RUTSIRO DISTRICT

MARKING GUIDE S4 PHYSICS THEORY TERM II, 2023 -2024

SECTION A: ATTEMPT ALL QUESTIONS (70 MARKS)

1) a)Without deviation **(1mark)** undeflected, undeviated

b) Dispersion **(1mark)** or refraction towards the base of prism

c) Real **(1mark)** magnified and inverted

2) d (2 marks)

3) c (2 marks)

4) d (2 marks)

5) a. True (T) (2marks)

b. False (F) (2marks)

c. True (T) (2marks)

d. False (F) (2marks)

e. False (F) (2marks)

6) b (2marks)

7) a)(i)unstable equilibrium **(1mark)**

(ii) Neutral equilibrium **(1mark)**

(iii) Stable equilibrium **(1mark)**

b) 300 x =120x30 **(1mark)**

x= 12 cm **(1mark)**

8) a) defects	**Correction**
Nearsightedness (or myopia)	**use of diverging lens (1mark)**
Hypermetropia (Long –sightedness)	**use of converging lens (1mark)**
Astigmatism	**wearing corrective lenes (1mark)**
Presbyopia	**converging lenses. (1mark)**

b) Near point of the person is 1 m , it means that he can see an object kept at 25 cm clearly only if image formed of this object by corrective lens is at 1 m.

Using Sign convention rules we consider

u=−25cm as image is formed real we are using minus sign **(0.5mark)**

v=−1m=−100cm (0.5mark)

So 1/f=(1/v) − (1/u) (0.5mark)

1/f=(1/−100) − (1/−25)

so f= (100/3) cm=(1/3)m (0.5mark)

Power P=(1/f)=1/(1/3)=3D (1mark)

9) If the final image is at infinity, the objective forms an image at the focal point of the eye piece.

Let f_e be the focal length of the eye piece and f_0 of the objective

The position of an image of l_o from L_o = separation – focal length of eye piece **(1mark)**

ve = (22.1 – 2.50) cm

v_e = 19.5cm

Magnifying power $M = D/f_e (v_e/f_o – 1)$ **(1mark)**

But for a normal eye, D = 25cm **(1mark)**

Thus M = 25/2.5 (19.5/1.6 – 1) =111.8 **(1mark)**

10) a) $\omega = \phi/t$**(1 mark)**where ϕ is angular displacement

$\omega = (2\pi /40)$ rad/s = 0.157 rad.s−1 **(1mark)**

b) v = ω.r **(1mark)**

v = 0.157 × 2.5 = 0.39 m.s−1 **(1 mark)**

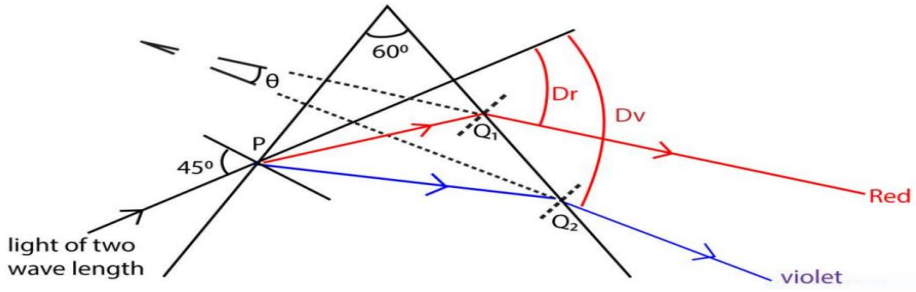
11) a) The degradation of energy is the process by which energy becomes less available for doing work.

b) Electric energy is transformed into heat and light

c) A turbine converts the kinetic energy of falling water from the dam into mechanical energy, then a generator connected to the turbine converts the mechanical energy from the turbine into electrical energy.

