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   **Friday, 08th November 2019 a.m.**

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

4. Non-programmable calculators may be used.

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

6. 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)   Coefficient of linear expansivity of the

   brick $= 1.2 \times 10^{8}$ $^{-5}$K $^{-1}$
   - (v)   Speed of light in air $= 3 \times 10$ m/s.
   - (vi)   Speed of sound in air $= 340$ 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.

   (i)   Which pairs of instruments would you use to correctly measure the diameter of a small ball

   bearing?
   A   Measuring tape and vernier caliper
   B   Slide rule and micrometer screw gauge
   C   Vernier caliper and slide rule
   D   Micrometer screw gauge and vernier caliper
   E   Metre rule and micrometer screw gauge

   (ii)   A piece of cork of volume 100 cm ^{3} is floating on the surface of water. If the density of

   the cork is 0.25 g cm^{-3} , what volume of the cork is immersed in the water? $_3$

   A   100 cm$_{33}$ B   0.25 cm $_3$ C   25 cm^3
   D   100.25 cm   E   0.025 cm

   (iii)   A layer of colorless water floating on a blue copper (II) sulphate solution becomes blue after sometime. Which physical process supports the observation made?
   A   Diffusion   B   Cohesive   C   Surface tension
   D   Adhesive   E   Osmosis

   (iv)   A pin-hole camera 200 mm long produces an image of 2 mm diameter of the sun. If the sun's

   distance from the earth is about 1.5×10^8 km, what is the diameter of the

   sun? $_6$ $_5$

   A $1.5 \times 10_8{}^4$ km   B $1.5 \times 10_3$ km   C 3×10 km

   D 7.5×10 km   E 3.0×10 km

   (v)   Which phenomena is a result of the earth being exactly along the same line between the centre of the sun and the moon?

A   Lunar eclipse   B   Penumbra   C   Solar eclipse

D   Umbra   E   Reflection
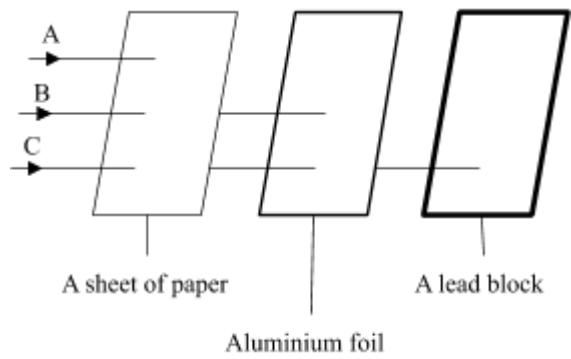
(vi)   Which metals become strongly magnetized when subjected to a magnetic field?

A   Nickel and copper   B   Zinc and aluminium   C   Cobalt and iron

D   Aluminium and lead   E   Iron and zinc

(vii)   A body moved upward a distance of 20 m. Calculate the time taken to reach the maximum

height.

A   2 s   B   5 s   C   10 s   D   15 s   E   11 s

(viii)   The temperature of a certain liquid is measured to be 300K. What will be its temperature in degrees centigrade?

A   273°C   B   100°C   C   57°C

D   37°C   E   27°C

(ix)   Which factors influence friction between tyres of a car moving with constant speed and surface of the road?

A   Weight and speed   B   Speed and nature of the surface

C   Nature of the surface and weightD   Surface area of the tires and speed E   Acceleration and nature of the surface

(x)   When the sun shines on the dark-coloured driving wheel of a car, the wheel feels warm.

Why?

A   It is because the sun warms the car by induction.

B   It is because the sun gives energy to the wheel by convection.

C   It is because the sun radiates thermal energy to the wheel.

D   It is because the sun conducts thermal energy to the wheel.

E   It is because the sun conducts thermal energy to the wheel.

i	ii	iii	iv	v	vi	vii	viii	ix	x
D	C	A	B	A	C	A	E	C	C

2. Match the properties of radiations in **List A** with the corresponding radiations in **List B** by writing the letter of the correct response beside the item number in the answer booklet provided. The responses might be used more than once.
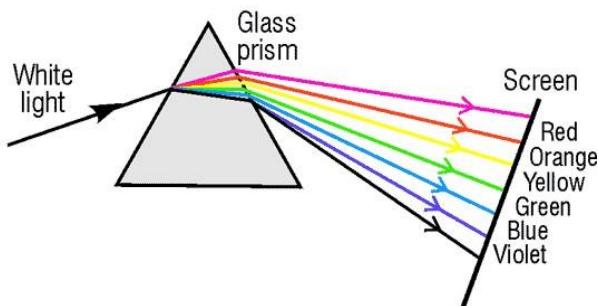
List A	List B
(i) Has weak-moderate ionising power.	
(ii) Is deflected towards south pole of the magnet.	
(iii) Has high penetrating power but stopped by lead sheet.	
(iv) Has the least penetrating power but stopped by a sheet of paper.	
(v) Has a speed up to 10% times the speed of light in vacuum.	

i	ii	iii	iv	V
B	A	C	A	A

SECTION B (60 Marks)

Answer **all** questions in this section.

