REPUBLIC OF RWANDA

KARONGI DISTRICT **2nd TERM EXAMNATION**

CLASS: S4 A11 (PCB, PCM, MPG and MPC)

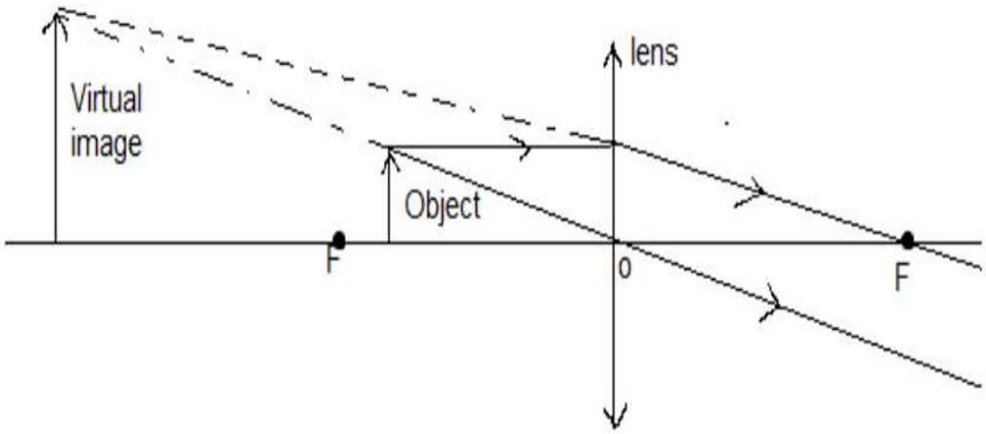
Marking guide for District CA ADVANCED LEVEL 2023-2024

SUBJECT: PHYICS THEORY II

SECTION A: Attempt ALL questions (55 marks)

1. **C** **(2marks)**
2. **B** **(2marks)**
3. **C** **(2marks)**
4. **A** **(2marks)**
5. **B** **(2marks)**
6. **D** **(2marks)**
7. **A** **(2marks)**

8. An image of an object is a virtual image when the rays of the light do not actually pass through it; they only seem to come from it. A virtual image would not be obtained on a cinema screen. **(1mark)**
The formation of a vitual image by a thin converging lens occurs for a real object placed inside its principal focus.



N.B: Well drawn figure will be marked out of (3marks)

b) This lens can be used as a single microscope because it forms an upright and magnified image. **(1mark)**

9. a) Conservation of linear momentum

$$V = \frac{m_1V_1+m_2v_2}{m_1+m_2}$$ **(1mark)**

$$V = \frac{(1.80\times10^3kg)(15.0m/s+(9.00\times10^2kg)(-15.0m/s)}{1.80\times10^3kg\times9.00\times10^2kg}$$ **(1mark)**



b) Change in velocity of the SUV: $\Delta v_1 = v_{1f} - v_{1i}$ **(0.5mark)**

$$\Delta v_1 = 15.00m/s - 5.0m/s = 10m/s$$ **(0.5mark)**

Change in velocity of the compact car: $\Delta v_2 = v_{2f} - v_{2i}$ **(0.5mark)**

$$\Delta v_2 = 5.00m/s - (-15.0m/s) = 20m/s$$ **(0.5mark)**

c) Change in initial kinetic energy $\Delta K_i = \frac{1}{2} m_1 \Delta V_1{}^2 + m_2 \Delta V_2{}^2$ **(0.5mark)**

$$\Delta K_i = \frac{1}{2}[(9.00 \times 10^2 kg) \times (10m/s)^2 - (1.80 \times 10^3 kg) \times (20m/s)^2]$$

$$\Delta K_i = -2.7 \times 10^5 J$$ **(0.5mark)**

Change in final Kinetic energy: $\Delta K_f = \frac{1}{2}(m_1 + m_2)V^2$

$$\Delta K_f = \frac{1}{2}(1.80 \times 10^3 kg + 9.00 \times 10^2 kg) \times (5.00m/s)^2$$

$$\Delta K_f = 3.38 \times 10^4 J$$ **(0.5mark)**

Change in Kinetic energy: $\Delta K = \Delta K_f - \Delta K_i = 30.38 \times 10^4 J$ **(0.5mark)**

10. (a) Flight time is the time taken by a projectile to travel a distance in a medium from its initial position at initial time t_o to final position where it touches the ground at final time t_f. **(1mark)** while the periodic time is the time taken by body executing a uniform circular motion to accomplish one complete cycle. **(1mark)**

