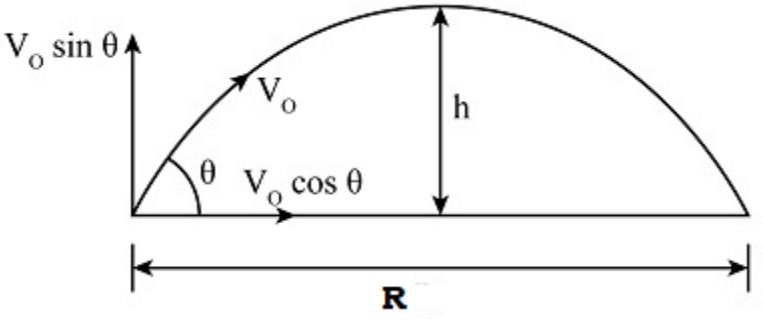
SECTION A: Attempt all questions (70marks)

1. **a)** Visual angle is the angle subtended by an object at the eye **(1mark)**
   b) Near point is the point at which the eye is able to view the object clearly with the greatest details **(1mark)**
2. **a)** One Joule of work is said to be done when a force of one Newton displaces a body through a distance of one meter in the direction of force. **(1mark)**
   b) The SI unit of Power is Watt or J/s. **(1mark)**.
   Its dimension $[M][L^2][T^{-3}]$ **(1mark)**
   c) **(3marks)**

Conservative force	**Non- conservative force**
Work done does not depends upon the path followed	Work done depends upon the path
Work done in around trip is zero	Work done in around trip is not zero
e.g: Spring force, gravitational force, etc	e.g: Friction force, air resistance, etc

3. Applications of lenses in real life:
   Eyeglasses, cameras, microscope, telescopes, Magnifying glasses, projectors, and binoculars. **(3marks)**
4. Scalar Quantities are defined as physical quantities that have magnitude or size only. For example, distance, speed, mass, density, etc. **(1.5marks)** vector quantities are those physical quantities that have both magnitude and direction. For example, displacement, velocity, acceleration, force, etc. **(1.5 marks)**
5. 

   From $s = ut + \frac{1}{2}at^2$ **(1mark)**

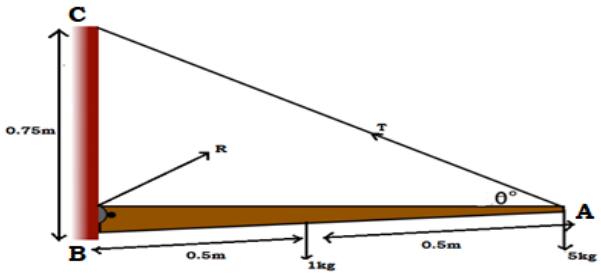
   Vertical displacement, $y = (u\sin\theta)t - \frac{1}{2}gt^2$ **(1mark)**

   At a certain point y=0 $\Rightarrow 0 = (u\sin\theta)t - \frac{1}{2}gt^2$ **(1mark)**

   Time (t) for flight $\Rightarrow t = \frac{2u\sin\theta}{g}$ **(1mark)**

6. a) .The sum of forces must be zero. **(0.5marks)**
   .The sum of the moments of the forces about a point in the anticlockwise direction is equal to the sum of the moments of the forces about the same point in the clockwise direction. **(0.5marks)**

b) i. **(1mark)**



ii. Taking moments about B

$$\Rightarrow (1kg \times 0.5) + (5kg \times 10) = T \times 1 \sin\theta$$

but $\theta = \tan^{1}\left(\frac{0.75}{1}\right) = 36.87^{0}$ **(1mark)**

$$\Rightarrow (1kg \times 0.5) + (5kg \times 10) = T \times 1 \sin 36.87$$

$$\Rightarrow T = \frac{5.5 \times 9.87}{\sin 36.87} = 89.8N$$ **(1mark)**

iii. At equilibrium. on resolving horizontally

$$\Rightarrow R\cos\theta = T\cos\theta \qquad \Rightarrow R\cos\theta = 89.8\ co\ 36.87$$ **(1mark)**

