CAMEROON COLLEGE OF ARTS, SCIENCE AND TECHNOLOGY
LOWER SIXTH SCIENCE 1&2 PHYSICS PROMOTION EXAMINATION.
FRIDAY 14th May 2004 at 7 am.

Subject title	**Physics**
Paper No	**Paper 2**
Paper Code	**780**

Two and a half hours

ANSWER ALL SECTIONS ON A SEPARATE SET OF PAPERS.
SECTION A (One hour)

1. A discus was thrown and it covered a distance of 74.4 m.
   (a) What is the least initial speed required to cover this range?
   (b) What assumption(s) do you make?
   (c) How was the motion restricted?
   (d) How can the effects in (c) be overcome practically? (8 marks)

2.

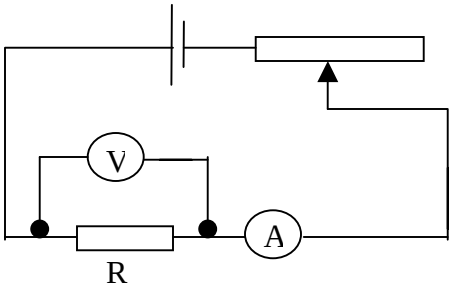


Fig 1

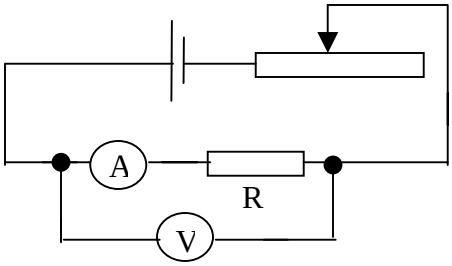


Fig 2

   (a) Which law(s) can each of the figures be used to investigate?
   (b) Under what circumstance(s) is each figure used? Explain your answer.
   (c) Sketch the characteristic that can be obtained if R is tungsten. (7 marks)

3. The intensity, I, of a pulse traveling along a material (e.g a fibre) is given exponentially by the following equation $I = I_o e^{-\alpha s}$ where I_o = intensity at x = 0 and α = attenuation coefficient.
   (a) Define intensity
   (b) Explain whether this equation represents an increase or a decrease in the intensity along the material.
   (c) Find the value of the intensity at a distance of (In2)/ α from the source.
   (6 marks)

4. Explain under what condition tropical crops can be grown in temperate regions. How feasible is this for a large population? (5 marks)

5. Good electrical conductors are good thermal conductors. This suggests that there is a common agent in both mechanisms.
   (a) Briefly explain the role played by the common agent in electrical and heat conduction.
   (b) Explain why diamond is an electrical insulator but a good thermal conductor.
   (7 marks)

6. The pressure P at a point in a fluid is related to its density, ρ, and depth of the point, h, according to the equation $P = A\rho + B\rho h + C$ where A, B and C are constants.
   (a) Explain how units can be used to test the correctness of a physical equation.
   (b) Determine the units of A, B and C. (6 marks)

7. A battery of two cells in series is connected across a 5 Ω resistor and the current in the circuit is 0.55 A. A second identical resistor is connected in parallel with the first and the current is 0.91A. Find the emf and internal resistances of each cell. (5 marks).

SECTION B (One hour)
ANSWER THIS SECTION ON A SEPARATE SET OF PAPERS.

8. (a) (i) State two conditions necessary for two sources of light to produce interference.
   (ii) How are these conditions fulfilled in Young's double slit experiment? (5 marks).
   (c) When a thin film transparent plastic is placed over one of the slits in Young's double slit experiment, the central bright fringe is displaced by 4.50 fringes. The refractive index of the material is 1.48 and the wavelength of the light in air is 5.5×10^{-7} m.
   (i) By how much does the film change the optical path?(Is this an increase or decrease in the path?)
   (ii) What is the thickness of the film? (5 marks)

(c) A jeep cruises along a straight section of a road at a speed of 15.0 m s^{-1}. The driver hears a change in frequency of 100 Hz when he passes a police checkpoint and the police agents blows a whistle of frequency f.
   (i) If the speed of sound is 340 m s^{-1}, what is the frequency f?
   (ii) The jeep then approaches a bridge that reflects sound waves. If the driver sounds his horn of frequency 500 Hz, what is the change in frequency heard by the driver? (7 marks)

(d) The speed of sound in dry air at 30 ^{o}C is 348 m s^{-1}. Calculate the speed of sound in air at 20 ^{o}C. (3 marks).

9. (a) (i) Explaining your symbols, define temperature on the Celsius scale.
   (ii) Other than the property indicated here, list three physical properties that the symbols in (i) above may represent. How well do these properties agree in temperature measurement?
   (iii) The volume, V of a fixed mass of mercury at a temperature θ ^{o}C measured on the perfect gas scale is given by $V = V_o(a + b\theta + c\theta^2)$ where a = 1, $b = 1.818 \times 10^{-4}$, $c = 8.0 \times 10^{-8}$ and V and V_o are volumes at θ ^{o}C and volume at 0 ^{o}C respectively on the gas scale.
   Calculate the temperature expected on a mercury thermometer when the gas scale is 50.0 ^{o}C. (10 marks)

