

**THE 1<sup>ST</sup> OXFORD-THE DAILY STAR NATIONAL PHYSICS OLYMPIAD  
DHAKA  
FRIDAY, APRIL 29, 2011  
ROUND 2**

**PLEASE READ THE FOLLOWING INSTRUCTIONS:**

1. Please write your student code and school name on the box provided in the answer script.
2. The examination consists of two rounds and the stipulate time for each round is one hour.
3. Round two have [4] four questions and you have to answer all of them
4. Use the **Answer Sheets** provided is to fill in your answers. Numerical results should be given in 2 decimal places. *Do not forget to state the units.*
5. No rough sheet will be provided. All the working should be done in the space provided on the question paper.
6. You may use the calculator to solve the problems.
7. Turn over the page *only* when you are instructed to do so.
8. This question Paper consists of 5 printed pages and I blank page.

1. A ball of mass  $0.08 \text{ kg}$  is vertically thrown upward with a velocity  $30 \text{ m/s}$  from a platform  $100 \text{ m}$  from the ground.  
Take the value of  $g = 10 \text{ m/s}^2$ .
- Estimate maximum height reached from the ground,
  - Find velocity before impact with the ground,
  - Calculate the duration of its flight,
  - Find the loss in potential energy when the ball fall down from its peak height to the ground,
  - Find the momentum change from its peak height to the ground.

2. The gravitational attraction force between bodies of mass  $m_1$  and mass  $m_2$  and when a mass of  $m$  is moved from the Earth's surface to the height of  $h$  we can write the change in gravitational potential energy as:

$$F = \frac{G m_1 m_2}{R^2} \quad \text{and} \quad \Delta P.E = \frac{GmMh}{R(R+h)}$$

Where  $G$  is a constant =  $6.67 \times 10^{-11} \text{ N m}^2/\text{kg}^2$ ,  $M$ , mass of earth =  $6.0 \times 10^{24} \text{ kg}$  and  $R$ , radius of earth =  $6300 \text{ km}$ .

- Calculate gravitational force between two masses of  $2 \text{ kg}$  and  $5 \text{ kg}$  respectively,
- Measure a distance from mass  $2 \text{ kg}$  where the attraction due to two forces is zero.
- The earth is taken to be a one of the body, find gravitational force acting on mass of  $2 \text{ kg}$  on the surface of earth
- Estimate the change gravitational energy when  $2 \text{ kg}$  is moved through  $100 \text{ m}$ ,

3. Using a drill machine it takes  $250\text{ s}$  to make a hole in a piece of brass of mass  $0.65\text{ kg}$ . Given that the average power delivered to the drill from the mains is  $300\text{ W}$ . Also given that 80% of the energy supplied to the drill is used up to raise the temperature of the brass and specific heat capacity of brass is  $390\text{ J}/(\text{kg K})$ .
- Calculate how much energy is used in drilling the hole initially?
  - Estimate the initial rate of temperature rise.
  - Specific heat capacity of water is  $4200\text{ J}/(\text{kg K})$ , what amount of water would have 10 degree rise in temperature if same amount of energy used up at a)?
  - Estimate the time required if same amount of water would be heated to same temperature difference by  $3.0\text{ kW}$  heater.

4. A  $2.0\text{ m}$  long heating element with the resistivity of material  $2.0 \times 10^{-8}\ \Omega\text{ m}$ , is used in firing alarm. Given that the radius of the wire is  $2.4 \times 10^{-4}\text{ m}$ .  
[Clue:  $R = \rho l/A$ ,  $A = \pi r^2$ , and  $P = I^2R$ ]
- Estimate the resistance of the wire.
  - Calculate the power loss if the device is rating  $3.0A$ .
  - What amount of charge it will drag from the source in a day?
  - Calculate the rate at which it loses power per unit square meter.