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1. A 100 g calorimeter contains 300 g of water at room temperature. 50 g of ice is added to this calorimeter and the equilibrium temperature recorded is 282.7 K. Calculate the room temperature. The specific heat capacity of copper = 380 $Jkg^{-1}K^{-1}$, the specific latent heat of fusion of ice = 3.25 x 10^5 JK^{-1}.
2. In figure 1, the meters labeled M_1 and M_2 each read 1.5 A when the switch K is closed.

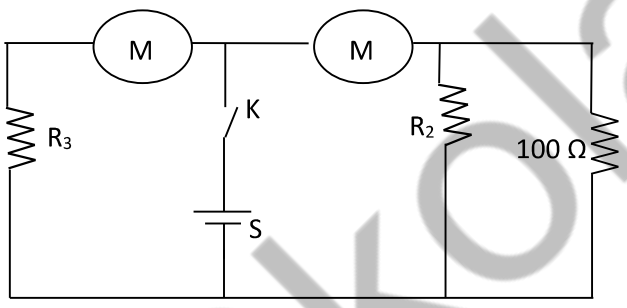
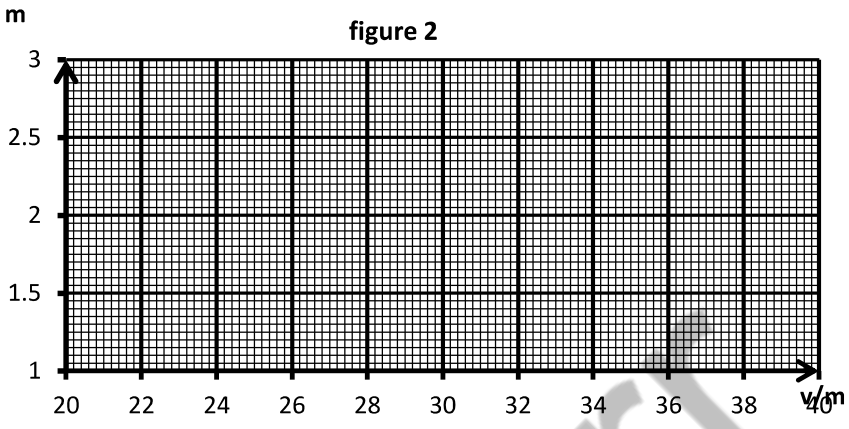


Figure 1

The source S supplies 300 W to the resistor R_1, R_2 and 100 ohms respectively. Calculate
(i) The potential difference across R_1 (ii) The value for the resistance R_2

3. A car is normally threaded with wire loops. Donlop tyres have about 200 loops a tyre. A car running on such tyres travels at speed of 16.7 ms^{-1} along a level road such that the magnetic field of the earth makes an angle of 53^0 with the axis of the tyre at all the times. If the magnetic field is 1.2 x 10^{-5} T, calculate
   i. The induced current through a loop if the tyre's diameter is 0.65 m and the resistance per unit length is 8.0 x 10^{-3} ohms per meter.
   ii. How much power is generated on the tyre due to the motion in the earth's magnetic field?
   iii. What does it suggest to you about the usage of threaded tyres?

4. (a) In an experiment to determine the focal length of a convex lens, f, the magnification, m, was calculated from different image distance, v. The results are displayed in figure 2.



Use the graph to determine the value for the focal length, f, of the convex lens.

b) State any two advantages that optical fibre has over copper cable used for the transmission of information.

5. (a) Explain hysteresis curve for rubber.

   b) Explain why in practice, car tyres are made with synthetic rubber which has a smaller area of hysteresis as compared to natural rubber.

   c) Sketch on the same set of axes stress – strain curves for the following materials

