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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: 2:30Hours **Thursday, 09th February 2012 a.m.**

Instructions

1. This paper consists of sections A, B and C.
2. Answer **ten (10)** questions choosing **four (4)** questions from section A and **three (3)** questions from each of sections B and C.
3. Marks for each question or part thereof are indicated.
4. Mathematical tables and non-programmable calculators may be used.
5. Cellular phones are **not** allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklet (s).
7. The following information may be useful:
   - (a) Acceleration due to gravity, $g = 9.8\ m/s^2$
   - (b) Stefan's constant, $\sigma = 5.67 \times 10^{-8}\ Wm^{-2}K^{-4}$
   - (c) Radius of the sun, $R_s = 7.04 \times 10^8 m$
   - (d) Speed of light, $c = 3.0 \times 10^8 m/s$
   - (e) Wien's constant, $= 2.9 \times 10^{-3}\ m\,K$
   - (f) The value of the ratio $\frac{1}{4\pi\varepsilon_o} = 9.0 \times 10^9\ mF^{-1}$
   - (g) Permeability of free space, $\mu_o = 4\pi \times 10^{-7}\ NA^{-2}$
   - (h) Electronic charge, $e = 1.6 \times 10^{-19}\ C$
   - (i) Mass of an electron, $M_e = 9.1 \times 10^{-31}\ Kg$
   - (j) Velocity of sound in air, $v = 340\ m/s$.
   - (k) Plank's constant, $h = 6.63 \times 10^{-34} Js$
   - (l) Avogadro's number, $N_A = 6.02 \times 10^{26}$ atoms/Kmol
   - (m) Radius of the earth, $R_e = 6.4 \times 10^3 km$
   - (n) Coefficient of thermal conductivity of Aluminium $= 210\ Wm^{-1}K^{-1}$
   - (o) Distance of the Earth from the sun, $R = 1.5 \times 10^{11} m$
   - (p) Pie, $\pi = 3.14$

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SECTION A (40 marks)

Answer **four (4)** questions from this section.

1. (a) (i) Briefly explain two types of errors that are likely to occur whenever an experimental measurement is made. **(1 mark)**

(ii) The length, L of a simple pendulum which is about 0.5m can be measured within 1mm. What accuracy is required in the measurement of the periodic time, T of 100 oscillations if the errors in L and T are to produce equal percentage in the calculated value of acceleration due to gravity, g? **(3 marks)**

(b) (i) How is a precise physics experiment related to an accurate one? **(2 marks)**

(ii) The diameter of a steel rod is given as (56.47 ± 0.02) mm. What does this mean? **(1 mark)**

(c) (i) What is meant by the statement that " an equation is homogeneous with respect to its units". **(1 mark)**

(ii) The stress S, required to fracture a solid can be expressed as $S = k\sqrt{\frac{\lambda E}{d}}$

where, k is a dimensionless constant, E is the Young's modulus and d is the distance between the planes of atoms separated by the fracture. If the equation is dimensionally consistent, find the dimensions of the physical quantity, λ and suggest the meaning of this quantity. **(2 marks)**

2. (a) Distinguish the terms projectile and trajectory as applied to projectile motion. **(2 mark)**

(b) A meteorite is traced by a radar as it falls through the earth's atmosphere when its altitude is $3.0 \times 10^4 m$. The screen shows that the meteorite is travelling with the velocity of 58.3m/s at an angle of 28.3^0 below the horizontal. In the absence of air and at re-entrance to the earth's atmosphere;

(i) how much time elapse before the meteorite strike the earth? **(2 marks)**

(ii) what is the magnitude and direction of the velocity of meteorite just before the impact with the earth? **(2 marks)**

(c) (i) What assumptions are made in the treatment of projectile motion? **(1 mark)**

(ii) Find the angle of projection of a projectile at which the horizontal range and the maximum height have equal values. **(3 marks)**

3. (a) (i) Can a sailboat be propelled by air brown at sails from a fan attached to the boat? Give reasons for your answer. **(2 marks)**

(ii) "Action and reaction forces are equal and opposite to each other". If it is so, why don't they produce a net force on an object? **(2 marks)**

(b) A child is whirling a 0.012kg ball on a string in a horizontal circle whose radius is 0.10cm. If the ball travels once around the circle in 0.5sec;

(i) determine the centripetal force acting on the ball. **(2 marks)**

(ii) why does such a force do not work in a circular orbit? **(1 mark)**

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(c) If the speed of the ball in (b) is doubled, by what factor does the centripetal force increases? **(3 marks)**

4. (a) Explain the following statements with reference to the surface tension:
   (i) Why it is not possible to separate two pieces of paper joined by glue? **(1.5 marks)**
   (ii) Why it is not sensible to rub the canvas of a tent in wet weather? **(1.5 marks)**

