



## AP<sup>®</sup> Physics B 2003 Sample Student Responses

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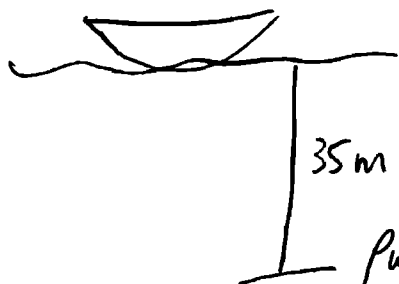
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6. (10 points)

A diver descends from a salvage ship to the ocean floor at a depth of 35 m below the surface. The density of ocean water is  $1.025 \times 10^3 \text{ kg/m}^3$ .

(a) Calculate the gauge pressure on the diver on the ocean floor.



$$P = \rho g h$$

$$= (1.025 \times 10^3 \text{ kg/m}^3)(9.8)(35)$$

$$= 351575 \text{ N/m}^2$$

$$\therefore P = 3.5 \times 10^5 \text{ Pa}$$

(b) Calculate the absolute pressure on the diver on the ocean floor.

$$P = P_0 + \rho g h$$

$$= 1 \times 10^5 \text{ N/m}^2 + 351575 \text{ N/m}^2$$

$$= 451575 \text{ Pa}$$

$$\therefore P = 4.5 \times 10^5 \text{ Pa}$$

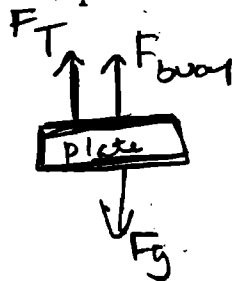
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The diver finds a rectangular aluminum plate having dimensions  $1.0 \text{ m} \times 2.0 \text{ m} \times 0.03 \text{ m}$ . A hoisting cable is lowered from the ship and the diver connects it to the plate. The density of aluminum is  $2.7 \times 10^3 \text{ kg/m}^3$ . Ignore the effects of viscosity.

(c) Calculate the tension in the cable if it lifts the plate upward at a slow, constant velocity.

$$V = 0.06 \text{ m}^3$$

$$\rho_{\text{al}} = 2.7 \times 10^3 \text{ kg/m}^3$$



$$\rho = \frac{M}{V} \quad M = \rho V$$

$$m_{\text{al}} = 162 \text{ kg}$$

$$F_T + F_{\text{buoy}} - F_g = ma$$

const velocity  
 $a=0$

$$\begin{aligned} \therefore F_T &= F_g - F_{\text{buoy}} \\ &= 162(9.8) - (1.025 \times 10^3)(9.8)(0.06) \\ &= 1587.6 - 602.7 \\ &= 984.9 \end{aligned}$$

$$\therefore F_T = 985 \text{ N}$$

(d) Will the tension in the hoisting cable increase, decrease, or remain the same if the plate accelerates upward at  $0.05 \text{ m/s}^2$ ?

increase       decrease       remain the same

Explain your reasoning.

$$F_T + 602.7 - 1587.6 = 162(0.05)$$

$$F_T = 993 \text{ N}$$

$\therefore F_T$  increases

To accelerate upwards, force must increase.

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6. (10 points)

A diver descends from a salvage ship to the ocean floor at a depth of 35 m below the surface. The density of ocean water is  $1.025 \times 10^3 \text{ kg/m}^3$ .

(a) Calculate the gauge pressure on the diver on the ocean floor.

$$\begin{aligned}
 P &= P_0 + \rho gh \\
 &= \cancel{1.0 \times 10^5 \text{ Pa}} + (1.025 \times 10^3 \text{ kg/m}^3) (9.8 \text{ m/s}^2) (35 \text{ m}) \\
 &= \cancel{4.52 \times 10^5 \text{ Pa}} = 3.52 \times 10^5 \text{ Pa}
 \end{aligned}$$

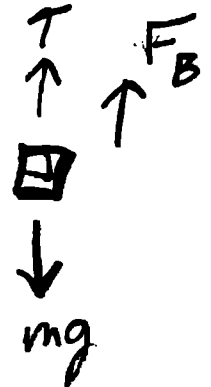
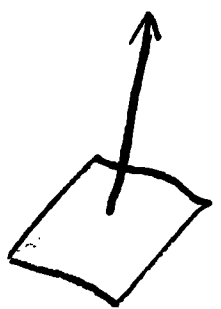
(b) Calculate the absolute pressure on the diver on the ocean floor.

$$\begin{aligned}
 P &= P_0 + \rho gh \\
 &= 1.0 \times 10^5 \text{ Pa} + (1.025 \times 10^3 \text{ kg/m}^3) (9.8 \text{ m/s}^2) (35 \text{ m}) \\
 &= 4.52 \times 10^5 \text{ Pa}
 \end{aligned}$$

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The diver finds a rectangular aluminum plate having dimensions  $1.0 \text{ m} \times 2.0 \text{ m} \times 0.03 \text{ m}$ . A hoisting cable is lowered from the ship and the diver connects it to the plate. The density of aluminum is  $2.7 \times 10^3 \text{ kg/m}^3$ . Ignore the effects of viscosity.

(c) Calculate the tension in the cable if it lifts the plate upward at a slow, constant velocity.



MASS

$V = .06 \text{ m}^3$

$(2.7 \times 10^3) (.06)$

$m = 162$

$(m = \rho V)$

CONSTANT  $v$

$\therefore a = 0$

$T + F_B = mg$

$F_B = \rho V g$

$= (2.7 \times 10^3) (1.0 \times 2.0 \times 0.03) (9.8)$

$F_B = 1587.6 \text{ N}$

$T = mg - F_B$

$162(9.8) - 1587.6$

$T = 0 \dots$

(d) Will the tension in the hoisting cable increase, decrease, or remain the same if the plate accelerates upward at  $0.05 \text{ m/s}^2$ ?

increase       decrease       remain the same

Explain your reasoning.

*Handwritten scribble*

$T + F_B - mg = ma$

$T = ma + mg - F_B$

(THE SAME)

IF ACCELERATION INCREASES, SO WILL T  
IF THE MASS AND  $F_B$  REMAIN THE SAME

$T_{\text{LARGER}} = ma_{\text{LARGER}}$  (PART C)

$a = .05 \text{ m/s}^2 > 0 \text{ m/s}^2$

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