   i) Iron ii) Glass

6. The following expression gives the variation of electric charge Q through a capacitor C with time t.

   $Q = AC(1 - e^{\frac{-t}{BC}})$

   A. and B are physical constants. Show that the units of A and B are the volt and the ohm respectively

7. Figure 3 shows a basic amplifier circuit with an n – p – n transistor.

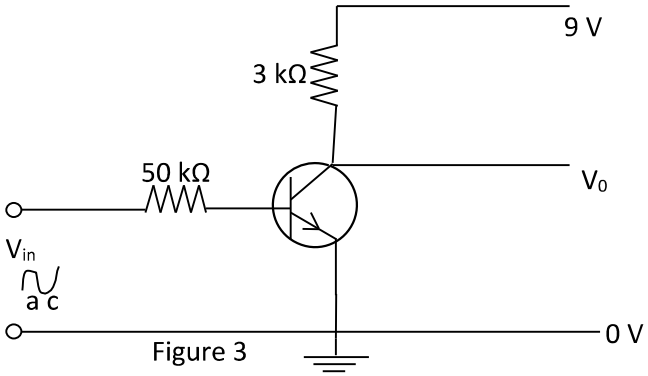


Figure 3

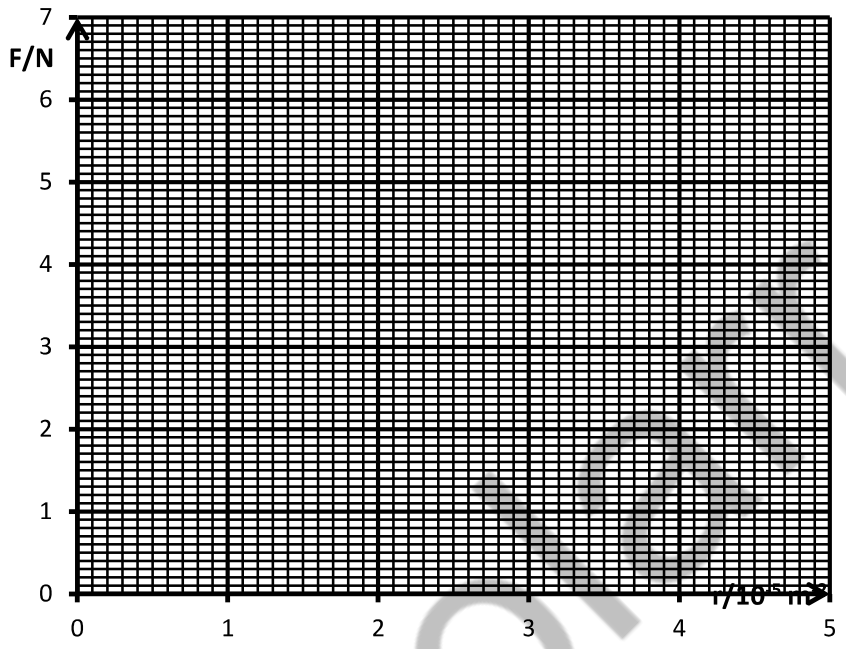
If the voltage V_i is 2.0 V, ac and dc gain for the transistor is 60. Calculate

i. The base current
ii. The collector current
iii. The output voltage.

On the same axis, sketch graphs to show how the input voltage and the output voltage vary with time

8. (a) (i) state Coulomb's law.

Figure 4 shows how the force, F, varies with the inverse of the square of separation between two equal charges Q, placed in the medium.

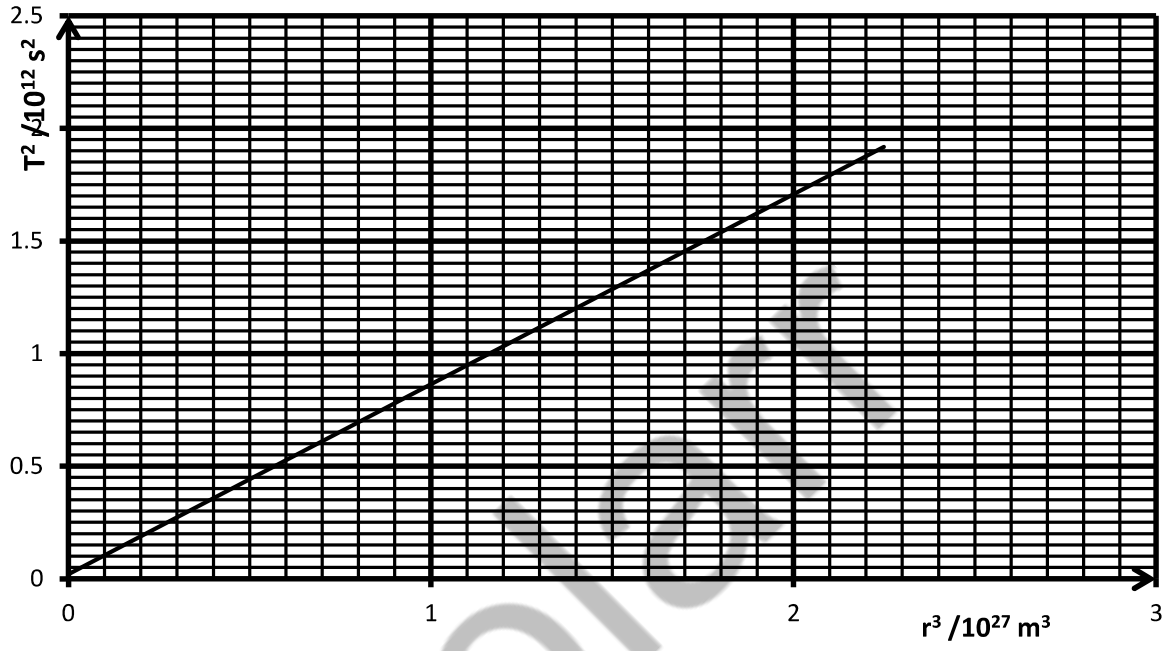


(ii) Use the graph to obtain a value for the permittivity of the medium if Q has a value of 4.4 x 10^{-3} C.
(iii) Hence obtain a value for the dielectric constant
(b) Two particles carrying charges Q_1 = 4.0 μC and Q_2 = -3 μC are placed at a distance of 5.0 cm apart
(i) Sketch the electric field lines between the charges
(ii) Determine the point on the line passing through the two charges at which the resultant field is zero.
(c Explain why birds are not often electrocuted when they land on high voltage lines
(d) (i) State Newton's law of gravitation
(ii) When a planet moves in a circular orbit of radius r, about the sun, the centripetal force is provided by the gravitational attractive force. Show that the periodic time T of the planet is given by the expression

