REPUBLIC OF RWANDA

SOUTHERN PROVINCE
NYANZA DISTRICT
E-mail: nyanzadistrict@nyanza.gov.rw

PHYSICS EXAMINATION
Monday, March, 18/03/2024
Time: 9.00 AM - 12.00 PM

SUBJECT: **PHYSICS II**
CLASS: **SENIOR 4**
DURATION: **3 HOURS**
COMBINATIONS:

- **PHYSICS-CHEMISTRY-MATHEMATICS (PCM)**
- **MATHEMATICS-PHYSICS-COMPUTER SCIENCES (MPC)**
- **PHYSICS-CHEMISTRY-BIOLOGY (PCB)**
- **MATHEMATICS-PHYSICS-GEOGRAPHY (MPG)**
- **PHYSICS- ECONOMICS-MATHEMATICS (PEM)**
- **ASSOCIATED NURSING PROGRAM (ANP)**

INSTRUCTIONS:

This exam contains two section (A&B):
Section A: Attempt all questions **(70Marks)**
Section B: Attempt any three questions. **(30Marks)**

Section A: Attempt all questions (70Marks)

1. What is mean by a) Visual angle **(1mark)**
b) Near point. **(1mark)**

2. a) Define a Joule **(1mark)**
b) Give SI unit of Power and its dimension **(2marks)**
c) Differentiate conservative force and non-conservative force (**3marks)**

3. Suggest any six applications of lenses in real life (**3marks)**

4. Distinguish between scalar and vector quantities by giving two examples for each. **(3marks)**

5. A projectile is fired in air with a speed $u\ m/s$ at an angle θ to the horizontal. Find the time for flight of the projectile. **(4marks)**

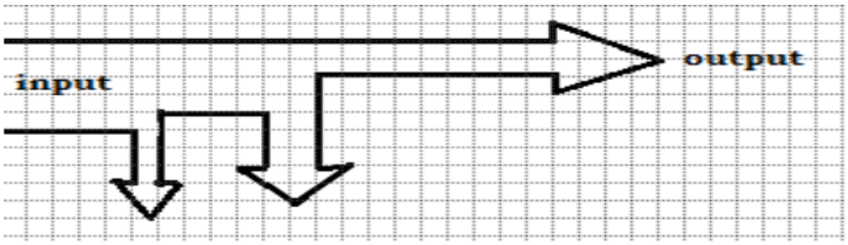
6. a) State the conditions for equilibrium of a rigid body under the action of coplanar forces. **(1mark)**
b) A mass of 5kg is suspended from the end A of a uniform beam of mass 1kg and length 1m. The end B of the beam is hinged in a wall. The beam is kept horizontally by a rope attached to A and to a point C, in the wall at a height 0.75m above B.

i. Draw a sketch diagram to show the forces acting on the beam **(1mark)**
ii. Calculate the tension in the rope (**2marks)**
iii. What is the exerted by hinge on the beam? **(3 marks)**

7. a) What main advantages do fossil fuels have over the renewable energy resources? **(2marks)**
b) What are two main disadvantages of fossil fuels compared to renewable energy? (**2marks)**

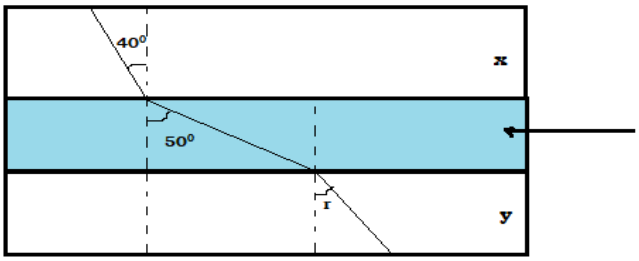
8. Explain how electric generator works. **(4marks)**

9. a) What is the Sankey diagram? **(1mark)**
b) What is the efficiency of a system whose Sankey diagram is shown below? **(1mark)**



c). If the power output is 400 MW. Calculate the power input of the system. (**2marks)**

10. The figure below shows a layer of liquid confined between two transparent plates x and y of refractive indices 1.54 and 1.44, respectively. A ray of monochromatic light making an angle 40^0 with normal to the interface between medium X and the liquid is refracted through an angle of 50^0 by the liquid.



