

# Midterm Exam No. 03 (2018 Spring)

## PHYS 205A-001: University Physics

Date: 2018 Apr 13

---

(Name)

---

(Signature)

### Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 3.
2. Total time = 50 minutes.
3. There are 7 questions in this exam.
4. Equation sheet is provided separately.
5. To be considered for partial credit you need to show your work in detail and organize it clearly.
6. A simple calculator (with trigonometric functions) is allowed.
7. Use of mobile phones is strictly prohibited. It should stay out of reach during the exam.

1. (10 points.) The force acting on a particle varies as shown in the figure below. Find the work done by the force on the particle as it moves from  $x = 10$  m to  $x = 30$  m.

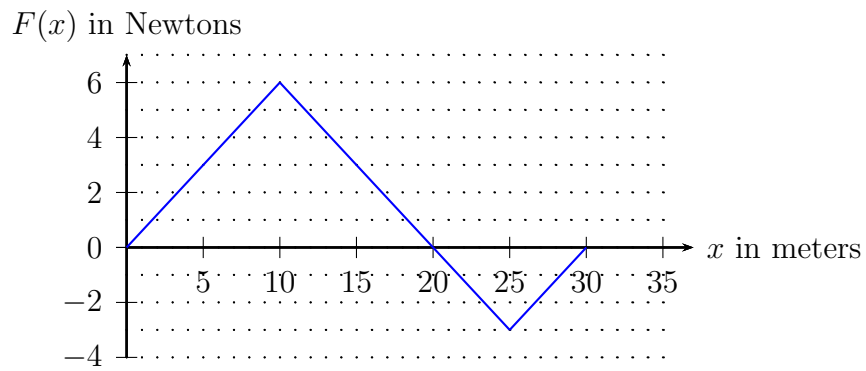


Figure 1: Problem 1.

2. (10 points.) A 0.60 kg basketball is dropped out of the window that is 6.5 m above the ground. The ball is caught by a person whose hands are 1.5 m above the ground.
- (a) Identify the forces acting on the basketball during the drop.
  - (b) Determine the work done by the gravitational force.
  - (c) Determine the change in gravitational potential energy.
  - (d) Determine the change in kinetic energy.

3. **(10 points.)** Adolf and Ed are wearing harnesses and are hanging at rest from the ceiling by means of ropes attached to them. Face to face, they push off against one another. Adolf has a mass of 99 kg, and Ed has a mass of 66 kg. Following the push, Adolf swings upward to a height of 0.60 m above his starting point. To what height above his own starting point does Ed rise?

4. **(10 points.)** A bullet with mass  $m_1 = 3.00$  g is fired into a wooden block of mass  $m_2 = 1.00$  kg, that hangs like a pendulum. The bullet is embedded in the block (complete inelastic collision). The block (with the bullet embedded in it) goes  $h = 30.0$  cm high after collision. Calculate the speed of the bullet before it hit the block.

5. (10 points.) A shooter of mass 75 kg shoots a bullet of mass 5.00 g in a direction  $45.0^\circ$  with respect to the horizontal, standing on a frictionless surface at rest. If the muzzle velocity of the bullet is 600.0 m/s, what is the recoil speed of the shooter?

6. **(10 points.)** Determine the center of mass of the Earth-Moon system. Check if the center of mass of the Earth-Moon system is inside or outside the Earth. Given mass of Earth is 81 times the mass of Moon, and the distance between the center of Earth and center of Moon is 60 times the radius of Earth. Radius of Earth is  $6.37 \times 10^6$  m.

7. (10 points.) Consider the potential energy curve shown in the figure below with respect to distance  $r$ , which is given by the expression ( $r > 0$ )

$$U(r) = \frac{\beta}{2r^2} - \frac{\alpha}{r}, \quad \alpha > 0, \quad \beta > 0. \quad (1)$$

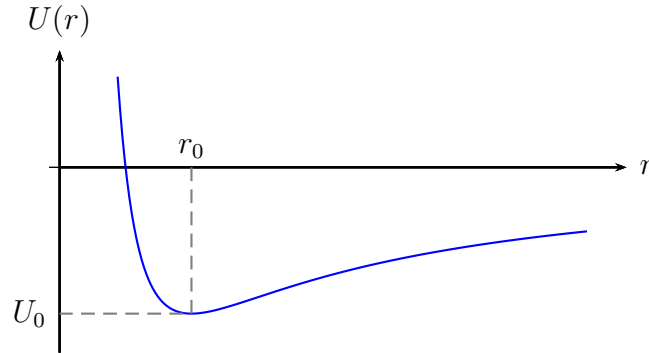


Figure 2: Problem 7.

- (a) Determine the distance  $r_0$  at which the force corresponding to this potential energy is zero.
- (b) Determine the potential energy  $U_0$  when the force is zero.