LINDI MUNICIPAL COUNCIL
FORM FOUR UMEKTA PHYSICS 1 – JULY 2023
MARKING SCHEME

SECTION A (16 MARKS)

1.

i	ii	Iii	iv	V	vi	Vii	viii	ix	x
D	E	B	D	B	E	B	E	C	A

(01 each =10marks)

2

i	Ii	Iii	iv	V	Vi
G	C	A	J	E	B

(01 each = 06marks)

SECTION B (54 MARKS)

3.a) The air in the refrigerator cabinet in contact with the freezer at the top is colder than the air below. It is therefore denser and sinks to the bottom. The less cold air rises to the top and becomes colder hence sinks. Therefore the air in the refrigerator cabinet is thus kept cold with help of the freezer **(04 marks)**

(b) Given:
Mass of the sphere (m) = 5kg
Tension in the rope (T) = 60N
Required: Volume of the sphere (V) = ?

Weight of the sphere (W) = mg **(00 $\frac{1}{2}$ marks)**

$= 5kg \times 10N/kg = 50N$ **(00 $\frac{1}{2}$ marks)**

NOTE: tension in rope act downward, weight of sphere act downward, and upthrust on the sphere act upward

Total downward force on sphere = tension + weight **(00 $\frac{1}{2}$ marks)**

= 60N + 50N= 110N **(00 $\frac{1}{2}$ marks)**

From: Archimedes' principle

Upthrust = weight of fluid displaced = 110N

Mass of liquid displaced = $\frac{w}{g}$ **(00 $\frac{1}{2}$ marks)**

$= \frac{110N}{10N/kg} = 11kg$ **(00 $\frac{1}{2}$ marks)**

Volume of liquid displaced = $\frac{mass}{density}$ **(00 $\frac{1}{2}$ marks)**

$$= \frac{11kg}{1300kg/m^3} = 0.008m^3$$ **(0 1 marks)**

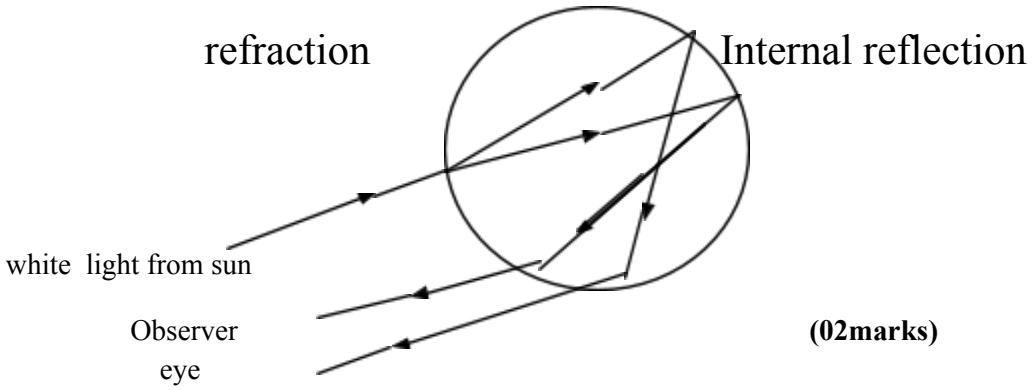
From: the law of flotation

Volume of liquid displaced = volume of the sphere

The volume ot the hollow metal sphere is $0.008m^3$ **(00 ½ marks)**

4. a)Formation of rainbow

Rain bow are formed when sunlight is scattered from the rain drops into the eye of the observer. This is caused by dispersion of sunlight as it refracted and reflected by rain drops. The rain drop must be infront of the viewer **(02marks)**



(02marks)

b) length of the wire ,l =2m

cross section area of the wire, A=0.5mm^2 =0.5 x10^{-6}m^2

Resistance , R =2.2Ω

Resistivity,(ρ) = ?

i)

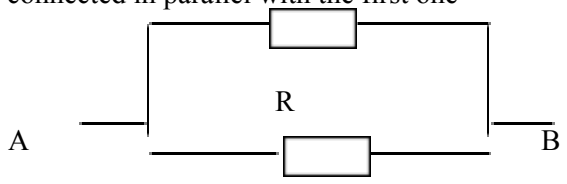
$$\text{Resistance} = \frac{resistivity \times length}{area}$$ **(00 ½ marks)**

$$resistivity = \frac{RA}{l}$$ **(00 ½ marks)**

$$= \frac{2.2\Omega \times 0.5 \times 10^{-6} m^2}{2m} = 5.5 \times 10^{-7} \Omega m$$ **(00 ½ marks)**

