Question 1: **[06 Marks]**

The pressure of a gas is the magnitude force exerted per unit area. If the magnitude of the force magnitude is (**255±5**) **N** and the area of a cylindrical vessel is (**1.50±0.02**) **m^2**),

Calculate the pressure in SI units (Nm^{-2}). (06)

Question 2: **[06 Marks]**

Sinusoidal waves **5.0 cm** in amplitude are to be transmitted along a string, under the tension of **100N**, which has a linear mass density of **0.040 kg/m**. If the source can deliver a maximum power of **300 W**.

Calculate the highest frequency at which the source can operate. (06)

Question 3: [15 Marks]

3.1. A **50.0 g** aluminium disk at **300 ^{o}C** is placed in **200 cm^3** of ethyl alcohol at **10.0^{o}C**, and then quickly removed. The aluminium temperature is found to have dropped to **120 ^{o}C**. The specific heat of alcohol is **2.40 kJ.kg^{-1}.^{o}C^{-1}** and density of alcohol is **790 kg/m^3** What is the new temperature of the ethyl alcohol? (06)

3.2. An aircraft piston engine that burns petrol, the heat of combustion for petrol is **5.00×10^7 J/kg**, has a power output of **1.10×10^5 W**.

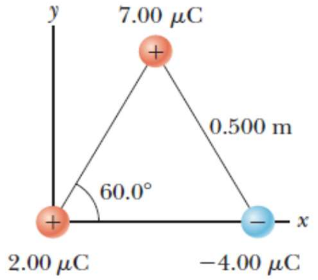
3.2.1. How much work does this engine do in **1.00 h**? (03)

3.2.2. This engine burns **34.0 kg** of petrol per hour. How much heat does the engine take in per hour? (03)

3.2.3. What is the efficiency of the engine? (03)

Question 4: [40 Marks]

4.1. Three charges are located at the corners of an equilateral triangle as shown in the figure.



Calculate the total electric force on the **7.00 μC** charge. (10)

4.2. A disk of radius **2.50 m** is oriented with its normal unit vector A at **60.0°** to a uniform E-field of magnitude **6.00×10^3 N/C**.

Find the electric flux through the disk. (03)

4.3. A positive charge of **0.300 μC** is moving from point A to B in a parallel plate with an electric field strength of **100 V/m**. The distance between points A and B is **12.0 cm** and is the same as the distance between B and C.

4.3.1. Is the work done by the electric field force or by an external force? (02)

4.3.2. How much work is done? (03)

4.3.3. What is the potential difference between points A and B? (03)

4.3.4. What is the potential difference between points B and C where C is parallel to B in the field and **12.0 cm** from B? (03)

4.4. A **0.500 cm** diameter plastic sphere, used in a static electricity demonstration, has a uniformly distributed **40.0 pC** charge on its surface.

What is the electric potential near its surface (04)

4.5. A transformer has **400** primary turns and **1800** secondary. The input voltage is **12.0V** and the output current is **3.00A** when connected to a resistor.

4.5.1. What is the output voltage? (03)

4.5.2. Determine the input current. (03)

4.5.3. What is the value of the resistor? (03)

4.5.4. How much power is dissipated by the resistor? (03)

Question 5: [33 Marks]

5.1. An electron moving at **8.40×10^{3} km/s** enters a uniform magnetic field of strength **115 mT**.
Find radius, R. (06)

5.2. At the upper surface of the Earth's atmosphere, the time-averaged magnitude of the Poynting vector **$\langle S\rangle = 1.35\times10^{3}$ W.m^{-2}**, is referred to as the solar constant. Assuming that the Sun's electromagnetic radiation is a plane sinusoidal wave,

5.2.1. Find the magnitude of the electric field. (04)

5.2.2. Find the magnitude of the magnetic field. (04)

5.2.3. Find the total time-averaged power received by a **1.65m×1.00m** solar panel. (04)

5.3. The electrical power output of a large nuclear reactor facility is **955 MW**. It has **45.0%** efficiency in converting nuclear power to electrical. With the assumption that each nuclear fission produces **199 MeV**,

5.3.1. Calculate the thermal nuclear power output of in megawatts. (03)

5.3.2. How many $^{235}_{92}U$ nuclei undergo fission if the system runs for a day? (05)

5.3.3. Calculate the mass of $^{235}_{92}U$ used in one year of full-power operation. (07)