$$\Rightarrow R\sin\theta + 89.8\sin 36.87 = 6kg \Rightarrow R\sin\theta = 6kg - 89.8\sin 36.87$$

$$\Rightarrow \tan\theta = \frac{6kg - 89.9\sin 36.87}{89.8\cos 36.87} = \frac{6 \times 9.81 - 89.8\sin 36.87}{89.8\cos 36.87} = 0.069$$

$\therefore \theta = \tan^{-1} 0.06 = 3.95^{0}$ **(1mark)**

$$\Rightarrow R\cos 3.95 = 39.8\cos 36.87$$

$$\Rightarrow R = 72.01N$$ **(1mark)**

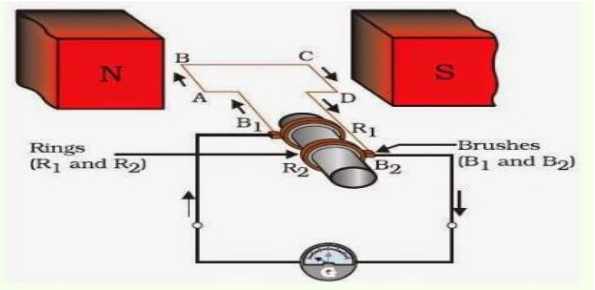
7.a) any two suggestions carry **(2marks)**

- Fossil fuels can generate a large amount of electricity at a single location.
- They can be found very easily.
- They are cost-effective.
- Transportation of oil and gas can be done easily through pipelines.
- They have become safer over time.
- Despite being a finite resource, it is available in plenty

b) (any two suggestions carry **2marks)**

- Fossil fuels are not renewable energy sources. If we do not reduce consumption, we will run out of them, very quickly. ...
- Fossil fuels pollute the environment. Fossil fuels contribute to greenhouse gases, which is one of their major disadvantages. ...
- In the case of irresponsible use, they can be dangerous.

8. A well labelled figure **/(2marks)**



To make electrical energy, the generator needs a magnetic field and a moving wire to come together. The movement of the wire through the magnetic field is mechanical energy. The force of the two coming together makes the electrons start to flow in the copper wire, thus converting the energy into electricity. **(2marks)**

9. a) Sankey diagrams are a data visualization technique or flow diagram that emphasizes flow /movement / change from one state to another in which the width of the arrows is proportional to the flow rate of the depicted extensive property. **(1mark)**

b) $\eta = \frac{2}{5} \times \% = 40\%$ **(1mark)**

c) $\eta = \frac{Pout}{Pin} \times \%$ **(1mark)**

$$40\% = \frac{400 \times 10^6}{Pin}\% \implies Pin = \frac{400 \times 10^6}{40} = 10 \times 10^6 w \quad \textbf{(1mark)}$$

10.a) $1.54 \sin 40 = n_1 \sin 50$ **(1mark)**

$\therefore n_1 = 1.29$ **(1mark)**

b) $\Rightarrow 1.29 \sin 50 = 1.44 \sin r$ **(1mark)**

$\therefore r = \sin^{-1}\left(\frac{1.29 \sin 50}{1.44}\right) = 43.33^0$ **(1mark)**

c) This means that there should be grazing emergence in Y. Suppose that the minimum angle of incidence in X is i **(1mark)**

$$i = \sin^{-1}\left(\frac{1}{1.54}\right) = 40.5^0 \quad \textbf{(1mark)}$$

11. a) But since the angles are small

$i_1 = nr_1$ similarly $i_2 = nr_2$ **(1mark)**

As the deviation $d = (i_1 - r_1) + (i_2 - r_2) = (nr_1 - r_1) + (nr_2 - r_2)$ **(1mark)**