12) a) i) Total internal reflection is the bouncing back of all incident light into the more dense medium when the angle of incidence exceeds the critical angle for a ray originally travelling from the more dense to a lens dense medium.

ii) Critical angle is the angle of incidence in more optically denser medium for which the angle of refraction in the less dense medium is 90^0.



b) **(1mark for drawing)**

Case I: Consider the deviation suffered by red light At P, Snell's law becomes . na sin 45° = 1·64 sin r_1 ∴ r_1 = 25·54° But $r_1 + r_2 = 60° \Rightarrow r_2 = 60° - r_1 = 60° - 25·54°$ ∴ r_2 = 34·46° **(0.5 mark)**

At Q1, Snell's law becomes na sin i_2 = 1·64 sin 34·46° ∴ i_2 = 68·13°. **(0.5 mark)**

Total Deviation Dr = $d_2 + d_1$ where $d_1 = i_1 - r_1$ and $d_2 = i_2 - r_2 \Rightarrow$

Dr = (45° – 25·54°) + (68·13° – 34·46°) ∴ Dr = 53·13° **(1mark)**

Case II: Consider the deviation suffered by violet light At P, Snell's law becomes . na sin 45° = 1·66 sin r_1 ∴ r_1 = 25·21° But $r_1 + r_2 = 60° \Rightarrow r_2 = 60° - r_1 = 60° - 25·21°$ ∴ r_2 = 34·79° **(0.5 mark)**

At Q, Snell's law becomes na sin i_2 = 1·66 sin 34·79° ∴ i_2 = 71·28°. **(0.5 mark)**

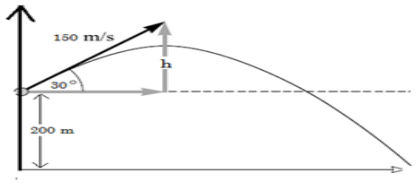
Total Deviation Dv = $d_2 + d_1$ where $d_1 = i_1 - r_1$ and $d_2 = i_2 - r_2 \Rightarrow$

Dv = (45° – 25·21°) + (71·28° – 34·79°) ∴ Dv = 56·28°. **(1mark)**

Thus required angular separation θ = Dv – Dr

θ = 56·28° – 53·13° ⇒ θ =3·15° **(1mark)**

13)



$$h = \frac{u^2 \sin^2\theta}{2g} = \frac{(150)^2 \sin^2 30}{2\times 9.81} = 286.69\,m$$

i) Maximum height $H = 200 + 286.69 = 486.69\,m$

ii) $y = -\frac{1}{2}at^2 + v_0 \sin\theta t$

$$-200m = -\frac{1}{2}(9.81)(t)^2 + 150\sin t$$

$$t = 4.52\,s$$

14) a) - During an elastic collision, the interacting bodies separate after interaction and there is conservation of total kinetic energy.
- During inelastic collision, there is bouncing after interaction and there is loss of kinetic energy.

b) Let p1 be the linear momentum of the two balls before collision.

P2 be the linear momentum of the two balls after collision

P1 = $m_A V_A + m_B V_B$ **(1mark**) =0.100 x10 kgm/s=1 kgm/s **(1mark)**

P2=(0.100+0.700)v **(1mark)** Inelastic collision Principle of conservation of linear momentum (0.100+0.700)v=1

V=1.25 m/s **(1mark)**

15) a)work: is defined as the product of the force and the distance moved in the direction of the force

b) The work done on the object during each 2.00 s interval can be calculated using W = Faverage d, which is equivalent to calculating the area under the graph for that section. The work done in each interval; is as follows: 0 – 2 s: Faverage = (0N + 8N)/2 = 4 N d = 2 m Work = 8 J

2 – 4 s: Faverage = (8N + 12N)/2 = 10 N d = 2 m Work = 20 J

4 – 6 s: Faverage = (12N + 12N)/2 = 12 N d = 2 m Work = 24 J

6 – 8s: Faverage = (12N + 6N)/2 = 9 N d = 2 m Work = 18 J

8 – 10 s: Faverage = (6N + 6N)/2 = 6 N d = 2 m Work = 12 J

i) During the 10.0 m of displacement a total of 82.0 J of work was done on the object.

Wnet = $\Delta K = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$ v==5.23 m/s (**4marks)**

ii) During the first 6.0 m of displacement a total of 52 J of work was done of the object.

Wnet = $\Delta K = \frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$ v ==6.51 m/s (**2marks)**

SECTION B: ATTEMPT ONLY THREE QUESTIONS (30 marks)

16) a) Net force is equal to zero **(1mark)** or

$\sum F_{ext} = 0$ Algebraic sum of x and y components of the external forces applied to the object must be equal to 0 respectively.

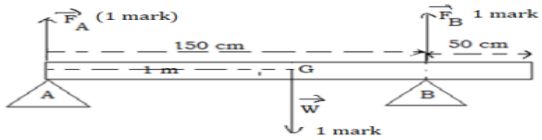
Net torque is equal to zero **(1mark)**

$\sum \tau = 0$ .The algebraic sum of the clockwise torques is equal to the algebraic sum of the counterclockwise torques.

