Worked Solutions for ENGAA Papers by Topic

Section 2

Topic: Geometry

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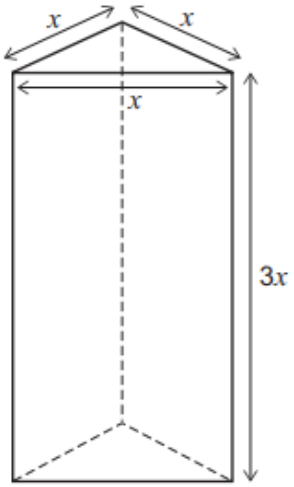
ENGAA S2 2020 - Question 8

8 The diagram shows a solid triangular prism.



The sides of the triangular cross section of the prism are of length x.

The height of the prism is $3x$.

The uniform density of the prism is ρ.

The gravitational field strength is g.

What is the minimum pressure the prism can exert when it rests on level ground?

A $3\rho g$

B $3\rho g x$

C $\frac{\rho g}{4}$

D $\frac{\rho g x}{4}$

E $\frac{\sqrt{3}\rho g}{4}$

F $\frac{\sqrt{3}\rho g x}{4}$

ENGAA S2 2020 - Question 8 - Worked Solution

$P = \frac{F}{A}$ *As* $F = \rho V g$ *is constant, we ant to maximise* A *in order to minimise* P

$P = \rho g \frac{V}{A}$

$$= \rho g h$$
$$= \rho g \frac{\sqrt{3}}{4}$$

Answer is F

ENGAA S2 2019 - Question 7

7 A solid pyramid of height 140 m has a square base.

The density of the stone from which the pyramid is made is 2100 kg m^{-3}.

Atmospheric pressure is 100 kPa.

What is the average pressure on the ground under the pyramid?

(gravitational field strength = 10 N kg^{-1}; volume of a pyramid = $\frac{1}{3}$ × base area × vertical height)

A 98 kPa

B 108 kPa

C 198 kPa

D 980 kPa

E 1080 kPa

F 2940 kPa

G 3040 kPa

ENGAA S2 2019 - Question 7 - Worked Solution

$$P_{ground} = P_{atm} + P_{pyramid}$$

$$P_{pyramid} = \frac{weight}{base\ area} = g \times \frac{V \times \rho}{A} = \frac{1}{3}gh\rho \ using\ V = \frac{1}{3}Ah$$

$$= 10Nkg^{-1} \times \frac{1}{3} \times 140m \times 2100kgm^{-3}$$

$$= 980,000\ Pa$$

$$\therefore P_{pyramid} = 100kPa + 980kPa$$

$$= 1080\ kPa$$

Answer is E

ENGAA S2 2019 - Question 8

8 The pressure exerted by a gas at constant temperature is directly proportional to its density.

A spherical bubble of gas forms at the bottom of a glass containing a fizzy drink.

The radius of the bubble at the point of formation, at the bottom of the drink, is R.

The depth of the liquid in the glass is h, and the density of the liquid of the drink is ρ.

Atmospheric pressure is P.

As the bubble rises, its radius changes.

Which expression gives the radius of the bubble when it is at a distance x below the surface of the drink?

(gravitational field strength = g; volume of sphere = $\frac{4}{3}\pi r^3$ where r is the radius; the mass and the temperature of the gas in the bubble remain constant)

A $R\left(\frac{h\rho g - P}{x\rho g - P}\right)^{\frac{1}{3}}$

B $R\left(\frac{h}{x}\right)^{\frac{1}{3}}$

C $R\left(\frac{h\rho g + P}{x\rho g + P}\right)^{\frac{1}{3}}$

D $R\left(\frac{x\rho g - P}{h\rho g - P}\right)^{\frac{1}{3}}$

E $R\left(\frac{x}{h}\right)^{\frac{1}{3}}$

F $R\left(\frac{x\rho g + P}{h\rho g + P}\right)^{\frac{1}{3}}$

ENGAA S2 2019 - Question 8 - Worked Solution

$$P.V \text{ is constant}$$

$$(h\rho g + P).4\pi R^3 = (x\rho g + P).4\pi\left(R'\right)^3$$

$$\therefore R' = \left(\frac{h\rho g + P}{x\rho g + P}\right)^{\frac{1}{3}} R$$

Answer is C

ENGAA S2 2018 - Question 15

15 A solid cube with a total surface area of 96 cm^2 is suspended from a spring of spring constant $2.0 \times 10^4\ N\,m^{-1}$ and causes the spring to extend by 1.6×10^{-4} m.

The cube is removed from the spring and placed on a horizontal surface where it rests with one face on the surface.

What is the pressure exerted by the cube on the surface and what is the density of the material from which the cube is made?

(gravitational field strength = $10\ N\,kg^{-1}$)

	pressure / $N\,m^{-2}$	*density* / $kg\,m^{-3}$
A	2.0×10^1	5.0×10^{-2}
B	2.0×10^1	5.0×10^4
C	3.3×10^2	5.0×10^{-2}
D	3.3×10^2	5.0×10^3
E	3.3×10^2	5.0×10^4
F	2.0×10^3	5.0×10^{-2}
G	2.0×10^3	5.0×10^3
H	2.0×10^3	5.0×10^4

ENGAA S2 2018 - Question 15 - Worked Solution

$$SA = 6L^2 = 96$$

$$L^2 = 16$$

$$L = 4\ cm$$

Mass of cube:

$$kx = mg$$

$$m = \frac{2.0\times10^4\times1.6\times10^{-4}}{10}$$

$$= 0.32\ kg$$

$$P = \frac{F}{A}$$

$$= \frac{mg}{A}$$

$$= \frac{3.2}{L^2}$$

$$= 2000\ Nm^{-2}$$

Density;

$$\rho = \frac{m}{v}$$
$$= \frac{0.32\ kg}{(0.04m)^3}$$
$$= 5000\ kg$$

Answer is G.