$= (n-1)(r_1 + r_2) = (n-1)A$ **(1mark)**

b) from d=(n-1)A $\Rightarrow d_1 = (n_1 - A) \therefore d_1 = (1.52 - 1) \times 5^0 = 2.6^0$ **(1mark)**

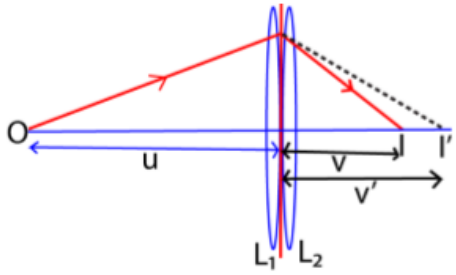
similarly $d_2 = (1.5 - 1) \times 5^0 = 2.5^0$ **(1mark)**

so angular separation $= 2.6^0 - 2.5^0 = 0.5^0$ **(1mark)**

12. a) Consider two lenses A and B of focal lengths f_1 and f_2 respectively

So for lens A from $\frac{1}{f} = \frac{1}{u} + \frac{1}{v} \Rightarrow \frac{1}{f_1} = \frac{1}{u} + \frac{1}{v'}$ **(1mark)**

Consider two thin lenses L_1 and L_2 of focal length f_1 and f_2.



For lens L_1,

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

$$\frac{1}{f_1} = \frac{1}{u} + \frac{1}{v'} \quad \text{.....(i)} \quad \textbf{(1mark)}$$

For L_2, I' acts as the object

$$\frac{1}{f_2} = \frac{1}{-v'} + \frac{1}{v} \quad \text{.....(ii)} \quad \textbf{(1mark)}$$

Eqn. (i) + Eqn. (ii)

$$\frac{1}{f_2} + \frac{1}{f_2} = \frac{1}{u} + \frac{1}{v} = \frac{1}{F}$$

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$$

Where F is the focal length of combined lens,

b) i. since A and B interchangeable then OB=IA

$\Rightarrow OB - OA = IA - AB \therefore OA = BI$

$\therefore 2\overline{OA} + 15 = 45 \Rightarrow OA = 15cm$ **(1mark)**

So if the lens is at A , u =15cm and v=30 cm and from

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v} \Rightarrow \frac{1}{f} = \frac{1}{15} + \frac{1}{30} \therefore f = 10\ cm$$ **(1mark)**

ii. $m = \frac{v}{u}$

(1mark)

At B, u=30 cm and $v = 15cm \therefore m = \frac{15}{30} = 0.5$ **(1mark)**

13.

a) $I = \frac{E}{Rtot} = \frac{1.5}{(2+28)\Omega} = 0.05A$ **(0.5marks)**

Potential drop in a battery $= Ir = 0.05 \times 2 = 0.1\,v$ **(0.5marks)**

P.d at the terminals of a battery $= v = E - Ir$ **(0.5 marks)**

$v = 1.5 - 0.1 = 1.4\,v$ **(0.5 marks)**

b) Power dissipated as heat in the battery

$P = VI = I^2 r = (0.05)^2 \times 2 = 0.005\,w$ **(1mark)**

c) Power dissipated as heat in the resistor of $28\,\Omega$

$P = I^2 R = (0.05)^2 \times 28 = 0.07\,w$ **(1mark)**

14.

Advantages of using solar cell

- ✓ The installation is not expensive **(1mark)**
- ✓ no pollution of atmosphere **(1mark)**
- ✓ solar energy is clean

Disadvantages of using solar cell:

- ✓ are used only in sun season **(1mark)**
- ✓ storage system is expensive **(1mark)**

15.