The resistivity of the wire is $5.5 \times 10^{-7} \Omega m$ **(00 ½ marks)**

ii) Consider a wire connected in parallel with the first one



(00 ½ marks)

2.2Ω

Effective resistance between point A and B is given by;

$$R_T = \frac{R_1 R_2}{R_1 + R_2} = \frac{2.2\Omega \times R}{2.2\Omega + R}$$ but: $R_T = 1\Omega$ **(00 1/2 marks)**

$$1.0\Omega = \frac{2.2R}{2.2 + R}$$

$1\Omega\ (\ 2.2\Omega + R) = 2.2R$

$2.2\Omega + 1R = 2.2R$

$2.2\Omega + 1R - 1R = 2.2R - 1R$

$$\frac{2.2}{1.2} = \frac{1.2R}{1.2}$$

$R = 1.83\Omega$ **(00 1/2 marks)**

The length will be given by;

$$length = \frac{resis\tan ce \times area}{resistivity} = \frac{1.83\Omega \times 0.5 \times 10^{-6} m}{5.5 \times 10^{-7}\Omega m} = 1.66m$$ **(01mark)**

The length of the wire is 1.66 meters **(00 1/2 marks)**

5.a) The level of the liquid being heated in a vessel first falls before starting to rise because the vessel expands first before the liquid. **(04marks)**

b) Data given

Pitch, (p) =1.0mm

Arm length, (l) =70mm

Efficiency (e) = 40%

Effort (E) =10N

Required: Load , (L) = ?

Velocity ratio, (VR) = distance moved by effort / distance moved by load

= Circumferance of the circle / Pitch (p) **(00 1/2 marks)**

$$= \frac{2\pi l}{p}$$ **(00 1/2 marks)**

$$= \frac{2 \times 22/7 \times 70mm}{0.1mm}$$

$= 4400$

Velocity ratio of the simple machine is 4400 **(00 1/2 marks)**

From,

Efficiency = mechanical advantage (MA) X100%

Velocity ratio (VR) **(00 1/2 marks)**

M.A = $\frac{Efficiency \times V.R}{100\%}$ **(00 1/2 marks)**

$= \frac{40\% \times 4400}{100\%}$

= 1760

Mechanical advantage is 1760 **(00 1/2 marks)**

Mechanical advantage , M.A $= \frac{Load(L)}{Effort(E)}$ **(00 1/2 marks)**

Load = M.A × Effort **(00 1/2 marks)**

$= 1760 \times 10N$

= 17600 N **(00 1/2 marks)**

The load is 17600N **(00 1/2 marks)**

6 .a) Ways of increasing the frequency of note produced by a guitar

- increasing the tension in the string **(01mark)**
- decreasing the length of the string **(01mark)**
- using a string with small cross-section area **(01mark)**

b) Given

Mass of the pendulum(m) =100g = 0.1kg

Height raised ,(h) = 20cm = 0.2m

Maximum potential energy(PE_{max}) = ?

(PE_{max}) = mass (m) × height (h) × acceleration (g) **(01mark)**

= mgh

= 0.1kg × 10N/Kg × 0.2m **(00 1/2 marks)**

= 0.2 Nm **(00 1/2 marks)**

Potential energy is 0.2 Joules **(01mark)**

ii)The maximum speed of the bob is observed at the lowest part C of the bob.

From: principle of conservation of energy

Kinetic energy = Potential energy **(00 1/2 marks)**

$\frac{1}{2}mv_{max}^2 = mgh$ **(00 1/2 marks)**

$v_{max}^2 = \frac{2mgh}{m}$

$v_{max} = \sqrt{2gh}$ **(00 1/2 marks)**

$= \sqrt{2 \times 10m/s^2 \times 0.2m}$

= 2 m/s **(00 1/2 marks)**

The maximum speed of the bob is 2m/s **(01mark)**

7.a) Object appear coloured when light falls onto it because coloured objects tend to reflect light of its colour falling onto it and absorb the rest **(04marks)**

b) **Given:**

height of the girl (h_0) = 1.2m
object distance (u) = 6m
image distance (v) = 15cm

REQUIRED: height of the girl image (h_i) = ?

