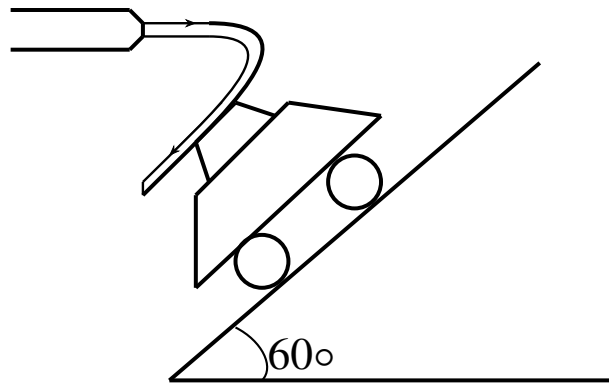


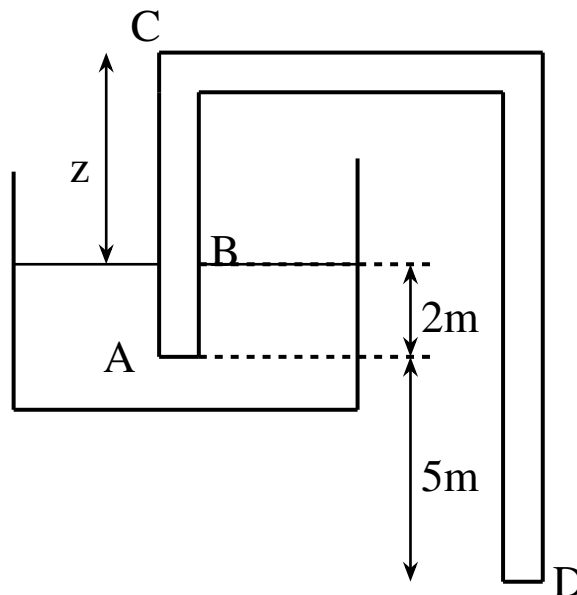
XE-2022

EE24Btech11022 - Eshan Sharma

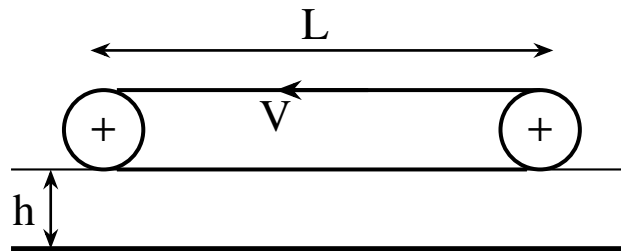
- 1) A wooden cylinder (specific gravity = 0.6) of length L and diameter D floats in water (density 1000 kg/m^3). Find out the minimum value of D/L for which the cylinder floats with its axis vertical. (Round off to three decimal places)
- 2) Consider a cart of mass 10 kg placed on an inclined plane (angle of inclination 60° with horizontal) as shown in the figure. A turning vane of negligible weight is mounted on the cart. A horizontal steady water jet is issued from a stationary nozzle of area 0.1 m^2 and strikes the turning vane as shown in the figure. The vane turns the jet downward parallel to the inclined plane. Find out the minimum jet velocity (in m/s) which will not allow the cart to come down. Neglect friction, consider density of water = 1000 kg/m^3 and acceleration due to gravity = 10 m/s^2 . (Round off to two decimal places)



- 3) A siphon is used to drain out water (density 1000 kg/m^3) from a tank as shown in the figure. What can be the maximum height z (in meters) of the point C ? Consider acceleration due to gravity = 10 m/s^2 , pressure at point A = 101 kPa , vapor pressure of water = 29.5 kPa , and neglect friction. (Round off to two decimal places)



- 4) The horizontal belt of negligible weight shown in the figure moves with a steady velocity V of 2.5 m/s and skims over the top surface of an oil film of depth $h = 3$ cm. The length L and width b of the belt are, respectively, 2 m and 60 cm. Find the viscosity of the oil (in Pa-s), given that the minimum power required to move the belt is 100 W. Neglect the end effects. (Round off to two decimal places)



- 5) Number of atoms per unit area of the (110) plane of a body-centered cubic crystal, with lattice parameter a , is
- $\frac{1}{a^2}$
 - $\frac{\sqrt{2}}{a^2}$
 - $\frac{1}{\sqrt{3}a^2}$
 - $\frac{1}{\sqrt{2}a^2}$
- 6) Match the following materials with their corresponding bonding types.

Material	Bonding
$P : \text{Cu}_{0.5}\text{Al}_{0.5}$	1: Ionic
$Q : \text{ZnS}$	2: Covalent
$R : \text{Na}_2\text{O}$	3: Metallic
$S : \text{Li}_4\text{SiO}_4$	4: Mixed

- P - 4; Q - 2; R - 3; S - 1
 - P - 3; Q - 4; R - 2; S - 1
 - P - 3; Q - 2; R - 1; S - 4
 - P - 3; Q - 1; R - 4; S - 2
- 7) In an ideal rubber, the primary factor responsible for elasticity up to small strains is
- Change in both enthalpy and entropy
 - Change in enthalpy, but no change in the entropy
 - No change in enthalpy, but change in the entropy
 - Neither a change in enthalpy, nor a change in the entropy
- 8) Which one of the following statements is true for an intrinsic semiconductor?
- Electrical conductivity increases with increasing temperature and pressure
 - Electrical conductivity increases with increasing temperature and decreasing pressure
 - Electrical conductivity increases with decreasing temperature and increasing pressure
 - Electrical conductivity increases with decreasing temperature and pressure
- 9) A differential scanning calorimetry (DSC) experiment tracks the heat flow into or out of a system as a function of temperature. If the experiments given in the options below are performed at 1 atmospheric pressure, then in which case will the DSC thermogram exhibit a spike, either upward or downward?
- Heating 10 mg of pure Cu from 323 K to 673 K
 - Cooling pure water from 323 K to 278 K
 - Heating pure ice from 263 K to 284 K
 - Cooling a Pb-Sn alloy at the eutectic composition from 323 K to 273 K

- 10) Which one of the following solvent environments will likely result in swelling of solid polystyrene?
- 0.1 M NaOH in H_2O
 - HCl (aq.) of $\text{pH} = 6$
 - Distilled water
 - Benzene
- 11) Vickers microhardness (HV) of a ductile material A is higher than another ductile material B. Which of the following is/are true?
- Young's modulus of A is greater than B
 - Yield strength of A is greater than B
 - Scratch resistance of A is greater than B
 - Ductility of A is greater than B
- 12) The enthalpy required to create an oxygen vacancy in CeO_2 is 4 eV. The number of oxygen vacancies present per mole of CeO_2 at 1000 K is _____. (Round off to the nearest integer)
- Given:
- N_A : Avogadro's number = $6.02 \times 10^{23} \text{ mol}^{-1}$
 - k_B : Boltzmann's constant = $8.62 \times 10^{-5} \text{ eV/K}$
- 13) An electrochemical reaction is known to occur at +4.50 V against a Li^+/Li reference electrode. The potential of the same reaction against a Zn^{2+}/Zn reference electrode is _____ V. (Round off to two decimal places).
- Given:
- $E^0 (\text{Li}^+/\text{Li}) = -3.04 \text{ V}$ versus Standard Hydrogen Electrode
 - $E^0 (\text{Zn}^{2+}/\text{Zn}) = -0.77 \text{ V}$ versus Standard Hydrogen Electrode