THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

131/1 **PHYSICS 1**
(For Both School and Private Candidates)

Time 3 Hours **28 May 1999 A.M.**

Instructions

1. Answer ALL Questions
2. The marks for each question or part thereof are given in brackets.
3. Mathematical tables, slide rules and calculators may be used.
4. Remember to write your index number on every page of your answer booklet provided.
5. Constants below may be useful:

Acceleration due to gravity,	$g = 9.8\ ms^{-2}$
Density of water,	$= 1000 kgm^{-3}$
Mean radius of the earth,	$R = 6.4 \times 10^{6} m$
Speed of light,	$c = 3 \times 10^{8} ms^{-1}$
Speed of sound in air,	$v = 340 ms^{-1}$
Planck's constant,	$h = 6.6 \times 10^{-34} Js.$
Electronic charge,	$e = 1.6 \times 10^{-19} C$
Universal gas constant,	$R = 8.31\ J\ mol^{-1}\ K^{-1}$
Permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}$

$\left(\frac{1}{4\pi\varepsilon_0} = 9 \times 10^{9}\right)$

$1\ eV = 1.6 \times 10^{-19}\ J.$

1. (a) Mention two applications and two limitations of dimensional analysis. (02)

   (b) The frequency f of a note produced by a taut wire stretched between two supports depends on the distance ℓ between the supports, the mass per unit length of the wire, μ, and the tension T. Use dimensional analysis to find how f is related to ℓ, μ, and T. (03)

2. (a) Define the following terms: (i) momentum (ii) impulse of a force (01)

   (b) A jet of water emerges from a hose pipe of a cross-sectional area $5.0 \times 10^{-3} m^2$ with a velocity of $3.0 ms^{-1}$ and strikes a wall at right angle. Assuming the water to be brought to rest by the wall and does not rebound, calculate the force on the wall. (04)

3. (a) What do you understand by the term escape velocity?

   (b) Calculate the escape velocity from the moon's surface given that a man on the moon has ⅛ his weight on earth. The mean radius of the moon is $1.75 \times 10^6 m$. (04)

4. (a) Give two similarities between simple harmonic motion and circular motion. (01)

   (b) On the same set of axes, sketch how energy exchange (kinetic to potential) takes place in an oscillator placed in a damping medium. (04)

5. (a) State the parallel axis theorem. (02)

   (b) Show that the Kinetic energy (K.E.) of rotation of a rigid body about an axis with a constant angular velocity w is given by $KE = ½ Iw^2$ where I is the moment of inertia of the rigid body about the given axis. (03)

6. (a) Distinguish between static and dynamic friction. (02)

   (b) With the help of a well labelled diagram briefly explain how you will determine the coefficient of viscosity of a liquid by a constant pressure head apparatus in the laboratory. (03)

7. (a) Explain in terms of surface energy, what is meant by the surface tension, γ of a liquid. (03)

   (b) What energy is required to form a soap bubble of radius 1.00mm if the surface tension of the soap solution is $2.5 \times 10^{-4} Nm^{-2}$? (02)

8. (a) Write down the equation of continuity of a fluid defining all your symbols. (02)

   (b) The velocity at a certain point in a flow pipe is $1.0 ms^{-1}$ and the gauge pressure there is $3 \times 10^5 Nm^{-2}$. The cross-sectional area at a point 10m above the first is half that at the first point. If the flowing fluid is pure water, calculate the gauge pressure at the second point. (03)

9. (a) What do you understand by the terms: (i) Thermodynamic temperature scale and
   (ii) Triple point of water? (02)

(b) The resistance of a platinum wire at a temperature T°C measured on a gas scale is given by

$R(T) = R_o(1 + aT + bT^2)$.

What temperature will the platinum thermometer indicate when the temperature on the gas scale is 200°C? (take $a = 3.8 \times 10^{-3}$ and $b = -5.6 \times 10^{-7}$). (03)

10. (a) What is the coefficient of thermal conductivity of a material? (01)

(b) The temperature difference between the inside and outside of a room is 25°C. The rom has a window of an area $2m^2$ and the thickness of the window material is 2mm. Calculate the heat flow through the window if the coefficient of thermal conductivity of the window material is 0.5 SI units. (04)

11. (a) Write down the equation of state of an ideal gas defining all the symbols used. (02)

(b) If the root-mean-square velocity of a hydrogen molecule at 0°C is 1840m/s, find the root-mean-square velocity of the molecule at 100°C. (03)