From: magnification formula

$$m = \frac{v}{u} = \frac{h_i}{h_0}$$ **(01Marks)**

$$\frac{15\times10^{-2}m}{6m} = \frac{h_i}{1.2m}$$ **(01Marks)**

$$h_i = \frac{15\times10^{-2}m\times1.2m}{6m}$$ **(01Marks)**

$= 3\times10^{-2}m$ **(01mark)**

= 3cm

The height of the girl image is 3cm **(01mark)**

8. (a) i. Because air pressure in space is nearly zero such that body temperature is enough to boil the blood **(2 marks)**

ii. Because gravitational force is almost zero in outer space **(2 marks)**

(b) Total force stretching spring (F) = load + pan weight **(00 1/2 marks)**

= 2N + 0.4N

= 2.4N **(00 1/2 marks)**

From: Hookes' law $k = \frac{F}{e}$ (**where:** k is force constant) **(00 1/2 marks)**

$$k = \frac{2.4N}{24mm}$$ **(00 1/2 marks)**

= 0.1 N/mm **(00 1/2 marks)**

Given: e =16mm to find F

From: $k = \frac{F}{e}$

$$F = ke = 0.1N/mm\times16mm$$ **(00 1/2 marks)**

= 1.6N **(00 ½ marks)**

Load = F- pan weight **(00 ½ marks)**

= 1.6N – 0.4N

= 1.2N **(00 ½ marks)**

The load on the scale pan is 1.2N **(00 ½ marks)**

SECTION C (30 MARKS)

9. a) The strength of the magnet cannot increased beyond limit because when all domains have been oriented in the same direction, no further magnetization is possible and material is said to be saturated **(04 marks)**

b) The coin cuts magnetic field lines and hence e.m.f is induced. From Lenz's' law the induced e.m.f act in a way to oppose the change causing it hence create a force opposing its weight downwards. **(04 marks)**

(c) Data given;

Primary current (I_P) = 0.6 A
Secondary current (I_S) = 0.1A
Primary turns (N_P) =200 turns
REQUIRED: Secondary turns (N_S) =?

From: $\frac{N_S}{N_P} = \frac{V_S}{V_P} = \frac{I_P}{I_S}$ (Transformer equation) **(2 marks)**

$$N_S = \frac{N_P \times I_P}{I_S}$$ **(00 ½ marks)**

$$= \frac{200 \times 0.6A}{0.1A}$$

=1200 turns **(00 ½ marks)**

Number of turns in secondary coil is 1200 turns **(01 marks)**

Primary voltage = 240 V (Given)

$$\frac{V_P}{V_S} = \frac{N_P}{N_S}$$ **(2 marks)**

$$V_S = \frac{V_P \times N_S}{N_P}$$

$$= \frac{240V \times 1200}{200}$$ **(00 ½ marks)**

= 1440 V

Voltage in secondary coil is 1440 Volts **(01 marks)**

10. (a) When hall has many people, sound is absorbed by clothes and skin of audience ,thus echoes do not occur **but** when the hall has few people the sound is less absorbed and multiple echoes arises which hinders clear audibility of sound. **(03 marks)**

b) Consider a string fixed at point A and B

Fundamental frequency (f_0) L



(1 marks)

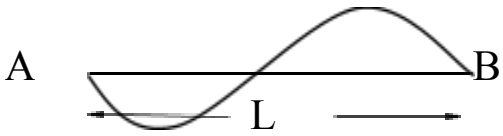
Length (L) $= \dfrac{wavelength(\lambda)}{2}$ **(00 ½ marks)**

Velocity = wavelength × frequency (f)

$$f_0 = \frac{V}{\lambda} \quad \textbf{but:} \quad \lambda = 2L$$

$$f_0 = \frac{V}{2L} \quad \textbf{(1 mark)}$$

First overtones



(1 mark)

$$L = \lambda$$

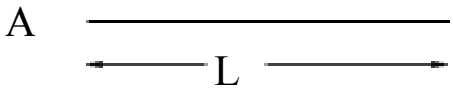
From: $V = f\lambda$

$$f = \frac{V}{\lambda} = \left(\frac{2}{2}\right)\frac{V}{L} \quad \textbf{(00 ½ marks)}$$

$$= 2\left(\frac{V}{2L}\right) \quad \text{where:} \quad f_0 = \frac{V}{2L}$$

$$f = 2f_0 \quad \textbf{(1 mark)}$$

Second overtones



(1 mark)

