

FORM FIVE TERMINAL EXAMINATION

PHYSICS 1

Time: 3:00 Hours **1st DECEMBER 2022**

INSTRUCTIONS

1. This paper consists of Section A and B with a total of nine (9) questions.
2. Answer **ALL** questions in both sections A and B.
3. Section **A** carries seventy (70) marks and Section **B** carries thirty (30) marks
4. Mathematical tables and non-programmable calculators may be used.
5. Cellular phones and any authorized materials are not allowed in the examination room.
6. The following information may be useful:
 - a) Acceleration due to gravity, $g = 9.8 \text{ m/s}^2$
 - b) Density of water $\rho = 1000 \text{ kg/m}^3$

SECTION A (70 MARKS)

Answer **ALL** question from this section.

- 1.a) i. Give two basic rules of dimensional analysis. **02 marks**
- ii. Mention two applications and two limitations of dimensional analysis. **02 marks**
- b) The frequency 'f' of a note given by an organ pipe depends on the length 'l' the air pressure 'p' and the air density D. use the method of dimension to find the formula for the frequency. What will be the new frequency of a pipe whose original frequency was 256 Hz if the air density falls by 2% and the pressure increases by 1%. **06 marks**
2. (a) i. Distinguish random error from systematic error. **02 marks**
- ii. The diameter of steel wire is $(0.28 \pm 0.01)\text{mm}$ what does it mean? **02 marks**
- (b) The coefficient of viscosity of a liquid found by using stoke's law is given by

$$\eta = \frac{2gr^2}{9\nu}(\rho_s - \rho_l)$$

Where;

density of steel ball, $\rho_s = (7800 \pm 1.00)\text{kgm}^{-3}$,

density of liquid, $\rho_l = (1260 \pm 1.00)\text{kgm}^{-3}$,

the velocity of steel ball, $v = (1 \pm 0.01)\text{ms}^{-1}$,

radius of steel ball, $r = (6.35 \pm 0.005)\text{mm}$,

and acceleration due to gravity, $g = 9.8 \text{ m/s}^2$

Calculate the experiment value of ' η' '

06 marks

3. a) i. Briefly explain why the horizontal components of the initial velocity of a projectile always remains constant. **02 marks**
- ii. List down two main assumptions in deriving the equation of projectile motion.
02 marks

- b) A basketball released the ball 2.10m above the floor when he is 9.0m from the basket. the ball goes through the rim of the basket which is 3.0m above the floor, 1.50 seconds after release. Find the initial velocity and the maximum height above the floor reached by the ball.
06 marks
4. a) (i) Explain why when catching a fastmoving ball, the hands are drawn back when the ball is being brought to rest. **02 marks**
- (ii) States Newton's laws which are used to derive the principle of conservation of linear momentum. **02 marks**
- b) A block is released from rest from a height 1.0m on a 45° rough inclined surface. It comes to rest after covering 3.0m on the horizontal part of the surface. find the coefficient of friction between the block and the surface. **06 marks**
5. a) (i) State the principle on which the rocket propulsion is based. **01 marks**
- (ii) Suppose that $2.1 \times 10^6 \text{kg}$ of fuel are consumed during burn lasting 1.5×10^2 seconds and given that there is a constant force on the rocket of $3.4 \times 10^7 \text{N}$ during this burn, calculate the initial vertical acceleration that can be imparted to this rocket when it is launched from rest. The rocket has a total mass, $m_0 = 2.8 \times 10^6 \text{ kg}$. **05 marks**
- b) A particle of mass 2.0kg strikes a fixed smooth plane while moving at a speed of 24ms^{-1} in a direction making an angle of 30° with the plane, if the coefficient of restitution between the particle and the plane is $\frac{1}{4}$, find the speed and direction at which the particle rebounds. **04 marks**
6. (a) What is the origin of centripetal force for;
- (i) A satellite orbiting around the earth. **01 mark**
- (ii) An electron in the hydrogen atom. **01 mark**
- (iii) Stone tied to a string. **01 mark**
- (iv) Car turning in a circular track. **01 mark**
- b) (i) Why there must be a force acting on a particle moving with uniform speed in a circular path? Write down an expression for its magnitude. **02 marks**
- (ii) Derive the expression $a = \frac{v^2}{r}$ where a , v and r stand for the centripetal acceleration, linear velocity and radius of circular path respectively. **04 marks**
7. a) (i) Briefly explain why the motion of a simple pendulum is not strictly simple harmonic. **02 marks**
- (ii) Why the velocity and acceleration of a body executing simple harmonic motion are out of phase? **02 marks**
- b) Two simple pendulums of length 0.4m and 0.6m respectively are set oscillating in step
- (i) After what further time will the two pendulums be in step again? **02 marks**
- (ii) Find the number of oscillations made by each pendulum during by the time found above? **02 marks**