(a) R = 54m, μ = 0.3

From $v = \sqrt{\mu g r}$ **(1 mark)**

$v = \sqrt{(0.3\ x\ 9.81\ x\ 54} = 12.60 ms^{-1}$ **(1 mark)**

(b) Case (i)

Vmax = $40 kmhr^{-1} = \frac{40\ x1000}{3600} = \frac{100}{9} ms^{-1}$

r = 20m, m = 400kg

From $v = \sqrt{\mu g r}$ **(1 mark)**

$\mu = \frac{v^2}{rg} = \frac{\left[\frac{100}{9}\right]^2}{20\ x\ 9.81} = 0.629$ **(1 mark)**

Case (ii)

Vmax = $50 kmhr^{-1} = \frac{50\ x1000}{3600} = \frac{125}{9} ms^{-1}$

From $v = \sqrt{\mu g r}$

$\mu = \frac{v^2}{rg} = \frac{\left[\frac{125}{9}\right]^2}{20\ x\ 9.81} = 0.983$ **(1 mark)**

Therefore, $0.629 \leq \mu \leq 0.983$ **(1 mark)**

SECTION B: ATTEMPT ANY THREE QUESTIONS (30MARKS)

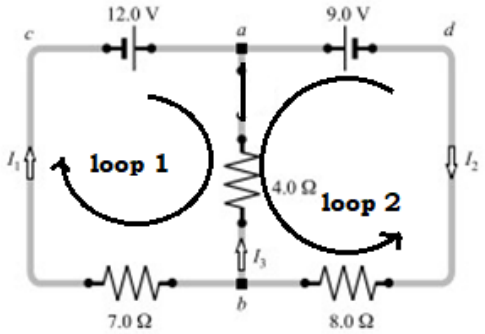
16.

a)

The algebraic sum of all the currents in any given circuit will be equal to zero. **(1mark)**

The law states that the sum of voltages in a closed loop is zero. **(1mark)**

b)



i) If the switch S is closed,

Junction a: $I_1 + I_3 = I_2$ **(1mark)**

Junction b: $I_2 = I_1 + I_3$

Loop I: $12 = 7I_1 - 4I_3$ **(1mark)**

Loop II: $-9 = -4I_3 - 8I_2$ **(1mark)**

$$\begin{cases} 12 = 7I_1 - 4I_3 \\ -9 = -4I_3 - 8I_2 \end{cases}$$

$$\begin{cases} 12 = 7I_1 - 4I_3 \\ 9 = 4I_3 + 8(I_1 + I_3) \end{cases}$$

$$\begin{cases} 12 = 7I_1 - 4I_3 \quad (3) \\ -9 = -4I_3 - 8I_2 \end{cases}$$

$$\begin{cases} 36 = 21I_1 - 12I_3 \\ 9 = 8I_1 + 12I_3 \end{cases}$$

$45 = 29I_1 \Rightarrow I_1 = \dfrac{45}{29} = 1.55A$ **(1mark)**

$12 = 7 \times 1.55 - 4I_3$

$12 - 10.85 = 4I_3$

$I_3 = -0.2875A$ **(1mark)**

$I_2 = I_1 + I_3 = 1.55 - 0.2875 = 1.2625A$ **(1mark)**

ii) Potential difference between points a and b.

Let us loop I

$V_{ab} + 12 = 7 \times 1.55 = 10.85 - 12$

$V_{ab} = 1.15v$ **(2marks)**

17.

a) Introduction (1mark)

Body (at least 4 paragraphs ideas/4x1.5marks=6marks)

Conclusion (1mark)

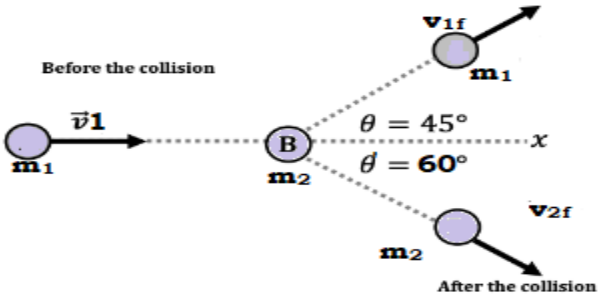
b) In a hydropower plant, the water stored in the dam has **potential energy**. When the water flows from higher altitude, the potential energy is converted **into kinetic energy**. When the flowing water rotates the turbine, the **kinetic energy is** converted into **mechanical energy. (0.5 marks for each highlighted word)**