3. (a) In a light experiment, a narrow beam of light directed onto a glass prism leaves the prism and falls on a white screen. Draw a labelled diagram to show the experimental set-up and observation seen on a screen.

   (b)   Explain two ways in which lens cameras differ from the human eye.

Lens Camera
  -Focuses by altering the distance between the lens and film
  -Image formed in the film is processed chemically to produce the final image.
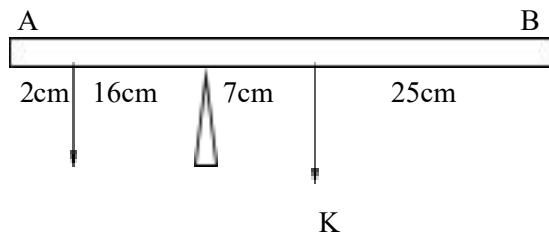
Eye
  -Focuses by altering the shape of the lens
  -Image formed is converted to electrical impulse, that travels via to brain, this impulse is interpreted to create final perceived image.

4. (a) Why a bubble of air increases in volume as it rises from the bottom of a pond of water to the surface? Briefly explain.

   This is because, the pressure under a liquid surface varies with depth. As depth increases, pressure increases. At the bottom of the pond there is greater pressure than at the top of the pond. Thus, when a bubble rises from below the surface it encounters less pressure. This causes the volume to increase and the bubble rises in size as it rises from a depth.

(b)   A half meter rule AB is freely pivoted at 18 cm from end A and balances horizontally when a body of mass 35 g is hung 48 cm from end B. Calculate the mass of the rule.

Consider the diagram below

Let K be the mass of the rule.

From principle of moments,

sum of clockwise moment=sum of anti-clockwise moment

K x 7cm = 35g x 16cm

7K=560,

divide by 7 both sides to get value of K

K =80 g.

5. (a) Figure 1 shows a simple machine B which has to be used to pull the packing case of 2000 N into the car by an effort of 500 N. Calculate the efficiency of machine B. **(5 marks)**
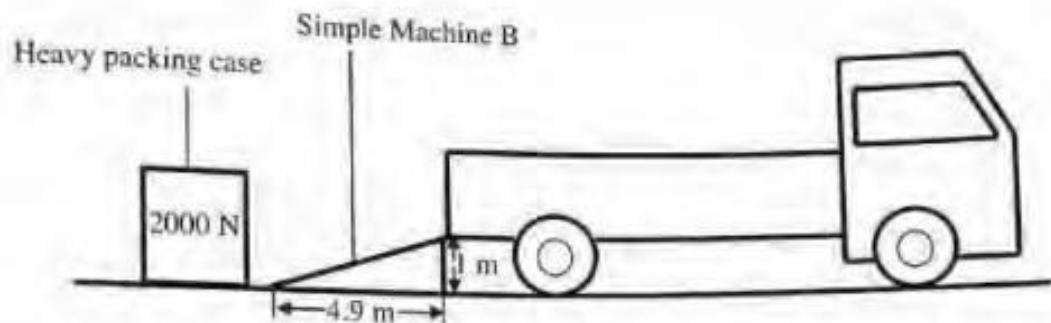
Figure 1

Consider inclined plane as shown below.

Apply Pythagoras theorem;

