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

**031/1**                              **PHYSICS 1**
(For Both School and Private Candidates)

**Time: 3 Hours**                                                    **Year: 2020**

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**Instructions**

1.  This paper consists of sections A, B and C with a total of **eleven (11)** questions.

2.  Answer **all** questions in sections A and B and **two** ( **2** ) questions from section C.

3.  Section A carries **fifteen (15)** marks, section B **sixty (60)** marks and section C carries **twenty five (25)** marks.

4.  Cellular phones and any unauthorized materials are **not** allowed in the examination room.

5.  Non-Programmable calculators may be used.

6.  Write your **Examination Number** on every page of your answer booklet(s).

7.  Where necessary the following constants may be used:
    (i)  Acceleration due to gravity, g $= 10$ m/s$^2$ .
    (ii) Density of water $= 1.0$ g/cm$_3$ . (iii) Pi, $\pi$
    $= 3.14$.
    (iv) Speed of light waves $= 3.0 \times 10^8$ m/s

# SECTION A (15 Marks)

Answer **all** questions in this section.

1. For each of the items (i) - (x), choose the correct answer among the given alternatives and write its letter beside the item number in the answer booklet provided. **(10 marks)**

   (i)    Which pairs of instruments is used for measuring lengths?
          A   A ruler and a measuring cylinder
          B   A micrometer screw gauge and a beam balance
          C   A vernier caliper and a micrometer screw gauge
          D   A pipette and a vernier caliper
          E   A beam balance and a spring balance

   (ii)   What are the two factors that determine Buoyancy?
          A   Volume of fluid displaced and mass of the object.
          B   Weight and mass of the object.
          C   Density of the fluid and weight of the object.
          D   Volume of the fluid displaced and density of the fluid.
          E   Mass of the object and density of the object.

   (iii)  Which physical phenomenon is observed when a tea bag is dipped into a cup of hot water?
          A   Steaming        B        Diffusion        C        Osmosis
          D   Evaporation              E   Boiling

   (iv)   In a light experiment, the results showed that less light was transmitted and the image was distorted. Which type of material was used?
          A   A translucent material    B        An opaque material
          C   A luminous material                D    A transparent material
          E   A non-luminous material

   (v)    A stone dropped from the top of a building hit the ground 4 seconds later. What was its velocity when hitting the ground?
          A   400 m/s B        45 m/s  C        40 m/s
          D   4.5 m/s                  E    0.4 m/s

(vi)   Why is Mercury preferred in clinical thermometers as a thermometric of a liquid to water and alcohol?

A   It is denser than other liquids.

B   It is opaque and does not need colouring.

C   It is more sensitive to temperature.

D   It is active and does not wet the glass.

E   It is a poor conductor of heat.

(vii)  A rectangular box of mass 10 kg rests on an inclined plane. If the coefficients of static and dynamic frictions are 0.55 and 0.25 respectively, at what angle will the box begin to slide?

A   $14.8°$   B      $24.8°$   C      $28.8°$   D      $38.8°$   E      $48.8°$

(viii) Heat would be lost in the thermos flask if the walls of the glass container were not coated with silver. Which process contributes to the heat loss?

A   Radiation      B      Conduction      C      Convection

D   Absorption            E   Transmission

(ix)   A launderer was thinking about a proper day for washing and drying clothes. Which day would he prefer most among the following?

A   Dry day B      Hot day C      Windy day

D   Still day            E   Cold day

(x)    Which process is involved in producing reverberation?

A   Refraction      B      Multiple reflection      C      Interference
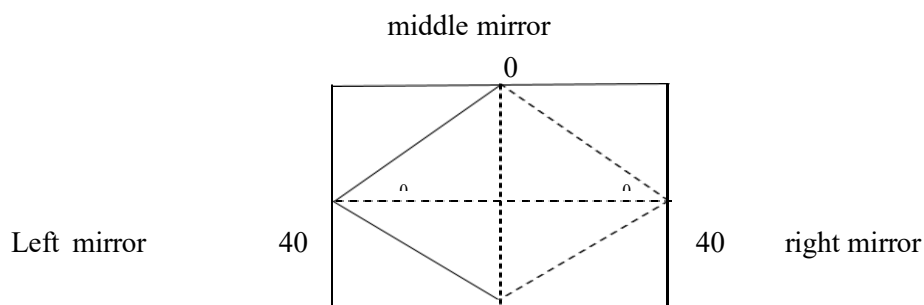
D   Diffraction            E   Reflection

| i | ii | iii | iv | v | Vi | vii | viii | ix | x |
|---|----|-----|----|----|-----|-----|------|----|----|
| C | C | B | A | C | D | C | B | C | B |