12. (a) What is the difference between refraction and diffraction as applied to waves? (02)

(b) A parallel beam containing two wavelengths 600nm and 602nm is incident on a diffraction grating with 400 lines per mm. Calculate the angular separation of the first order spectrum of the two wavelengths. ($1nm = 10^{-9}m$) (03)

13. (a) What is a "Doppler Effect"? (01)

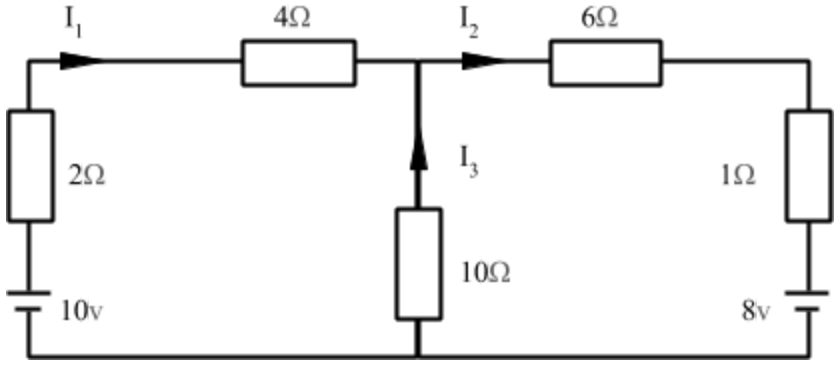
(b) A whistle sound of frequency 1200Hz was directed to an approaching train moving at 48km h^{-1}. The whistleman then listened to the beats between the emitted sound and that reflected from the train. What is the beat frequency detected by the whistleman? (04)

14. (a) Explain why an uncharged metal is attracted by a charged one? (02)

(b) Charges $Q_1 = 1.2 \times 10^{-12}$ C and $Q_2 = -4 \times 10^{-12}$ C are placed 5.0m apart in air. A third charge $Q_3 = 1 \times 10^{-14}$ C is introduced midway between them. Find the resultant force on the third charge. (03)

15. (a) State Kirchhoff's laws of circuit analysis (02)

(b)



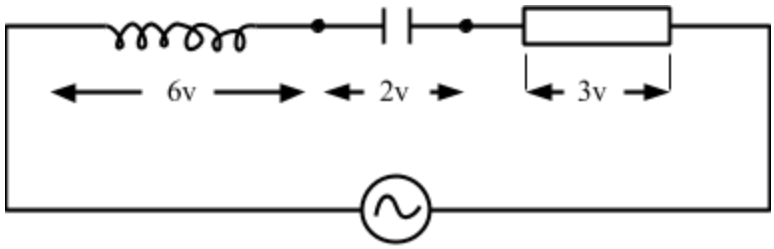
Determine the magnitudes of I_1 and I_3. (03)

16. (a) Write down an expression for the forces on an electron when moving perpendicular to:
(i) an electric field (ii) magnetic field. (02)

(b) An electron is moving in a uniform electric field of intensity $1.2 \times 10^{5} Vm^{-1}$.
Find the acceleration of the electron. (03)

17. (a) What is a resonant frequency of an oscillator? (01)

(b) Consider the LRC series circuit. The r.m.s. voltages across each component are as shown.



Calculate (i) The r.m.s. current passing through R. (01)
(ii) The resonant frequency for the values of L, C and R. (03)

18. (a) Draw the symbol of n-p-n transistor. (01)

(b) Distinguish between insulators, semi-conductors and metals as far as conduction is concerned. (04)

19. (a) What is the "work function" of a metal? (02)

(b) The work function of a metal is 2.0 eV. Calculate the stopping potential when the metal is illuminated by light of frequency of 6.0×10^{14} Hz. (03)

20. (a) What is (i) nuclear fusion and (ii) nuclear fission? (02)

(b) In the following nuclear reactions find the values of x, y and z.

(i) ${}_{1}^{2}H + {}_{1}^{2}H \rightarrow {}_{1}^{x}H + {}_{1}^{1}H + 4.0\ MeV$
(ii) ${}_{1}^{3}H + {}_{1}^{2}H \rightarrow {}_{1}^{y}He + {}_{0}^{1}n + 17.6\ MeV$
(iii) ${}_{92}^{235}U + {}_{0}^{1}n \rightarrow {}_{56}^{z}Ba + {}_{36}^{92}Kr + 3\ {}_{0}^{1}n + E$ (03)