$L^2 = (1)^2 + (4.9)^2$

$L^2 = 1 + 24.01 = 25.01$

L = 5 cm

from,

MA = Load/effort

= 2000/500 = 4

Also, from VR = load distance ÷ effort distance
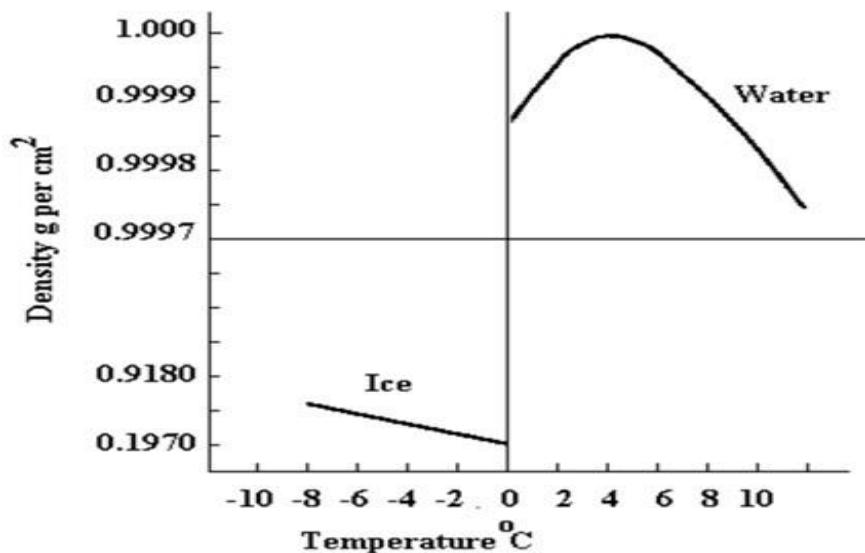
= 5/1 = 5

Then Efficiency = MA/VR x 100%

= 4/5 x 100% = 80%

6. (a) A beaker containing ice is heated from -5°C to 0°C and then from 0°C to 15°C. With the aid of a diagram, explain the variation of density with temperature.

The density of water does not vary uniformly with an increase in temperature. When an ice heated form -5°C to 0°C, the density of water increases linearly; But also, when the temperature increases from 0°C to 4°C, the density of water increases exponentially and it is at maximum. This situation is called Anomalous Expansion of Water.

(b)   A brick at 20°C has a dimension of 30 cm, 18 cm and 10 cm for length, width and height respectively. If a brick is heated to a new temperature of 150°C, calculate the new dimensions.

Given that
- Initial temperature(T1)=200C
- Dimensions= 30cm x 18cm x 10cm
- Final Temperature(T2)=150 0C

- Linear expansivity= 1.2 x 10-5 K-1

From,
$\Delta L = L \, \Delta T.$
= 0.000012 x 30 x (150 - 20)
= 0.0468 cm

Then,

new length = 30 + 0.0468 = 30.0468 cm.

For 18 cm, increase in length is given by,
0.000012 x 18 x (150 - 20) = 0.02808 cm
Then, new length = 18 + 0.02808
= 18.02808 cm.
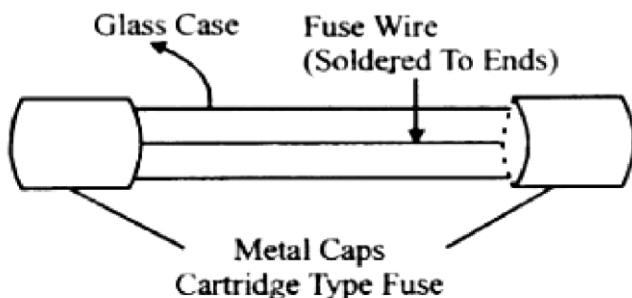
7. (a) With the aid of a diagram, explain the function of a fuse in an electrical appliance.

fuse is a safety device used to protect an electrical appliance against excess current.
This device is designed to allow only a certain amount of current pass through it. So, when there is excess current in electrical appliances than rated amount, then the fuse melts and cut off the flow of current between the parts of an electrical appliance.

Cartridge Type Fuse

(b)   A circuit in a house is protected by a 10 A fuse. The circuit is connected to the 240 V mains.

The following appliances are connected to the circuit:

Appliance	Power rating
Bulb 1	100 W
Bulb 2	75 W
TV	300 W
Heater	1500 W

Determine whether the fuse will blow on or off if all appliances are turned on.

SOLUTION
First, let find the total power of all appliances.
PT = 100 + 75 + 300 + 1500=1975W
But from the formula of Power
P=IV
P=1975 W, V=240v, I=?
 I = P / V
   = (1975) / (240)
  =8.229
  =8.23A

Therefore, the appliances in the house use an electric current of 8.23A only. Hence the fuse will blow on since it has rated at 10A

8.   (a) Why the inner core of the earth is solid while the outer core is liquid? Briefly explain.

This is because, The melting point of a material (temperature at which it changes from a solid to a liquid) varies with the pressure. So when pressure increases also the melting point has to increase. So the inner core is subjected to very high pressure compared to outer core. Therefore, this makes the melting pint of inner core lower than outer core because of very high pressure at the inner core despite of it high temperature.

(b)   The frequency obtained from a plucked string when the tension is 2 N is 400 Hz. Calculate the frequency when the tension is increased by 6 N.

Data Given

T1 = 2N

T2 = 6N + 2N = 8N

F1 = 400Hz, F2 = ?