2. Match the functions of the features of cathode ray tube in **List A** with the corresponding features in **List B** by writing the letter of the correct response beside the item number in the answer booklet provided.

| List A | List B |
|---|---|
| (i) It produces fast moving electrons when heated at high temperature. <br><br> (ii) Traces the direction of cathode rays in a cathode ray tube. <br><br> (iii) Deflects the electron beam vertically. <br><br> (iv) Deflects the electron beam horizontally. <br><br> (v) Accelerates the ejected electrons to the screen | A Perrin tube <br><br> B X-plate <br><br> C Anode <br><br> D Cathode <br><br> E Y-plate <br><br> F Maltese cross tube <br><br> G Vacuum |

| i | ii | Iii | iv | v |
|---|---|---|---|---|
| D | F | E | B | C |

3. (a) Three plane mirrors are arranged along three sides of a square. A ray of light is incident on the left side mirror at its midpoint with an angle of incidence of 40° so that the ray is afterwards reflected by other mirrors. Draw the appropriate path of the ray and calculate the angle through which the ray is turned at each of the three reflections. **(6 marks)**



middle mirror

Left mirror     40        40     right mirror

(b)    Explain two functions of the shutter in a camera.    **(4 marks)**

(i) The shutter acts as a gate in a camera
(ii) It controls the duration of time that light is allowed to pass through the lens and fall on the film.
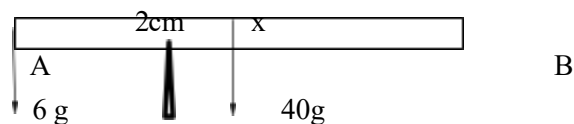
4.  (a)  Use a well labelled diagram to explain the working principle of a hydraulic braking system.



When a force is applied to the brake pedal, it pushes the piston in the master cylinder forward creating creating the pressure in the brake fluid. This pressure is transferred to the slave cylinder and multiplied, it pushes the brake shoe against the brake drum that is attached to the wheel of a vehicle, friction between the brake shoe and the brake drum slows down the wheel's rotation hence the vehicle stops.

(b)    A uniform pencil AB weighing 40 g can be balanced horizontally on a knife edge at 2 cm from the end A when a mass 60 g is hung from this end. What is the length of a pencil?

Consider a uniform pencil AB

Sum of clockwise moment = sum of an-clockwise moment

40g x X x 10N/Kg = 60g x 2cm x 10N/Kg

40X =120cm

Divide both sides by 40

X =3cmA half of a pencil AB =3cm + 2cm =5cm So, Full length of a pencil AB = (5cm x 2) =10cm

5. (a) Why the recoil velocity of a gun is much less than the velocity of the bullet? Explain by using the principle of conservation of linear momentum.

The recoil velocity of a gun is much less than velocity of bullet simply because, the gun has greater mass than bullet, since the linear momentum is directly proportional to the mass and its velocity.

(b) A hydraulic press consists of a pump, load and two cylinders in which the larger cylinder is eight times the diameter of a smaller one. Use a well labelled cross-sectional diagram of a hydraulic press to determine the value of mechanical advantage of this machine if it is working with efficiency of 90%.

(b) Data Given

Diameter of larder cylinder(D) =8x

Diameter of small cylinder(d) =x

Then,

V.R = D²/d²

V.R = (8x)²/x²

V.R = 64.

Efficiency =80 %
V.R = 64 But,

efficiency=

(MA/VR)