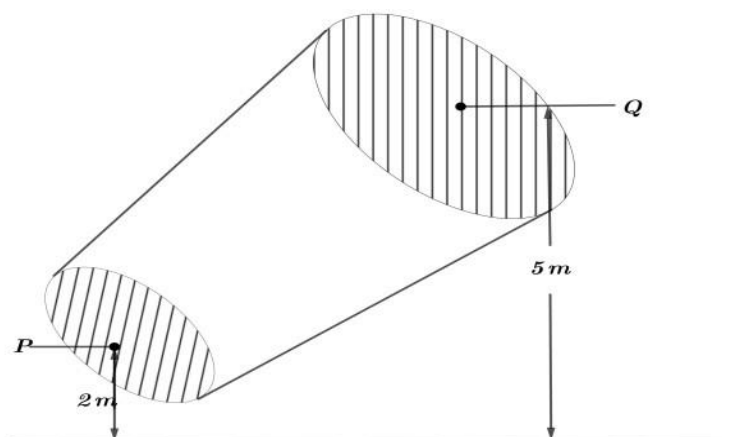
SECTION B (30 MARKS)

Answer **ALL** questions from this section

8. a) (i) How will you distinguish a hard-boiled egg from a raw egg by spinning each on a table top? **02 marks**
- (ii) What shall be the effect on the length of the day if the polar caps of earth melts?
02marks

- b) A uniform rod of mass 3.0kg and length 2.0m is suspended at one end so that it can move about an axis perpendicular to its length. If the rod is initially horizontal and then released, find the angular velocity of the rod when.
- It is inclined at 30° to the horizontal. **2.5 marks**
 - Reaches the vertical. **2.5 marks**
- c) (i) If the radius of the earth assumed to be a perfect sphere suddenly shrinks to half its present value, the mass of the earth remains unchanged, what will be the duration decrease of the day? **03 marks**
- (ii) How a swimmer jumping from a height is able to increase the number of loops made in the air **03 marks**

9. a) i. Name the principle which the continuity equation is based? **01 mark**
- ii. What is meant by Newtonian fluid? **01 mark**
- iii. Explain why a length of hose pipe which is lying in a curve on a smooth horizontal surface, straightens out when a fast-flowing stream of water passes through it. **02 marks**
- b) A non-viscous liquid of constant density 1000kg/m^3 flows in a streamline motion along a tube of variable cross section, the tube is kept inclined in the vertical plane as shown in figure below. The area of cross section of the tube at two points P and Q at heights of 2m and 5m respectively, are $4 \times 10^{-3}\text{m}^2$ and $8 \times 10^{-3}\text{m}^2$, the velocity of liquid at point P is 1 m/s , find the works done per unit volume by the pressure and the gravity force as the fluids flows through point P and Q. **06 marks**



- c) i. Based on the application of Bernoulli's principle, briefly explain why two ships which are moving parallel and close to each other experience an attractive force **03 marks**
- ii. Under what condition is the Bernoulli's equation applicable, give four conditions **02 marks**