(b) (i) From the expression $t_f = \frac{2v_0 sin\,\alpha}{g}$ **(0.5mark)**

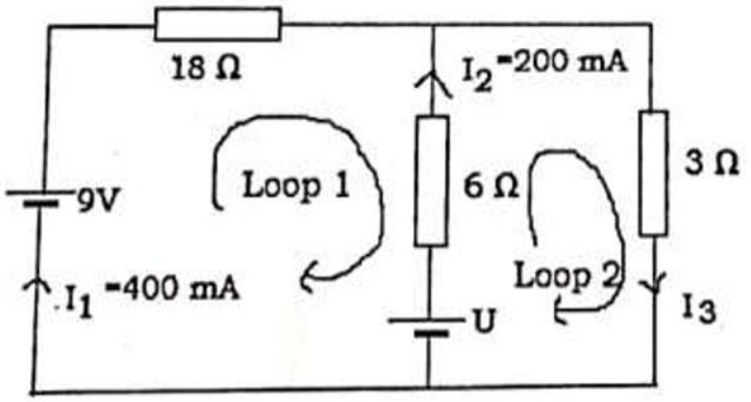
$$t_f = \frac{2 \times 600 \times sin\,60^0}{9.8} = 106.04sec$$ **(0.5mark)**

(ii) $R = \frac{V_0{}^2 sin2\alpha}{g}$ **(1mark)** $R = \frac{(600)^2 \times sin120^0}{9.8} = 31813.18m$ **(1mark)**

(iii) $t_{max} = \frac{V_o sin\alpha}{g}$ **(1mark)** $t_{max} = \frac{600 \times sin60^0}{9.8} = 53.02sec$ **(1mark)**

(iv) $h_{max} = \frac{V_0{}^2 sin^2\alpha}{g}$ **(1mark)** $h_{max} = \frac{(600)^2 sin^2\,60^0}{9.8} = 13775.51m$ **(1mark)**

11. a)



- $I_3 = I_1 + I_2$ **(1mark)**
- $I_3 = 400mA + 200mA = 600mA$ **(1mark)**

b) using Loop2: $U = 6 \times 0.2V + 3 \times 0.6V = 1.2V + 1.8V$ **(1mark)**

$U = 3V$ **(1mark)**

Or use Loop 1: we will get $9 - 0.4 \times 18 + 0.2 \times 6 - U = 0$

$U = 3V$

12. (a) (i) Sun, Wind, Water, etc. **(2sources× 1*mark* = 2*marks*)**

(ii) Coal, Crude oil, Natural gas, etc. **(2sources× 1*mark* = 2*marks*)**

(b) The three principal products of anaerobic digestion are biogas, digestate, and water **(only two answer on 2marks)**

13. (**a**) When connected in series, the devices and wires connecting them form a single pathway for electron flow between the terminals of the battery, generator or wall socket. **(1mark)** when connected in parallel, the devices and wires connecting them form branches, each of which is a separate path for the flow of electrons. **(1mark)**

(**b)** In a parallel circuit, the total current equals the sum of the currents in the separate branches. Therefore, if one light goes out, it does not affect others and it is suitable when connecting multiple loads. This

becomes easy to connect or disconnect a new element without affecting the working of other elements. (**2 reasons×1*mark*=2*marks***)

14. a) Image position $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ **(1mark)**

$\frac{1}{v} = -\frac{1}{20} - \frac{1}{30}$, $\frac{1}{v} = -\frac{5}{60} cm$ $v = -12cm$ **(1mark)**

b) Magnification of the image $M = -\frac{v}{u}$ **(1mark)**

$M = -\frac{12cm}{30cm} = -0.4$ **(1mark)**

c) Properties of the mage V is negative sign then **image is virtual, smaller than object (one point for 1mark)**

15. Biogas is considered an ideal fuel because of the following reasons:

a) Biogas does not cause much air pollution as the combustion process smoke free. **(1mark)**

b) Biogas produces a large amount of heat per unit mass and thus has high calorific value. **(1mark)**

c) Biogas does not leave any residue on burning and is thus a clean fuel.

d) Ease of production which includes easy availability of raw materials.

Any other points to be considered as correct answers.

