

Physics I

Set no. 5

Please assume that $g = 10 \text{ m/s}^2$ (magnitude the acceleration due to gravity) unless otherwise stated

- E** 1. Which of the following groups does NOT contain a scalar quantity (please choose)?
A. velocity, force, power
B. displacement, acceleration, force
C. acceleration, speed, work
D. energy, work, distance
E. pressure, weight, time
- E** 2. A boy holds a 40-N weight at arm's length for 10 s. His arm is 1.5m above the ground. Please find the work done by the force of the boy on this weight.
- E** 3. A boy carries a 40-N weight at arm's length for 10 s at arm's length for 10 seconds over a distance of 5 m. His arm is 1.5 m above the ground. Please find the work done by the force of the boy on the weight
- E** 4. The boy pulls the sledge ($m = 10 \text{ kg}$) with a force $\vec{F}$ directed at an angle of $\alpha = 30^\circ$ to the ground, moving in a steady motion. Please calculate the work of the force $\vec{F}$ on a $d = 50 \text{ m}$ distance, if the friction coefficient is $\mu = 0.4$.
- E** 5. The body rests on an even slope with a variable angle of inclination. Please draw all the forces acting on the block on the equilibrium. Please calculate the boundary angle for which the one above which the body starts to slide. The coefficient of friction is $\mu = 0.577$.
6. Please determine work of the force $\vec{F}$ if:
- a) $\vec{F} = [x^3 - 2x, 0]$; the displacement occurs along the x axis from A(0,0) to B(3,0),
b) $\vec{F} = [x^2 - 2yx, 2xy - y]$; the displacement occurs along the x axis from A(0,0) to B(3,0).
c) $\vec{F} = [x^2 - 2yx, 2xy - y]$, the displacement is: A(0,0) – B(2,0) – C(2,3) – D(3,0)
- E** d) $\vec{F} = [x^3 - 2x, 2x - y]$; the displacement occurs along the line $y = x$ from A(0,0) to B(3,3).
- E** 7. Please check if $\vec{F}$ is conservative force:
- a) $\vec{F} = [x^2 - 2yx, 2xy - y]$
b) $\vec{F} = [\frac{y^2}{x}, 2y \ln \frac{x}{b}]$, a, b – positive constants, $x > 0$

c) $\vec{F} = [-2xyz - y^3 - z^2, -x^2z - 3y^2x, -x^2y - 2zx]$

d) $\vec{F} = (yz - y^2)\hat{i} + (-x^2z + y^2x)\hat{j} + x^2y\hat{k}$

E

8. Potential energy for some interaction (1D case) is given by $U(x) = -\frac{a}{x^{12}} + \frac{b}{x^6}$, $a, b > 0$

where x is the distance between interacting bodies.

a) Please find the equilibrium distance x . Is it stable or unstable equilibrium?

b) Please find the force $\vec{F}$ of this interaction.

9. Potential energy for some interaction (3D case) is: $U(x, y, z) = xz + xy^2z^3 - zx^2y$. Please find the force $\vec{F}$ of this interaction.