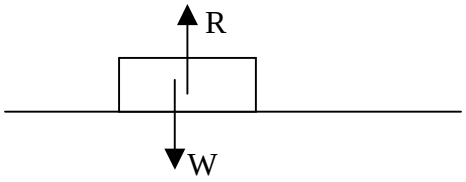
   (b) (i) Draw a sketch diagram showing the main features of a hydroelectric plant. The height h of the reservoir above the tail race is 56.0 m and the average volume rate of water discharged at the spiral casing is 150 m^3 s^{-1} and diameter of penstock being 4.0 m.
   (ii) Draw a block diagram showing the energy changes occurring at the plant.
   Calculate:
   (iii) the power gain at the spiral casing

(iv) the speed of water entering the spiral casing
(v) the power supplied to the generator when the efficiency is 0.9.
(vi) what are the possible energy losses in a transformer and how can they be minimized? (10 marks)

SECTION C (One hour)
ANSWER THIS SECTION ON A SEPARATE SET OF PAPERS

10. (a) Describe an experiment to measure the acceleration of free fall. (7 marks)

(b)

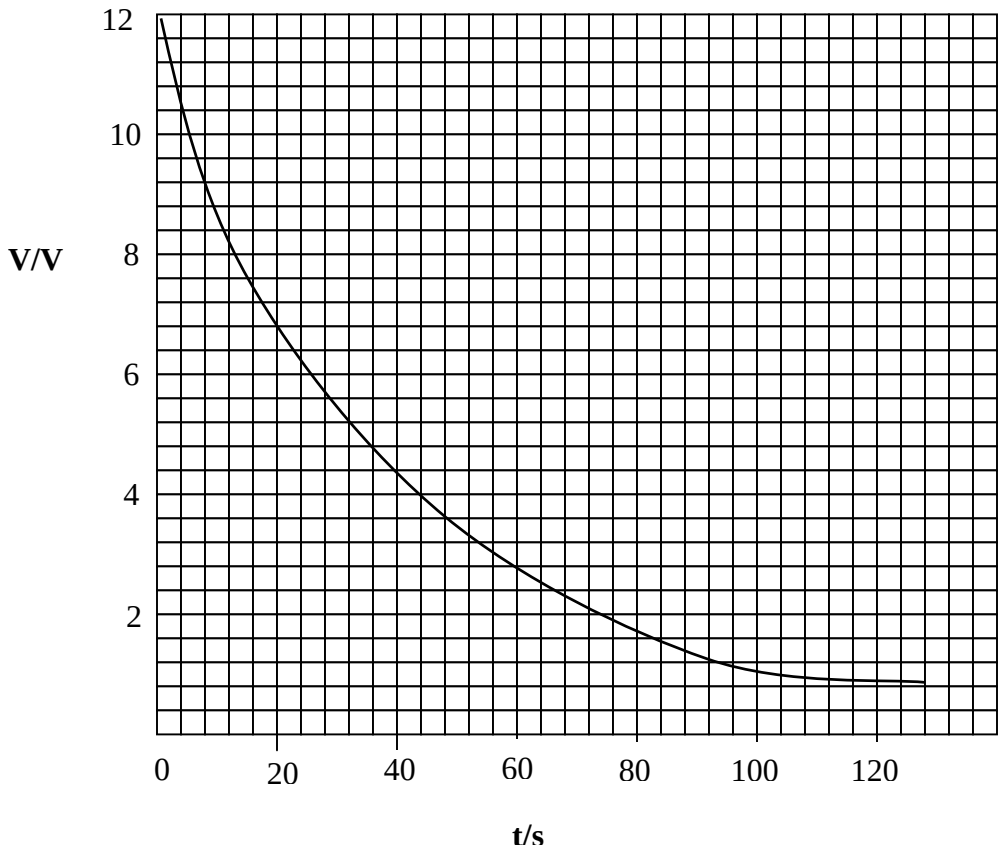


The diagram shows a box at rest on a horizontal surface with two forces R and W acting. Newton's third law of motion states that forces always occur in pairs, which implies that the forces are equal in magnitude.

(i) List three other implications of this law.
(ii) Explain how these four implications apply to W, the weight of the box.
(iii) Weight is a force that acts at a distance and is explained by a field. Give another example of such a force and name the field responsible for the force. (10 marks)

(c) A ball of mass 0.8 kg is whirled round at the end of a 0.9 m long string in vertical circle at a speed of 5 m s^{-1}. At what point in the motion is the tension maximum and what is its value? (3 marks)

11. (a) The potential difference, V, across a charged capacitor was measured every 10 s. The results are displayed on the graph.



At t = 15.0 s, a resistor of resistance 1.30 x 10^6 Ω was connected across the capacitor.

(i) Estimate the capacitance of the capacitor. (5 marks)

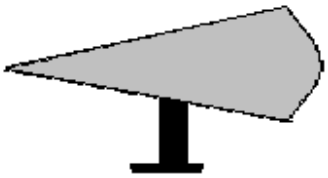
(ii) Estimate the initial charge on the plates of the capacitor (3 marks)

(iii) Estimate the time constant for the circuit. (3 marks).

(c) The diagram shows a charged conductor suspended on an insulating stand. Describe an experiment to show how the:

(i) surface charge distribution

(ii) potential varies over the surface of the conductor. (9 marks)



(c) The diagram shows a potentiometer with slide wire AB of resistance 5 Ω. The internal resistance of the driver cell is negligible. What should be the value of the resistance R_s in series with the driver cell so that 80 % of the resistance of the slide wire should balance cord a voltage p.d of 1.0 V? (4 marks).