Find the:

a) Refractive index of the liquid. **(2marks)**

b) Angle of refraction, r in the medium Y. **(2marks)**

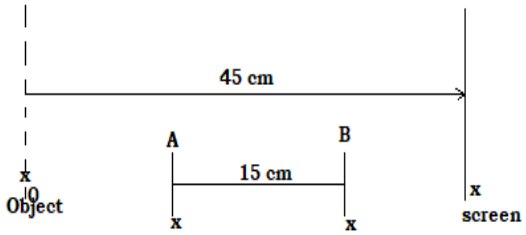
c) Minimum angle of incidence in medium X for which the light will not emerge from the medium Y. **(2marks)**

11. a) A ray of monochromatic light is incident at a small angle of incidence on a small angle prism in air. Obtain the expression $d = (n-1)A$ for the deviation of the light by the prism. **(3marks)**

b) Light of two wavelengths is incident at a small angle on a thin prism of refracting angle 5^0 and refractive indices 1.52 and 1.5 for two wavelengths. Find the angular separation of the two wavelengths after refraction by the prism. **(3marks)**

12. a) Derive the expression for the focal length of a combination of two thin converging lenses in contact, in terms of their focal lengths. **(3marks)**

b)



In the diagram in figure above, the image of the object is formed on the screen when a convex lens is placed either at A or B. If A and B are 15 cm apart, find

i) Focal length of the lens. **(2marks)**

ii) Magnification of the image formed when the lens is at B. **(2marks)**

13. An electric cell of emf 1.5V and internal resistance 2Ω is connected in series with a resistance of 28Ω. Calculate

a) The potential difference at the terminals of the battery. **(2 marks)**

b) The power dissipated as heat in the battery. **(1mark)**

c) The power dissipated as heat in the 28 Ω resistor. **(1 mark)**

14. The sun is the biggest source of energy in our environment. Energy given off by the sun is called solar energy. This energy is produced by nuclear fusion reactions on the sun and solar energy is in form of heat and light. Light from the sun can be used to make electricity where the solar cell is used in this conversion.
List the two advantages and two disadvantages of using solar cell. **(4marks)**

15. a) A bend on a level road forms a circular arc of radius 54m.
Find the highest speed at which the car can travel around the bend without slipping. The coefficient of friction between the car tyres and the road surface is 0.3. **(2 marks)**

b) A car of mass 400kg turns a corner at 40km/h without skidding, but at 50km/h, it skids off. If the corner forms an arc of radius 20m, find the values between which the coefficient of friction between the wheels and the road surface lies. **(4marks)**

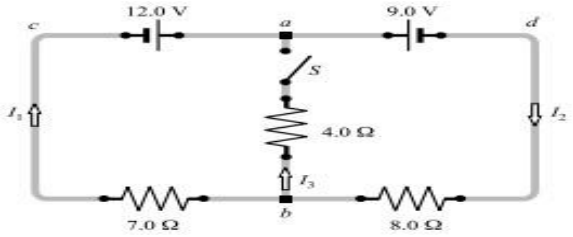
SECTION B: ATTEMPT ANY THREE QUESTIONS (30marks)

16. a) State Kirchhoff's rules. **(2 marks)**

b) Analyze the circuit diagram below and

i) Find the currents I_1, I_2, and I_3 if the switch S is closed. **(6marks)**

ii) Calculate the potential difference between point a and b as shown in figure. (**2marks)**



17. Energy in water can be harnessed and used. Since water is about 800 times denser than air, even a slow flowing stream of water, or moderate sea swell, can yield considerable amounts of energy.

Hydroelectricity is the term referring to electricity generated by hydropower; the production of electrical power through the use of the kinetic energy of falling or flowing water. It is the most widely used form of renewable energy, accounting for 16% of global electricity consumption.

a) Use essay form and discuss the contribution of water energy to the economic development of Rwanda **(8marks)**

b) Discuss the energy changes while hydroelectric power plant is working. **(2marks)**

18. a) By using a table, compare elastic and inelastic collision. **(4marks)**

b) A billiard ball moving with speed $u_1 = 3$ m/s in the x- direction sticks on equal mass ball initially at rest. The two balls are observed to move off at an angle 45^0 and 60^0 ball 1 above the x-axis and ball 2 below respectively. Find the velocities of two balls after collision. **(6marks)**

19. A compound microscope has an objective of focal length 2cm and an eyepiece of focal length 5cm. If an object is placed at a distance of 2.4cm in front of the field lens, find the magnifying power of the instrument and length of the tube if

a) Final image is at infinity. **(5marks)**

b) Final image is at least distance of distinct vision (25cm) **(5marks)**

20. An object is launched at a velocity of 20m/s in a direction making an angle of 20^0 upward with the horizontal .

a) What is the maximum height reached by the object? **(3marks)**

b) What is the total flight time (between launch and touching the ground) of the object? **(2marks)**

c) What is the horizontal range (maximum x above ground) of the object? **(2marks)**

d) What is the magnitude of the velocity of the object just before it hits the ground? **(3marks)**

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