From,

F1/F2 = sqrt(T2/T1)

F2 = 400 x sqrt (8÷2)

   = 800Hz

SECTION C (25 Marks)

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

9. (a) Carefully study Figure 2 which shows a design for an electrical operation model for lifting metal objects. Briefly explain three things you can do so that a heavier iron metal block can   be lifted.
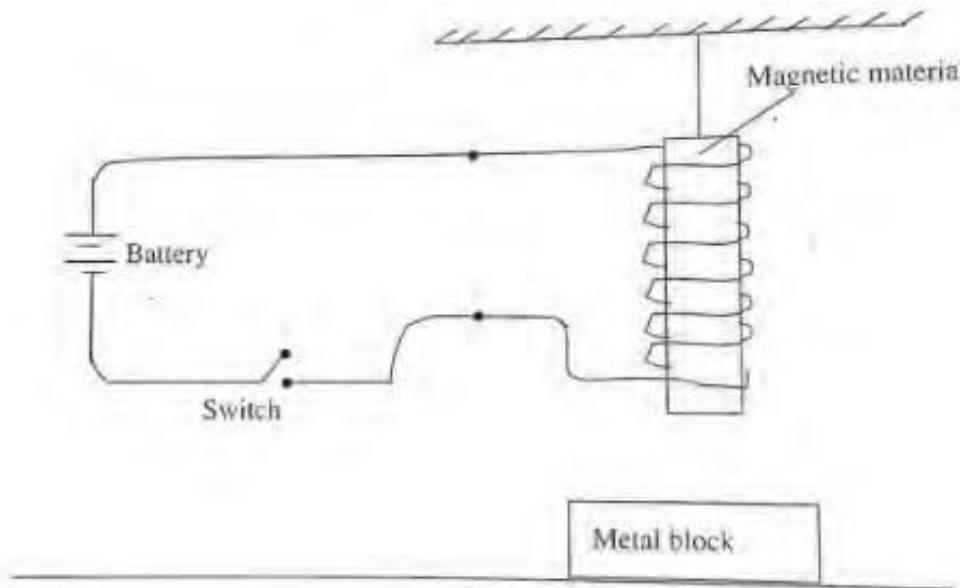

Figure 2

ANSWER

(i) To use soft iron core. This is because make a strong and permanent magnetism of a magnetic material

(ii)   To increase number of turns of wire(solenoid), If the number of turns increases, the magnet also become strong enough to lift a heavier iron.

(iii)   To use high electric current so as to create strong magnetic fields, which can make strong magnet enough to lift a heavy metal.

(b)   Why a musician must retune a stringed instrument if its temperature changes?

A musician retune a stringed instrument when temperature changes because stringed instrument length changes when temperature changes. If temperature increased, the string becomes long and when temperature decreased the string shortens, so the musician should retune it.

(c)   During a thunderstorm, the time between the flash of light and the thunder is 10 s. How far away is the thunderstorm?

Given that:

-Time (t) =10s

-Speed of Light In Air = 3 x 108m/s

-Speed of sound In Air = 340m/s

Distance = Speed x Time

D = 340 x10=3400m.

10. (a) A sample of carbon isotope $_6^{14}C$ has a half-life of 5700 years. What fraction of $_6^{14}C$ will remain after 11400 years?

Given That:

-Half life (t1/2)=57000 years

-Time for decay (t) =11,400 years

from N1/No = (1/2)²

hence factor is 1/4

(b) Describe the construction and mode of action of the PN junction semiconductor.

The PN junction is made up by combining a P-type semiconductor and N-type semiconductor in a single   continuous crystal.

Mode Of Action Of PN Junction.

The Electrons from n-type cross over the junction to P-type fill the holes, at the same time holes from P-type crossover the junction to capture electron from n-type. These movement of electrons and holes causes the n-type to become positively charged and the p-type to become negatively charged and creating a potential difference at the boundary. This stops further flow of electrons and holes at the boundary.

11. (a) Electrical energy is distributed in all parts of Tanzania by the National grid system which transmits alternating current at a very high voltage. Explain why is it necessary to have a very high voltage?

It is necessary to transmits A.C at high voltage so that to minimize amount of power lost as electricity flows from one location to another. The high voltage is necessary to overcome the voltage lost through resistance produced by cables, since the resistance increases as the length increases.

(b) A generator producing a varying current from 0 to 10 A was allowed to flow in a coil of magnetic field. After a time interval the current was observed to be 4 A. Describe how back e.m.f. Was induced in a self-induction.

When there is a varying current in generator from 0 to 10A, the induced e.m.f is produced, which acts as a back e.m.f

When the current in generator was increased to 10A, the induced e.m.f reduce the original current from 10A to 4A, this induced e.m.f acted as a back e.m.f in the coil of magnetic field, flow in opposite direction with that of original current of 10A