ADVANCED PHYSICS
SENIOR FOUR
DURATION: 3hours

MUSANZE DISTRICT
ACADEMIC YEAR: 2023-2024
SECOND TERM

DISTRICT COMPREHENSIVE ASSESSMENT, 2023-2024

SUBJECT: PHYSICS THEORY EXAM/100marks

COMBINATIONS:
PHYSICS-CHEMISTRY MATHEMATICS (PCM), MATH-PHYSICS-COMPUTER SCIENCE (MPC)
PHYSICS-CHEMISTRY-BIOLOGY (PCB), MATH- PHYSICS- GEOGRAPHY (MPG)
PHYSICS- ECONOMICS- MATH (PEM)

INSTRUCTIONS

- ✓ This paper consists of two sections:

SECTION A: Attempt all questions **(70marks)**
SECTION B: Attempt only three (3) questions of your choice **(30marks)**

- ✓ Non programmable scientific calculators and mathematical sets may be used where appropriate
- ✓ Use only a blue or black pen

ADVICE

- ✓ Read every question carefully before you start to answer it.
- ✓ Try to answer every question.
- ✓ Check your answers if you have time at the end.
- ✓ Look at the marks as a guide to how much time to spend on each question.
- ✓

USEFUL CONSTANTS:

- ✓ Acceleration due to gravity g= $10ms^{-2}$
- ✓ Index of refraction of light in air $n_a = 1$

1. **/6marks**

a) Explain what is meant by a virtual image, in geometrical optics?

b) Illustrate your answer by describing the formation of a virtual image of real object by a thin converging lens. Draw a ray diagram showing the passage of two rays through the lens for a non-axial object point.

c) Explain why such a lens can be used as a simple microscope.

2. **/6marks**

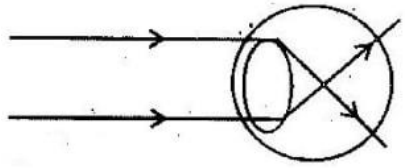
a) What is meant by Power of the lens.

b) Find the power of the combination of convex lens of focal length 50cm in contact with a concave lens of focal length 40cm.

c) Is the combination sub (a) act as converging or diverging lens

3. State two advantages and two disadvantages of using solar cells to generate electrical power. **/4marks**

4. The figure below shows how a distant object is focused in a defective eye.



a. State the nature of the defect. **/1.5marks**

b. Suggest suitable lens to correct the defect. **/1.5marks**

5. A converging lens forms a virtual image of a real object that is two times the objects size. The converging lens is replaced with a diverging lens having the same size focal length. What is the magnification of the image formed by the diverging lens? **/5marks**

6. **/6marks**

a) State the law of conservation of momentum

b) An object of mass 0.16kg is moving forwards at a speed of 0.50m/s. A second object of mass 0.10kg is at rest. The first object strikes the second object. After the collision, the second object moves forwards at a speed of 0.50m/ s. What is the speed of the first object after the collision?

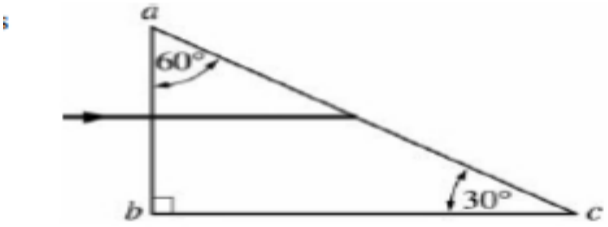
7. A ray of light in air is incident on a 30-°60°-90° prism, perpendicular to face ab, as shown in the diagram. The ray enters the prism and strikes face ac at the critical angle. **/6marks**

a) What is meant by critical angle

b) What does it mean index of refraction of prism is 1.5

c) What is the index of refraction of the prism?

d) Show the path followed by light in that prism



8. **/6marks**

a) Under which conditions a body is said to be in equilibrium

b) 1-kg rock is suspended by a massless string from one end of a 1-m uniform measuring stick. What is the weight of the measuring stick if it is balanced by a support force at the 0.25-m mark?



9. Suppose a uniform beam of length L =1.0 m and mass m = 2.0 kg is balanced on a pivot point, placed directly beneath the center of the beam. We place body 1 with mass m_1= 0.3 kg a distance d_1 = 0.4 m to the left of the pivot point, and a second body 2 with m_1= 0.6 kg a distance d_2 to the left of the pivot point, such that the beam neither translates nor rotates. **/7marks**

a) Draw a free-body diagram

b) What is the force F-pivot that the pivot exerts on the beam?

c) What is the distance d_2 that maintains static equilibrium?