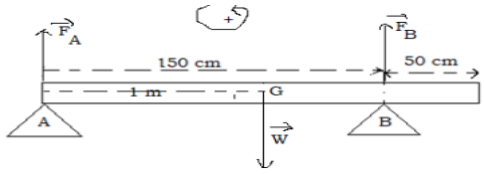
b) (i) Centre of gravity **(1mark)**

(ii)1m from the extremity A of the board **(1mark)**

(ii)Direction of forces (see the marks on figure) (**2marks)**



(iv)Torque is positive in anticlockwise direction and the reference point is the support A.



Torque of the support force $\vec{F}A$ with respect to point A

$\tau A = 0 x FA = 0$

Torque of the support force $\vec{F}B$ with respect to point A

$\tau B = 1.5 x FB$ **(1 mark)**

Torque of the weight *W* with respect to point A

$\tau w = -1 x 240 Nm = -240 Nm$ **(1 mark)**

$\sum \tau = 0$, $1.5\ F_B - 240 = 0$

$F_B = 240N/1.5 = 160\ N$ **(1mark)**

$\sum F = 0$, $F_A + F_B - 240N = 0$

$F_A = 240 - 160N = 80N$ **(1mark)**

17) (a) A is any object that is thrown or cast or fired or launched or projected forward into space (empty or not) by a force. Projectile motion is the motion which projectile execute.
(1mark)

(b) (i) $T = \frac{2V0 \sin \alpha}{g}$ (**1marrk)**

$$T = \frac{2X800Xsin60}{9.8}$$

T = 141.4 sec

(ii) $R = \frac{V_0^2 \sin 2\alpha}{g}$ **(1mark)**

$$R = \frac{800X800Xsin2X60}{9.8}$$ **(1mark)**

R = 5.6568X10^4 m

(ii) t = T/2 **(1mark)**

T= 141.4/2 =70.7sec

c)

a) We know that: $R = \frac{u^2 sin2\alpha}{g}$, $h = \frac{u^2 sin^2\alpha}{2g}$ and $T = \frac{2usin\alpha}{g}$ **(1mark)**

$\frac{h}{R} = \frac{\frac{u^2 \sin^2 \alpha}{2g}}{\frac{u^2 \sin 2\alpha}{g}} = \frac{u^2 \sin^2 \alpha}{2u^2 \sin 2\alpha} = \frac{\sin \alpha . \sin \alpha}{2(2 \sin \alpha \cos \alpha)} = \frac{\sin \alpha}{4 \cos \alpha}$ **(1mark)**

$\frac{h}{R} = \frac{\tan \alpha}{4}$ by cross-multiplication we get, $\tan \alpha = \frac{4h}{R}$ ***what is proved*** $\Longrightarrow$ $\tan \alpha = \frac{4h}{R}$ **(1mark)**

b) $\frac{h}{T^2} = \frac{\frac{u^2 \sin^2 \alpha}{2g}}{\left(\frac{2usin\alpha}{g}\right)^2} = \frac{u^2 sin^\alpha}{2g} \times \frac{g^2}{4usin^2\alpha}$, therefore $\frac{h}{T^2} = \frac{g}{8}$ **(1mark)**

what is proved $\Longrightarrow$ $h = \frac{gT^2}{8}$ **(1mark)**

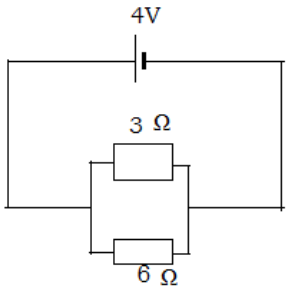
18) a) **Kirchhoff's current law(Junction rule)**

The algebraic sum of all currents entering a circuit's junction and leaving the same junction must be equal to zero **(1mark)**

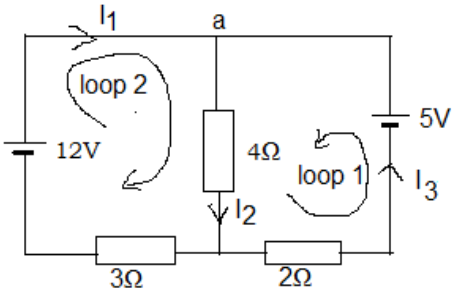
Kirchhoff's voltage law (Loop rule)