$$r^3 = \frac{GM}{4\pi^2}T^2$$

G = Gravitational constant
M = mass of the sun
(iii) Calculate the period of rotation of the moon about the earth if the radius of the moon is 3.5 x 10^8 m and the mass of the earth is 6.0 x 10^{24} kg
(e) Figure 5 shows how T^2 varies with r^3 for a planet of mass 7.0 x 10^{26} kg

figure 5



(i) Use the graph to obtain a value for the universal gravitational constant

(f) The mass of the earth is 80 times that of the moon and the distance from the centre of the moon to that of the earth is 3.5 x 10^5 m. Calculate the distance from the centre of the earth of the point on the line joining the centre of the earth and that of the moon where the resultant gravitational field of the earth and the moon is zero.

9. (a) A ball is projected with an initial speed, u, at an angle θ to the horizontal. Neglecting air resistance.
   (i) Describe qualitatively the motion of the ball
   (ii) How would air resistance affect the maximum horizontal displacement of the ball?

   (b) A bullet is fired from the top of a tall building, 100 m above the ground at an angle of 30^0 to the horizontal and at a speed of 300 ms^{-1}. Calculate

   (i) The distance of the bullet from the building when it reaches the ground

   (ii) The magnitude and direction of the velocity of the bullet as it hits the ground.

   (c) A wooden box of mass 0.80 kg is pushed along a horizontal floor by a force of 4.8 N. The motion of the box is opposed by a frictional force of 1.5 N between the box and the floor and the air resistance Kv^2 where K = 6.0 x 10^{-2} kg and v is the speed of the box.

   (i) Sketch a diagram showing the forces acting on the wooden box

   (ii) Calculate the maximum speed of the wooden box

   (d) (i) state the zeroth law of thermodynamics

   (ii) How does this law leads to the definition of temperature?

   (e) What is meant by?

(I) Primary energy sources (ii) Alternate energy sources

Discuss the use of primary and alternate energy sources in Cameroon.

(f) Sea water is trapped in a bay of area 4.0 x 10^7 m^2. The difference in levels of the water in the bay between high and low tides is 10 m.

(I) Calculate the average power obtainable for a tidal period of 12 hours if the density of water is 1100 kgm^{-3}.

(ii) Explain the factors which make coastlines not depend on tides as a source of energy.

10. (a) Describe an experiment to investigate how the intensity of α – rays vary with distance from the source of emission

(b) 8.0 mg of *radioisotope* of *half-life* 30 minutes is used for twelve minutes.

i. Explain the terms in italics

ii. What is the amount of the radioisotope remaining?

(c) The fusion of tritium nucleus with a deuterium nucleus releases energy according to the following equation.

$$^{2}_{1}H + ^{3}_{1}H \rightarrow ^{4}_{2}H + ^{1}_{0}n + \Delta E$$

(i) Calculate the energy ΔE that is released.

(ii) Given that the mass of one mole of deuterium is 2.0 g, how much energy is released per kilogram of deuterium fuel?

Mass of $^{2}_{1}H$ = 3.345 x 10^{-27} kg; Mass of $^{3}_{1}H$ = 5.008 x 10^{-27} kg; Mass of $^{4}_{1}H$ = 6.647 x 10^{-27} kg
Mass of $^{1}_{0}n$ = 1.675 x 10^{-27} kg; Avogadro's constant = 6.02 x 10^{23} mol^{-1}; Speed of light = 3.0 x 10^{8} ms^{-1}

(d) Describe an experiment to demonstrate ohms law

(e) Explain the deference between

(i) Ohmic and non – ohmic materials

(ii) Electromotive force (emf) and potential difference

(f) Determine

(i) I_1, I_2, and I_3 in figure 6

(ii) The potential difference between A and B.

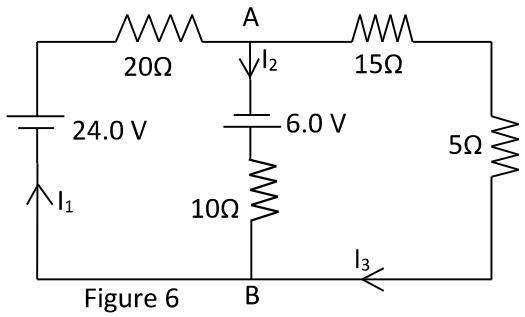


Figure 6

STUDENT'S PROPOSED ANSWERS TO JUNE 2001