x100%

90% = MA/64 x 100

M.A = 57.6

6. (a) Carefully study Figure 1. Explain what will happen to the bulbs P and Q in relation to the water levels X and Y when the heater is turned on. **(5 marks)**
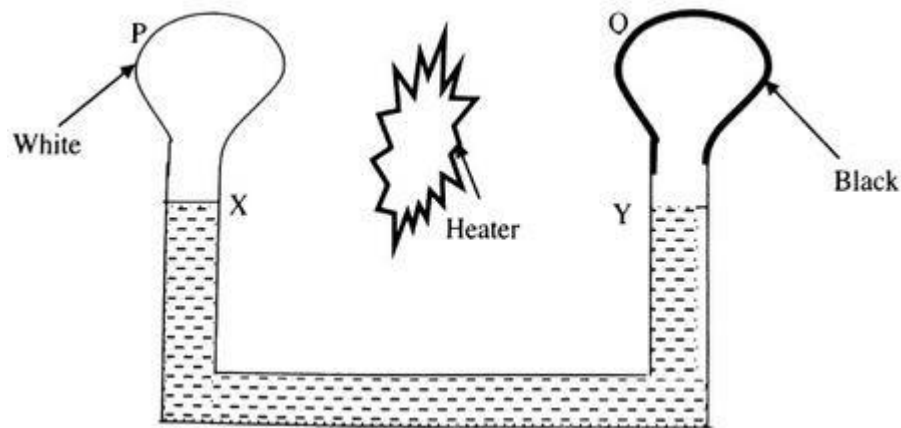


**Figure 1**

The black color being a better absorber of heat, hence bulb Q gets more heated faster than P due to heat radiated by the heater, this resulting in the expansion of air inside bulb Q. The expanded air requires more space and thus pushes water towards X. Hence, the level of water in Y falls while that in X rises.

(b) How would the dimensions of a newly constructed Tanzania standard gauge rail line change during the summer and winter days?

The newly constructed Tanzania Standard gauge rails expand during days, hence rails gap become smaller due to expansion, while standard gauge rails contracts during winter days, hence rails gap become wider due to contraction.

7. (a) In Figure 2, the labels A, B, C and D are identical electric bulbs connected in a circuit. Explain what will happen to the bulbs A, B and D when bulb C blows off and the key K is closed.
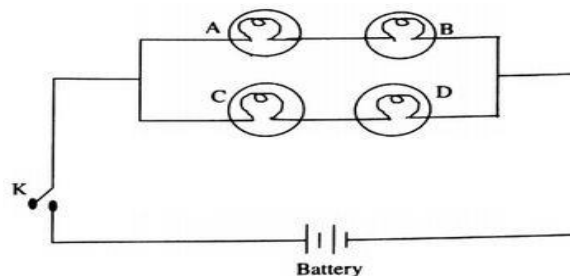


Figure 2

When the bulb C blows off and the key is closed, only the bulb A and B will give out light, while the bulb D will not give out light.

(b) Rutherford proton-neutron model shows that there are no electrons in the nucleus of an atom. How is it possible for a radioactive element to emit beta particles (electrons) from its nucleus?

It possible for a radioactive element to emit beta particles (electrons) from its nucleus, since it occurs when the ratio of neutrons to protons in the nucleus is too high. An excess neutron transforms into a proton and an electron. The proton stays in the nucleus and the electron is ejected energetically. The nucleus ejects the beta particle and some gamma radiation.

8. (a)    Figure 3 shows the profile of a radio wave. Study it carefully and determine its wavelength.
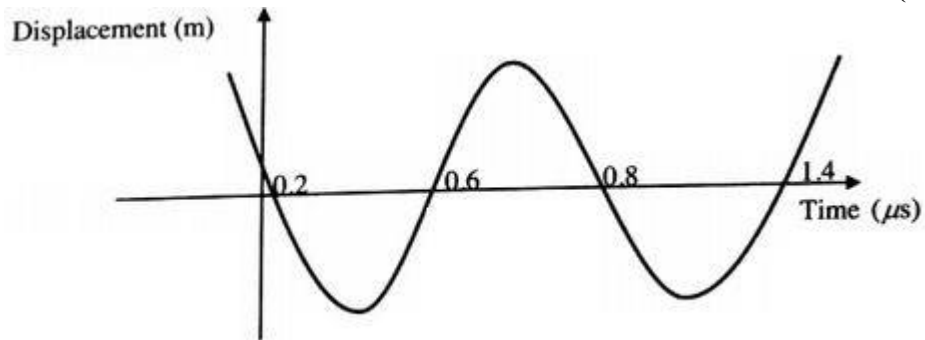
**(4 marks)**



**Figure 3**

Speed of light wave= 3 x 108m/s

Periodic  time  (T)  =

(1.4s - 0.6) = 0.8s      Since,

frequency =1/T =1/0.8 = 1.25

but v = f x wavelength

300000000= 1.25 x wavelength.

Wavelength = 240000000 m

(b)Explain how an earthquake occurs.

Earthquake occurs when rocks at a fault line slip or break, and two sections of Earth's crust physically move relative to one another. That movement releases energy, and two types of seismic waves radiate outward from the earthquake through Earth's interior and along its surface.