The algebraic sum of all voltages around any closed loop in an electric circuit must be equal zero**(1mark)**

b)Labelled and well drawn circuit **(2 marks)**



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



Loop 1: $5-4I_2-2I_3=0$ (2) (**1mark)**

Loop 2: $12-4I_2-3I_1=0$ (3)**(1mark)**

Substitute (1) into (2) and (3)

$5-4(I_1+I_3)-2I_3=0$ (4)

$12-4(I_1+I_3)-3I_1=0$ (5)

$5-4I_1-6I_3=0$ (6)

$12-7I_1-4I_3=0$ (7)

Multiply (6) by -2 and (7) by 3

$-10+8I_1+12I_3=0$ (8)

$36-21I_1-12I_3=0$ (9)

Adding (8) and (9) member by member gives $26-13I_1=0$

Then $I_1 = \frac{26}{13} A = 2A$ **(1 mark)**

Use (7) to determine I_3

$12-7x2-4I_3 = 0$

$$I_3 = -\frac{2}{4} A = -0.5A$$ **(1mark)**

$I_2=I_1+I_3$

$=2\ A-0.5A=1.5\ A$ **(1mark)**

19) a) (i)

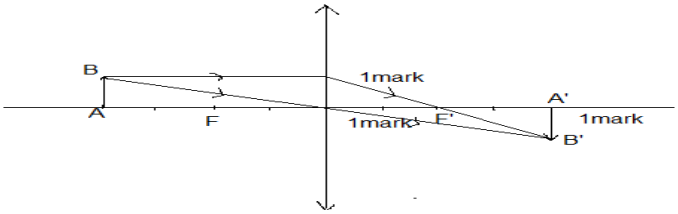


Image position p'=4 cm **(1mark)**

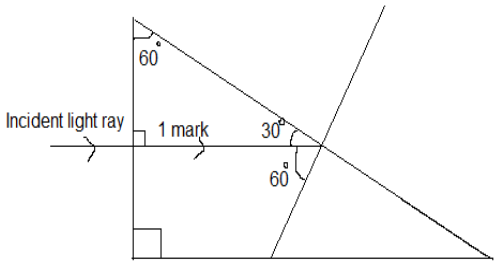
(ii)Measurement of the size of the image A'B' is 1 cm

(0.5 marks)

(iii) Image is real **(0.5mark)** inverted **(0.5mark)**

b) (i) It passes without deviation **.**Angle of incidence is 0

thus the angle of refraction is 0



(ii) Angle of incidence is 90°- 30°=60° **(1mark)**

(iii) The critical angle c is given by $\sin c = \frac{1}{1.5}$ **(1mark)**

c =41.8° **(1mark)**

(iv)It will undergo the total internal reflection **(0.5mark)**

The angle of incidence is greater than the critical angle

and the light ray passes from a more dense medium

to the less dense medium **(1mark)**

20) Students should use essay form and should be marked as instructed

The meaning of global warming Global warming is gradual increase in the overall temperature of the earth's atmosphere generally attributed to the greenhouse effect **(1mark)** caused by the increased levels of carbon dioxide, CFCs and other pollutants **(1mark)** resulting to the climate change.

Causes of global warming.

➢ The reduction of ice/snow cover due to global warming, which reduces albedo and increases the rate of heat absorption. **(1mark)**

➢ Reductions in the solubility of carbon dioxide in the sea due to increases in temperature, which increase atmospheric carbon dioxide concentrations. **(1mark)**

➢ Deforestation reduces carbon fixation by plans, which in turn increases carbon dioxide concentrations. **(1mark)**

➢ The natural rotation of the sun which changes the intensity of solar radiation hitting the earth **(1mark)**

➢ Natural processes such as volcanoes produce a large amount of Sulphur dioxide. **(1mark)**

➢ The release of methane from the cracks in the earth, landfill sites and through natural gas leaks. **(1mark)**

➢ The methane has an effect on the atmosphere which four times as bad for global warming as carbon dioxide. **(1mark)**

The world needs to change from this current situation on the use of non-renewable energy resources that cause global warming. The use of oil and coal must be replaced with all kinds of alternative energy sources. **(1mark)** One of the solutions is using biodiesel or bio-fuel made of waste from croplands. **(1mark)**

(Other correct 6points can be considered given by the students and mark it on 6marks)