   (b) (i) Mention two factors which may change the value of surface tension. **(2 marks)**
   (ii) Give comments on the statement that "water droplets are slippery when they fall on an oil surface". **(1 mark)**

   (c) A particle rest on the horizontal plat form which is moving vertically in a simple harmonic motion with an amplitude of 50mm. If above a certain frequency the particle ceases to remain in contact with the plat form throughout the motion;
   (i) determine the lowest frequency at which this situation will occur. **(2.5 marks)**
   (ii) at what position the particle ceases to remain in contact with the plat form? **(1.5 marks)**

5. (a) (i) What is the difference between Kelvin temperature scale and Celsius temperature scale? **(1 mark)**
   (ii) Mention three basic advantages of a gas thermometer. **(1.5 marks)**

   (b) (i) What is meant by a "perfect thermal source" as used in thermal radiation. **(1 mark)**
   (ii) The coefficient of volume expansion of glycerine is $4.9\times10^{-4}C^{-1}$. What is the fractional change in its density for a $30^{0}C$ rise in temperature? **(2.5 marks)**

   (c) (i) Define thermal conduction. **(1 mark)**
   (ii) An aluminium saucepan in contact with hot plate has a base of diameter 20.0cm and thickness of 0.5cm. If the saucepan contains water boiling away at the rate of $0.15gs^{-1}$, estimate the temperature at the lower surface of the saucepan vessel. **(3 marks)**

6. (a) (i) What is a perfectly blackbody? **(1 mark)**
   (ii) Give one limitation of Newton's law of cooling. **(1.5marks)**

   (b) Briefly explain the following:
   (i) Why does a good absorber of radiant energy appears black? **(2 marks)**
   (ii) Why two sheets of similar glass insulate much more effectively when separated by a thin layer of air than when they are in contact? **(2 marks)**

   (c) A roof measures 20m ×50m is blackened. If the temperature of the sun's surface is 6000K, calculate the solar energy incident on the roof per minute, assuming that half of it is lost when passing through the earth's atmosphere. **(3.5 marks)**

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SECTION B (30 marks)

Answer **three (3)** questions from this section.

7. (a) Define beat frequency. **(1 mark)**

(b) (i) List down four necessary conditions for a stationary wave to be formed. **(2 marks)**

(ii) An open pipe of length 15cm and a pipe of length 11.5cm closed at one end are both sounding their first overtones. If their notes are of the same frequency, what will be the end correction of the two pipes? State any assumption made in arriving at your answer. **(4 marks)**

(c) A transverse sinusoidal wave is generated at one end of a long horizontal string of linear density of 1.8×10^{-3} kg/m and is kept under a tension of 12.0 N by a bar which moves up and down repeating regularly twice each second through a distance of 0.25m. Determine the:

(i) Amplitude. **(1 mark)**

(ii) Wavelength of the wave. **(2 marks)**

8. (a) Define the following terms:

(i) Curie temperature. **(0.5 mark)**

(ii) Remanance. **(0.5 mark)**

(iii) Coercive force. **(0.5 mark)**

(b) (i) What is meant by electrical oscillation as used in electric circuit. **(2 marks)**

(ii) Briefly explain how a permanent magnet and a current in a conductor can be used to demonstrate electromagnetic induction. **(2.5 marks)**

(c) A toroid of mean circumference of 0.5m has 500 number of turns, each bearing a current of 0.15A. If the core is filled with iron of relative permeability of 5000, calculate the:

(i) Magnetic field intensity. **(2 marks)**

(ii) Magnetic flux density. **(2 marks)**

9. (a) (i) Define the term drift velocity. **(1 mark)**

(ii) A copper wire of cross-sectional area $3.0mm^2$ carries a current of 5.0 A. Find the magnitude of the drift velocity of electrons in the wire. **(3 marks)**

(b) (i) The resistance of an electric conductor varies linearly with its temperature. Write down the equation for this variations. **(1 mark)**

(ii) State the significance of the slope per unit resistance for the variation in (b) (i) above. **(2 marks)**

(c) A cell of e.m.f, E and internal resistance, r is used to drive the current, I through a load of resistance, R. Show that for the maximum electric power to be transferred to the load, a load resistance, R must be equal to the internal resistance, r of a cell. **(3 marks)**

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10. (a) (i) Distinguish between "frequency modulated" and "amplitude modulated" radio waves. **(2 marks)**

(ii) Explain why is FM radio broadcasting currently preferred than AM radio broadcasting? **(2 marks)**

(b) The speech signals in the frequency range of 300HZ to 3400HZ are used to amplitude a modulate carrier wave of frequency 200Khz. Determine the,