- ❖ It is not expensive
- ❖ Production of fertilizers
- ❖ Biogas production also helps in the easy disposal of organic waste

SECTION B: Attempt **Only three** questions **(45 marks)**

16. **a)** Introduction must be marked out of **2marks** and body of the essay will be marked out **6marks**, then the conclusion will be marked out of **2marks**

Example of essay asked

A lens is a transparent optical device limited with two spherical surfaces that affects the focus of a light beam through the refraction. The lenses are used in designing some optical devices.

Camera

A camera without a lens is useless to a photographer. The lens is what focuses light from what you see through the viewfinder into a tiny, (typically) 35mm spot on the back of a film. Camera has enabled people to capture images and share them with others around the world without having to be present at the scene.

Telescope

Telescopes which are used for formation enlarged images for the heavenly bodies. Telescope is a tool that allows people to see objects from far away, beyond human vision, this helps a lot in researching for scientists, especially for astronomers to discover new stars, planets and galaxies.

Microscope

The lenses are used in Microscopes which are used for formation magnified images of the tiny bodies that cannot be seen with the naked eye such as microbes, cells etc.

Eye glasses

Lenses are used in making of medical glasses to treat the vision defects.

They also used to make projectors, Simple microscope etc.

Briefly, without lenses, no glasses, no camera, no microscopes, no telescopes. People would not able to see clearly, to observe microorganisms, to study universe or to enjoy entertainment through movies and televisions.

b) A compound microscope consists of two lenses, an **objective lens** ***(1marks)*** (close to the object) and an **eyepiece** or **eye lens** ***(2marks)*** (close to the eye)
In the human eye, a real and **inverted** ***(1mark)*** image is formed on the light sensitive surface called the **retina** ***(1mark)***

17. a) (i) The angular magnification or magnifying power of an optical instruction is defined by the equation: $M = \frac{\beta}{\alpha}$ where **(1mark)**

- β is the angle subtended at the eye by the image formed when using the instrument.
- α is the angle subtended at the unaided eye (i.e. without the instrument) by the object at some stated distance. In the case of telescope, the stated distance must be where the image (e.g. moon) is, for the microscope, it is usually taken to be the distance of most distinct vision (i.e. N=25cm away) since it is at that distance the object is seen most distinctly by the normal, unaided eye.

Linear magnification is the of the mage distance $\gamma = \frac{V}{u} = \frac{h'}{h}$ **(1mark)**

Angular magnification $M = \frac{\beta}{\alpha} = \frac{25}{6} = 4.18$

Distance V is given by $v = \frac{uf}{u-f} = \frac{6\times5}{5-6} = -30cm$ **(1mark)**

Linear magnification $\gamma = \frac{V}{u} = \frac{30}{5} = 6$ **(1mark)**

(ii) $u = f + x, \quad v = f + y$ **(1mark)**

from the formula of the lens

$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ so, $\frac{1}{f} = \frac{1}{f+x} + \frac{1}{f+y}$ **(1mark)** $\frac{1}{f} = \frac{f+x+f+y}{(f+x)(f+y)}$ **(1mark)**

Therefore, $\frac{1}{f} = \frac{2f+y+x}{f^2+fy+fx+xy}$, **(1mark)**

$2f^2 + fy + fx = f^2 + fy + fx + xy$ **(0.5mark)**

$2f^2 - f^2 = fy - fy + fx - fx + xy$ **(0.5mark)**

By simplification we remain with $f^2 = xy$

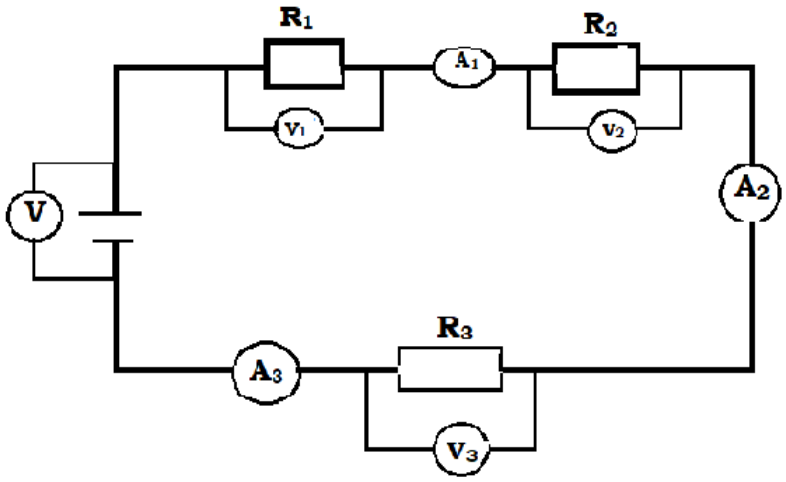
so, proved answer will be $f^2 = xy$ **(1mark)**

18.