## SECTION C (25 Marks)

Answer **two (2)** questions from this section.

9.  (a)  A piano wire and turning fork are devices which produces sound. Show clearly three ways in which a piano wire can be tuned to emit a note of the same frequency as a vibrating turning fork.

Piano wire can be tuned to emit a note of the same frequency as a vibrating turning fork in the following ways; -

(i)Frequency is inversely proportional to the length of the wire
- The length of the wire should be adjusted should be adjusted so as to produce an appropriate frequency.

(ii)Tension (T) of the wire: The frequency of wire is direct proportional to the square root of tension.
- Tension of the wire should be adjusted to produce appropriate frequency

(iii)Linear density of the wire (Mass per unit area)
- The linear density of the wire should be adjusted to produce the same frequency as turning fork, since the frequency is inversely proportional to the square root of linear density of a wire.

(b)  You are provided with a moving coil galvanometer of a coil resistance 20Ω and can carry a maximum current of 15 mA. How will you design this galvanometer to register 10 mA full scale deflection?

Given that

Resistance of galvanometer Rg =20Ω

Electric current of Ammeter IA = 15mA Electric current of a galvanometer Ig =10mA

from: The converting the reading coil Galvanometer into Ammeter reading the resistance of high

resistance (Shunt resistance (RS)) should be connected in parallel with a galvanometer.

then,

TA = Ig + IS

15mA = 10mA + IS

IS = 5mA

But also potential difference across galvanometer (Vg) = Potential difference across shunt resistance (VS)

Vg = IgRg

Vs = IsRs

IsRs = IgRg

5mA x Rs = 10mA x 20 Ω

5Rs = 200

RS = 40Ω

Therefore, in order to design galvanometer to register 10mA full scale deflection, A resistance of 40 Ω should be connected in parallel to the galvanometer.

10. (a) Distinguish the concepts of conductors, semiconductors and insulators in terms of their energy bands.

   Conductor:  There is no forbidden gap.

   Semi-Conductor: There is small forbidden gap

   Insulator:  There is large forbidden gap.

(b)     Figure 4 shows an electric circuit. Carefully study it and calculate the value of current x and r.
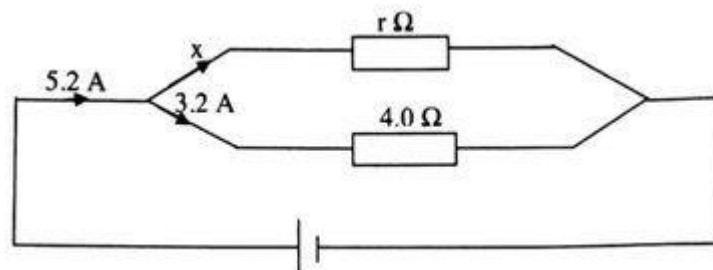
**(4 marks)**



**Figure 4**

(i) Current at x

From: When resistor connected in parallel current flowing in the circuit is different but while voltage is the same

Total current = Current passing in X + Current passing at 4?

5.2A = x + 3.2

A x = 5.2A - 3.2A = 2

Therefore, current at x =2.0A

But, Point at x and point at rare in series, hence current is the same

Therefore, current at r =2.0A

But voltage at r and voltage at 4? is the same

V=IR

V= 3.2 x 4 = 12.8V

Therefore, voltage at r is 12.8

12.8= 2 x r

2r =12.8, divide by 2

both sides r=6.4?

hence, value of r is 6.4?

(c) From part (b), determine the effective resistance.

> Effective resistance = Total resistance in the circuit.
> For parallel connection, 1/R = 1/R1 +1/R2
> R = (4 +6.4)÷ 25.6
> Hence, effective resistance is 2.46 ohms.

11. (a) Describe the mechanism of doping intrinsic semiconductor to obtain p-type semiconductor.

> Intrinsic semiconductor
> Is semiconductor which is pure enough such that the impurities in it do not significantly affect its electrical behavior

•The conductivity of intrinsic semiconductor increase with increase in temperature

•In low temperature the valency band is completely full, making the material insulator

(b) Why most of the transistors in use are n-p-n transistors?

Most transistor in use is n-p-n because the majority charge carriers are electrons which move faster than holes.

(c) Form One students were shouting in their classroom. Briefly explain how other students in the next room can hear them shouting.

The students in the next class can hear the shouting due to the Diffraction of the sound.