(i) bandwidth of the resultant modulated signals. **(2 marks)**

(ii) frequency range of the lower side band. **(1 mark)**

(c) The switching and amplifying action of a transistor was done by the circuit diagram below (see Figure 1)

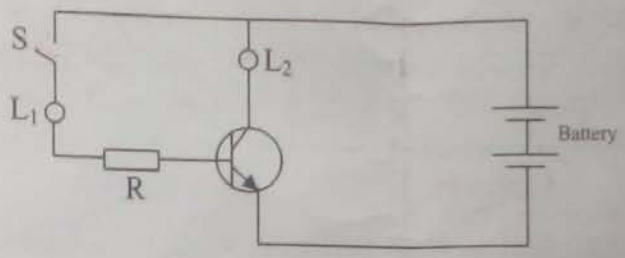


Figure 1

Briefly explain how does the circuit above can act as;

(i) a switch. **(1.5 marks)**

(ii) an amplifier. **(1.5 marks)**

SECTION C (30 marks)

Answer **three (3)** questions from this section

11. (a) (i) Define electric potential at a point. **(1 mark)**

(ii) Two capacitors of capacitance $1\times10^{-6}F$ and $1\times10^{-8}F$ are charged to the same potential. Give comments on which capacitor will give more intense electric shock if touched? **(2 marks)**

(b) (i) What is meant by relative permittivity. **(1 mark)**

(ii) The spherical shell of a Van de Graaff generator is to be charged to a potential of 10^6 V. Calculate the minimum radius of the shell if the dielectric strength of air is $3\times10^6 Vm^{-1}$. **(2.5 marks)**

(c) (i) Sketch a graph to show how a charge, Q varies with time, t during discharging process of a capacitor. **(2.5 marks)**

(ii) What is the significance of the gradient at any point along your graph in (c) (i) above. **(1 mark)**

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12. (a) (i) Compare the electrostatic and gravitational forces that exist between an electron and a proton. **(2 marks)**

(ii) The distance, r between an electron and proton in hydrogen atom is about $5.3\times10^{-11}m$. Compute the electrical and gravitational forces between these two particles. **(3 marks)**

(b) A capacitor C_1 is charged to a potential difference, V_1. The charging battery is removed and the capacitor is then connected to uncharged capacitor C_2 as shown in Figure 2.

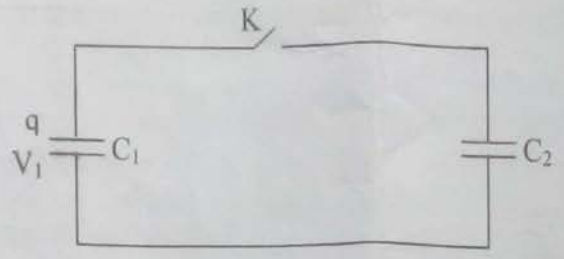


Figure 2

(i) What is the final potential difference, V across the combination? **(1.5 marks)**

(ii) Find the stored energy before and after the switch is thrown. **(1.5 marks)**

(iii) Is there any difference between the energy before and after the switch is thrown? Give reasons for your answer. **(2 marks)**

13. (a) (i) Define ionization potential. **(1 mark)**

(ii) Briefly explain the fact that de- Broglie waves are referred to as matter waves though are not composed of matter. **(3 marks)**

(b) The three lowest energy levels of the electron in the hydrogen atom have energies of $E_1 = -21.8\times10^{-19}J$, $E_2 = -5.43\times10^{-19}J$ and $E_3 = -2.43\times10^{-19}J$. Determine:

(i) The wavelength of H_α- spectral line due to the transition between energy level, E_3 and E_2. **(2.5 marks)**

(ii) The potential difference that enables an electron to be accelerated and cause the emission of H_α-spectral line. **(2.5 marks)**

(c) State any assumption made to support your answer in (b) (i) and (ii) above. **(1 mark)**

14. (a) (i) Name three layers of the atmosphere. **(1.5 marks)**

(ii) Describe any two major zones of the earth. **(4 marks)**

(b) (i) What are the factors that influence the velocities of P and S waves? **(1 mark)**

(ii) The P and S waves from an earthquake with a focus near the earth's surface travel through the earth at nearly a constant speed of $8km^{-1}$ and $6km^{-1}$ respectively. If there is no reflection and refraction of waves, how long is the delay between the arrivals of successive waves at a seismic monitoring station at 90^0 in the latitude from the epicentre of the earthquake? **(3.5 marks)**

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15. (a) (i) What do you understand by the word environmental physics? **(1 mark)**

(ii) Briefly explain three effects of seismic waves. **(3 marks)**

(b) (i) Mention three types of environmental pollution. **(1.5 marks)**

(ii) Explain on the following climatic factors which influence plant growth: Temperature, Relative humidity and Wind. **(4.5 marks)**

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