Microscope	**Telescope**
✓ Microscope are used to magnify small objects	✓ Telescope are used to magnify large objects (planets, stars)
✓ Microscope are placed close to the small object.	✓ Telescope are situated far away from the large objects.
✓ Microscope are typically small enough to sit on the table	✓ Telescope used by professionals are often very large, resting on the ground.
✓ Small aperture(diameter of the lenses)	✓ Large aperture (the diameter of the lenses)
✓ Microscopes often use artificial light	✓ Telescope use only natural light
✓ When you want to change your view, you change lenses of microscope	✓ On a Telescope, you change eyepieces when you want to change your view.
✓ Objective lens has small focal length $d>f_o+f_e$; d: separation (in normal adjustments)	✓ Objective lens has large focal length $d>f_o+f_e$; d: separation between lenses (The final image, in normal adjustments, is at infinity)
✓ The objective image is formed in front of the focal point of the eyepiece	✓ The image is formed at focal point of the eyepiece
✓ They are made by only by lenses	✓ Some of them may use mirrors prism.

Any 8 points on each side will be marked out of 15marks

19. a)



N.B: * Each resistance drawn well with its corresponding will be awarded **1mark** and on p.d will be marked out of **1mark.** **(total marks are 4)**

* Remember that current in series remain the same **A_1=A_2=A_3**

b) The resistor is an electrical circuit component with a fixed resistance value that is used to control current through the element or potential difference (p.d) across the element **(1mark) while** the resistance is a property of a material to oppose the flow of electric current or the ratio of p.d across the terminal of an element to the electric current passing through it. **(1mark)**

c) The current through R_1 is given by:

$$I_1 = \frac{V_1}{R_1} \quad \textbf{(1mark)} \qquad I_1 = \frac{4V}{2\Omega} = 2A \quad \textbf{(1mark)}$$

d) For resistor in series, the current remains the same $I = 2A$, **(1mark)**

- ✓ $V_2 = 2A \times 3\Omega = 6V$ **(1mark)**
- ✓ $V_3 = 2A \times 4\Omega = 8V$ **(1mark)**

e) The resistors are in series: $V = V_1 + V_2 + V_3$ **(1mark)**

$$V = (4 + 6 + 8)V = 18V \quad \textbf{(1mark)}$$

f) The equivalent resistance: $R_{eq} = R_1 + R_2 + R_3$ **(1mark)**

$R_{eq} = (2 + 3 + 4) = 9\Omega$ **(1mark)** **or** $R_{eq} = \frac{V}{I} = \frac{18}{2} = 9\Omega$

20.

a) The period $T = \frac{2\pi R}{V}$ **(1mark)** $T = \frac{2\pi \times 5cm}{200\pi cm \times /60sec} = 3sec$ **(1mark)**

b) (i) The speed of the car: $V = \frac{36000m}{3600sec}$ **(1mark)** $V = 10m/sec$ **(1mark)**

(ii) The centripetal force: $F = \frac{mV^2}{R}$ **(1mark)**

$$F = \frac{2000 \times 10^2}{50} = 4000N \quad \textbf{(1mark)}$$

c) (i) At maximum height: $V_y = 0$

Time to reach the maximum height:

$0 = -9.81t + 20 \sin 25^0$ **(2marks)** $t = 0.86sec$ **(1mark)**

(ii) The maximum height

$h = \frac{1}{2} gt^2 + V_0 t \, sin\theta$ **(1mark)**

$h = -\frac{1}{2}(9.81m/s^2(0.86\,\text{sec})^2 + (20m/sec) \times (0.86\text{sec}) = 3.65m$ **(2marks)**

(iii) The time of flight of the object is $t' = 2t$ **(1mark)**

$t' = 0.86sec \times 2 = 1.72sec$ **(2marks)**

Or $0 = \frac{1}{2} gt'^2 + V_o t' \, sin\theta$

$0 = \frac{1}{2}(9.81m/s^2)(t')^2 + (20m/s) \times 0.423t')$

$\leftrightarrow \quad t' = 1.72sec$ so ***the time flight is*** $\mathbf{1.72sec}$

END!!!!!!