oxygen gas, initially at temperature of 295 K and a pressure of 250.0 atm. Given that $1\ \text{L} = 1 \times 10^{-3}\ \text{m}^3$; $1\ \text{atm} = 1.013 \times 10^5$ Pa.

(i) What mass of oxygen gas is inside the bottle? (4 marks)

(ii) Suppose the oxygen is replaced by an equal mass of helium. If the temperature is still 295 K, what is the pressure in the bottle? (2 marks)

Question 4

(a) Two flat parallel plates, each of length 12.0 cm, are separated by a distance of 1.5 cm, as shown in Figure **(Q4a)**. The space between the plates is a vacuum. The potential difference between the plates is 210 V. The electric field may be assumed to be uniform in the region between the plates and zero outside this region. An electron initially travels parallel to the plates along a line mid-way between the plates. The speed of the electron is 5.0×10^7 m/s.

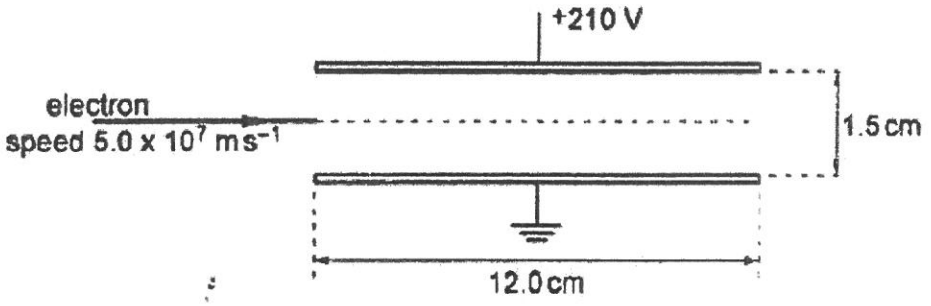

Figure (Q4a)

(i) Calculate the magnitude of the electric field strength between the plates. (2 mark)

(ii) For the electron between the plates, determine the magnitude and direction of its acceleration, (4 marks)

(iii) Calculate the time for the electron to travel a horizontal distance equal to the length of the plates. (2 marks)

(iv) Use your answer in part (iii) to determine whether the electron will hit one of the plates or emerge from between the plates. (3 marks)

(b) 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 (Q4b)**.

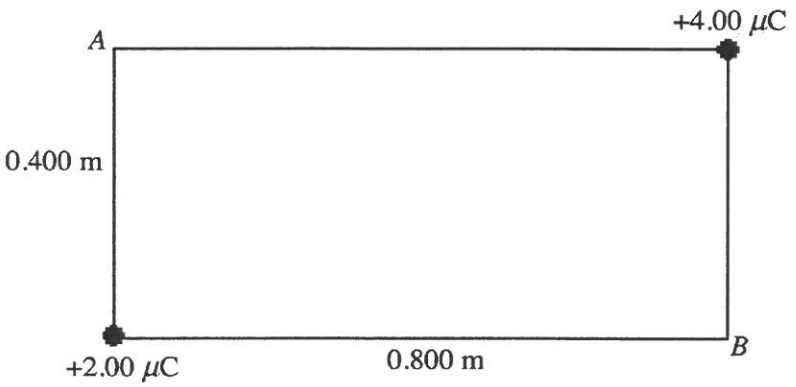

Figure (Q4b)

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

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

(c) A laser beam is incident at an angle of 30.0° to the vertical onto a solution of corn syrup in water. If the beam is refracted to 19.24° to the vertical.

(i) What is the index of refraction of the syrup solution? (3 marks)

(ii) Suppose the light is red, with wavelength 632.8 nm in a vacuum. Find its speed and frequency in the solution. (5 marks)

Question 5

(a) An electric heater is to be made from nichrome wire. Nichrome has a resistivity of 1.0×10^{-6} Ωm at the operating temperature of the heater. The heater is to have a power dissipation of 60 W when the potential difference across its terminals is 12 V. For the heater operating at its designed power,

(i) Show that the resistance of the nichrome wire is 2.4 Ω. (2 marks)

(ii) Calculate the length of nichrome wire of diameter 0.80 mm required for the heater. (3 marks)

(iii) A second heater, also designed to operate from a 12 V supply, is constructed using the same nichrome wire but using half the length of that calculated in part (ii). Explain quantitatively the effect of this change in length of wire on the power of the heater. (4 marks)

(b) Thirteen resistors are connected across points ***A*** and ***B*** as shown in the **Figure (Q5b)**. What is the equivalent resistance between points ***A*** and ***B***? (7 marks)

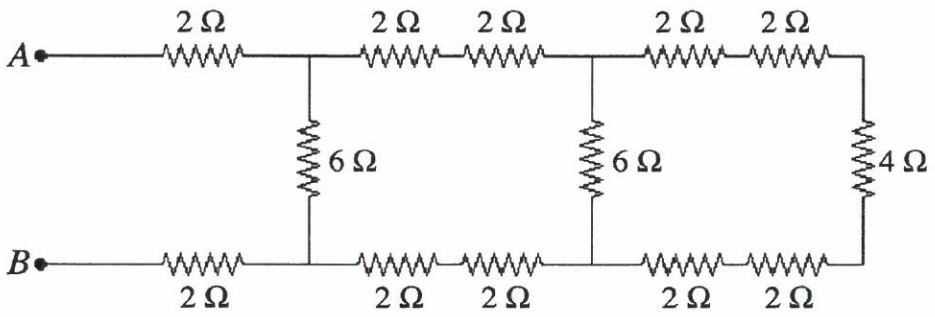

Figure (Q5b)

(c) A proton is fired into a magnetic field of strength, $B = 0.16$ T. The velocity of the proton is 8.0×10^6 ms^{-1} at right angles to the field. (Given mass of proton, $m_p = 1.673 \times 10^{-27}$ kg and charge of proton, $e = 1.6 \times 10^{-19}$ C)

(i) Find the magnitude of the force on the proton. (2 marks)

(ii) Find the radius of the path followed by the proton. (3 marks)

(iii) Sketch the path followed by the proton in the magnetic field. Indicate the direction of the magnetic force on the proton in your diagram. (2 marks)

(iv) Explain why the proton moves in a circular path. (2 marks)

--THE END--

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