10. **/7marks**

(a) Complete the sentences using words from the box.

chemical	heat	kinetic	light	sound

i) The panel of solar cells transforms ..... energy into electrical energy.

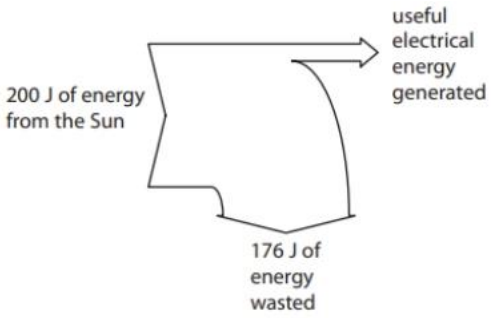
ii) The wind turbine transforms ..... energy into electrical energy

(b) On a windy day, the wind turbine transfers 78 W of power.

i) State the equation linking power, energy transferred and time.

ii) Calculate the amount of energy the turbine transfers in 10 s.

(c) The Sankey diagram shows the energy transferred by the panel of solar cells.



Calculate the efficiency of the panel of solar cells.

Comment on the results obtained.

11. Body of mass 2kg initially at rest moves under the action of an applied horizontal force of 7N on a table with coefficient of kinetic 0.1.State and Calculate

i) Work-energy theorem **/2marks**

ii) the work done by the net force on the body in 10s. **/3.5marks**

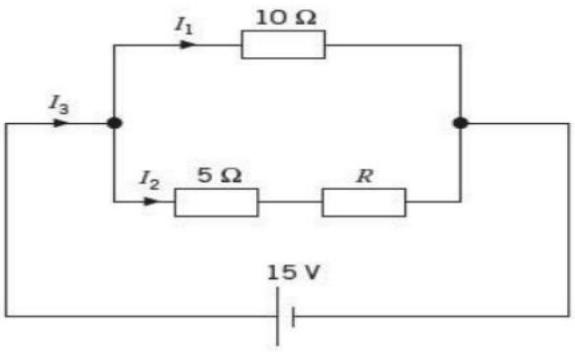
iii) Change in kinetic energy of the body in 10s and interpret your results. **/2.5marks**

12. In the circuit below the currents I_1 and I_2 are equal. **/7marks**

a) What is meant by Resistance

b) Calculate the resistance R of the unknown resistor and

c) The total current I_3



SECTION B: **Attempt only three/ each question carry 10marks**

13.
a) Explain the difference between the terms angular magnification and linear magnification, as used about optical systems.
b) Illustrate this, by calculating both, in the case of an object placed 5.0cm from a simple magnifying glass of length 6.0cm, assuming that the minimum distance of distinct vision for the observer is 25cm.
c) The objective and the eyepiece of a microscope may be treated as thin lenses with local length of 2.0cm and 5.0cm respectively. If the distance between them is 15cm and the final image is formed 25cm from the eyepiece, calculate the position of the object

14. A block of mass 1.6 kg is attached to a horizontal spring that has a force constant of 1.0x 10^3 N/m. The spring is compressed 2.0 cm and is then released from rest. State and calculate:
a) States Hooke's law
b) Calculate the speed of the block as it passes through the equilibrium position x =0 if the surface is frictionless.
c) Calculate the speed of the block as it passes through the equilibrium position if a constant friction force of 4.0 N retards its motion from the moment it is released.
d) What if the friction force were increased to 10.0 N? What is the block's speed at **x** =0?

15. A stone is thrown from the top of a building upward at an angle of 30.0° to the horizontal with an initial speed of 20.0 m/s. If the height of the building is 45.0 m,
a) What is meant by time of flight
b) How long does it take the stone to reach the ground?
c) What is the speed of the stone just before it strikes the ground?
d) How far does the stone strike the ground from the bottom of the building

16. A uniform horizontal beam with a length of 8.00 m and a weight of 200 N is attached to a wall by a pin connection. Its far end is supported

by a cable that makes an angle of 53.0° with the beam. If a 600-N person stands 2.00 m from the wall, find and draw:

a) The free-body diagram

b) The tension in the cable

c) The magnitude and direction of the force exerted by the wall on the beam.

17.

a) States Kirchhoff's laws

b) Find the currents I_1 , I_2 , and I_3 in the circuit shiown in below