$$L = \frac{3}{2}\lambda \quad \text{where:} \quad \lambda = \frac{2L}{3}$$

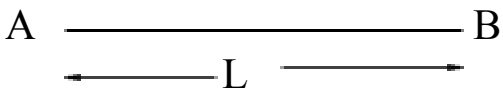
From: $V = f\lambda$

$$f = \frac{V}{\lambda} = \frac{V}{\frac{2L}{3}}$$ **(00 ½ marks)**

$$= 3\left(\frac{V}{2L}\right) \quad \text{where:} \quad f_0 = \frac{V}{2L}$$

$f = 3f_0$ **(00 ½ marks)**

Third overtones



(1 mark)

$$L = 2\lambda \quad \text{where:} \quad \lambda = \frac{L}{2}$$

From: $V = f\lambda$

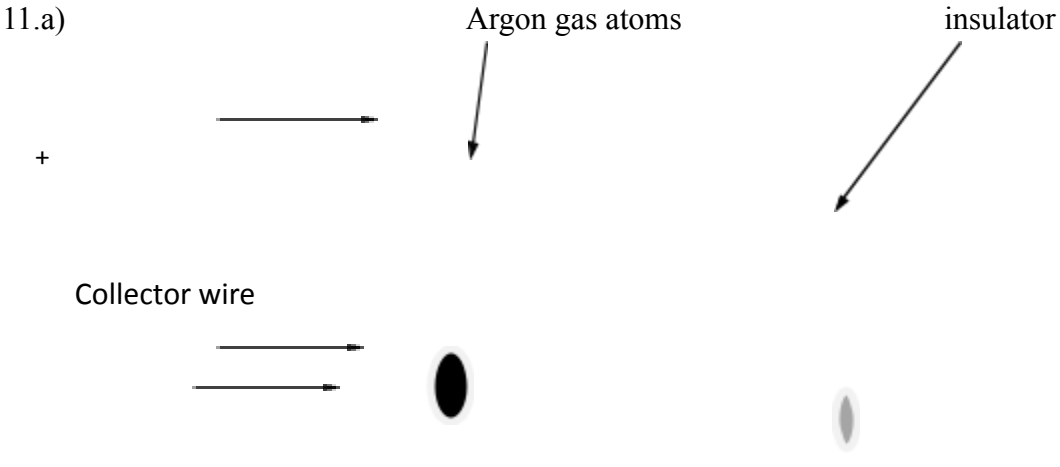
$$f = \frac{V}{\lambda} = \frac{V}{\frac{L}{2}}$$ **(00 ½ marks)**

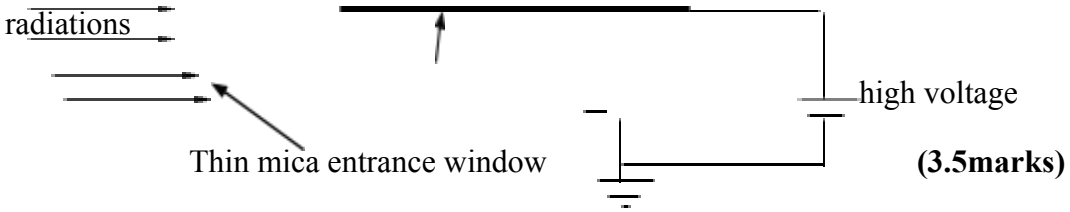
$$= \frac{2V}{L} = 4\left(\frac{V}{2L}\right) \quad \text{where:} \quad f_0 = \frac{V}{2L}$$

$f = 4f_0$ **(1 mark)**

(c) As they are cathode ray tubes, the screen are charged during operation by thermionic emission. These charges attract dust particles on the screen. **(03 marks)**

11.a)





(3.5marks)

-When radiations enters the tube, argon gas is ionized into argon ions and electrons **(01 ½ marks)**

- These are accelerated towards the cathode and the anode ionizing more argon atoms by collision**(01 ½ marks)**

- On cathodes the ions produce a current pulse which is amplified and input in a rate meter which gives counts per second hence the radiation is detected**(01 ½ marks)**

b) (i) The plane is charged after a long flight due to friction with air and clouds **(03 marks)**

ii)Passengers in the plane are not charged because there is an insulation in between the passengers cabin and the metal body of the plane which get charged due to friction with air ;but an attendant who will open the door from outside is at risk because if he/she touches the body of the plane the one will be electrified **(04 marks)**