18.

a) Comparison between elastic and inelastic collision **4marks)**

Elastic Collision	Inelastic Collision
Total momentum is conserved	Total momentum is conserved
Total kinetic energy is conserved	Total kinetic energy is not conserved
Forces involved are conservative forces	Forces involved are non-conservative forces
Mechanical energy is not dissipated.	Mechanical energy is dissipated into heat, light, sound etc.

b)



(1mark)

By considering x-direction

$m_1 v_{1i} + m_2 v_{2i} = m_1 v_1 \cos 45 + m_2 v_2 \cos 60$ **(1mark)**

for $m_1 = m_2$ and $v_{2i} = 0$

$m_1 v_{1i} = m_1 (v_1 \cos 45 + v_2 \cos 60)$

$v_1 = v_2$ **(1mark)**

$3m/s = v\left(\frac{v_2}{2} + 0.5\right)$

$3m/s = v(0.707 + 0.5)$ **(1mark)**

$3m/s = v(1.2)$

$v = 2.5 \, m/s$ **(1mark)**

Where $v_1 = v_2$ **(1mark)**

Then $v_1 = 2.5 \, m/s$ and $v_2 = 2.5 \, m/s$

19.

$\frac{1}{v}-\frac{1}{-2.4}=\frac{1}{2}$ **for** $v=12cm$

So that $m=\frac{v}{u}=\frac{12}{-2.4}=-5$

a) If the final image is at infinite (far point)

for eyepiece, $\frac{1}{\infty}-\frac{1}{u_e}=\frac{1}{5}$ **(1mark)**

$\frac{1}{u_e}=-5cm$ and **(1mark)**

$m_e=\frac{D}{f_e}=\frac{25}{5}=-5cm$ **(1mark)**

And $m_0=\frac{D}{f_e}=\frac{25}{5}=5$ **(1mark)**

So $m=m_e\times m_o=-5\times 5=-25$ **(1mark)**

b) If the final image is at D (near point)

For the eyepiece $\frac{1}{-25}-\frac{1}{u_e}=\frac{1}{5}$ **(1mark)**

$u_e=\frac{-25}{6}=-4.17\ cm$ **(1mark)**

And $m_e=1+\frac{D}{f_e}=1+\frac{25}{5}=6$ **(1mark)**

So, $mp=m\times m_o=-5\times 6=-30$ **(1mark)**

And $L=v+u_e=12+4.17=16.17\ cm$ **(1mark)**

In this situation eye is said to be strained and for a given microscope MP is maximum while length of tube is minimum.

20.

a) $t=\frac{vo\sin\theta}{g}=\frac{20\sin 25}{9.81}=0.86\sec$ **(1mark)**

$y=H\max=vo\sin\theta\, t-\frac{1}{2}gt^2$ for time $t=0.86\sec$ **(1mark)**

$H\max=20\sin 25-\frac{1}{2}\times 9.81\times(0.86)^2=3.64\ m$ **(1mark)**

b) $tf=\frac{2vo\sin\theta}{g}$ **1mark)**

$tf=\frac{2\times 20\times\sin 25}{9.81}=1.72\sec$ **(1mark)**

c) $R=vo\cos(\theta)\times tf$ **(1mark)**

$R=20\times\cos 25\times 1.72=31.26\ m$ **(1mark)**

d) $v_x=vo\cos(\theta)=20\times\cos(25)=18.12\ m/s$ **(1mark)**

$v_y=vo\sin(\theta)=20\times\sin(25)=8.45\ m/s$ **(1mark)**

$v=\sqrt{v_x^2+v_y^2}=\sqrt{(18.12)^2+(8.45)^2}$ **(1mark**

.....*End*.....