Unit 3 - Week 1

Assignment 1

The due date for submitting this assignment has passed. Due on 2020-02-12, 23:59 IST.
As per our records you have not submitted this assignment.

1) Mark the correct work flow of a MEMS force sensor: - *1 point*

- External force – Moving structure – Deflection of moving structure – calculate applied force – Measuring deflection
- External force – calculate applied force – Deflection of moving structure – Moving structure – Measuring deflection
- External force – Moving structure – Deflection of moving structure – Measuring deflection – calculate applied force
- Moving structure – Measuring deflection – External force – Deflection of moving structure – calculate applied force.

No, the answer is incorrect.
Score: 0

Accepted Answers:
External force – Moving structure – Deflection of moving structure – Measuring deflection – calculate applied force

2) What is the critical length (in mm) for a glass cube having density 2500 Kg/m^3 to float on a fluid having surface tension 27.56 mN/m ? Neglect the buoyancy force acting on block (Take g = 9.8 m/s^2). *2 points*

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 1.9,2.3

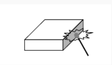
3) A block is hanging vertically downwards by 2 parallel beams of width W, length L and depth H. The beam material has elasticity E. What will be the equivalent spring constant of such a system? *2 points*

- $\frac{WHE}{L}$
- $\frac{WHE}{2L}$
- $\frac{2WHE}{L}$
- $\frac{WHE}{4L}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{2WHE}{L}$

4) Figure below shows a matchbox. Assume that each matchstick is 50 mm long and has cross-sectional area 4 mm^2. Assume also that each matchstick need 1 mm^2 of surface coating on the matchbox for ignition. Consider a matchbox of size 50 mm × 30 mm × 4 mm. Is there enough ignitable area for all the matchsticks it can enclose? *2 points*



- Have exactly same area to ignite all the sticks
- Not enough area to ignite all the sticks
- Insufficient data
- Have more than enough area to ignite all the sticks

No, the answer is incorrect.
Score: 0

Accepted Answers:
Have more than enough area to ignite all the sticks

5) Consider a cantilever beam of length l, width b, and depth h made of a material with Young's modulus Y. It has a fundamental natural frequency f_1. After scaling the width to ob and depth to βh, its natural frequency changes to f_2. Calculate the ratio of these frequencies (f1: f2), if values of α and β are $10^{(-3)}$ and $10^{(-4)}$ respectively. You can use, frequency, $f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$ where, k is stiffness and m is effective mass of the beam. Again, m = cm_b, where, c is a constant and m_b is actual mass of the beam. You can also consider only transverse vibration. *2 points*

- 10^{-1}
- 10^{-2}
- 10^{4}
- 10^{3}

No, the answer is incorrect.
Score: 0

Accepted Answers:
10^4

Consider a parallel plate capacitor of area A = 10^{-8} m^2 and gap g = 10^{-6} m. Compute (i) its capacitance and (ii) force between plates if potential difference between plates is 5 V, first without scaling and then scaled down by changing units from m to μm. Take ϵ_0=8.85 × 10^{-12} in S.I. unit.

Without scaling

6) Capacitance = _____ × $10^{(-14)}$F

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 8.6,8.9 *1 point*

7) Force = _____ × $10^{(-8)}$ N

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 110,111 *1 point*

With scaling

8) Capacitance = _____ × $10^{(-21)}$F

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 86,89 *1 point*

9) Force = _____ × $10^{(-8)}$ N

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 110,111 *1 point*

10) Choose the incorrect expression from the following in case of a one-side fixed beam (where ρ is the radius of curvature, E is the Young's modulus, w is the deflection, I is the area moment of inertia and M_0 is the applied moment). *1 point*

- $\frac{1}{\rho} = \frac{M_0}{EI}$
- $\frac{1}{\rho} = \frac{d^2w}{dx^2}$
- $\frac{d^2w}{dx^2} = \frac{EI}{F(l-x)}$
- None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{d^2w}{dx^2} = \frac{EI}{F(l-x)}$

11) Two statements are given below : - *1 point*
I. Strain energy in a body is $\int \frac{1}{2}\sigma\varepsilon dV$.
II. Castigliano's theorem states that $F_x = \frac{\partial SE(v_{ij})}{\partial v_{ij}}$, $u_x = \frac{\partial SE(F_{ij})}{\partial F_x}$ where SE(y) is the strain energy as function of y.

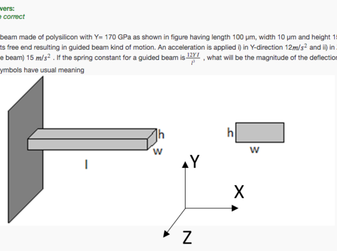
Choose the right option

- Only I is correct
- Only II is correct
- Both I and II are correct
- Both I and II are incorrect

No, the answer is incorrect.
Score: 0

Accepted Answers:
Both I and II are correct

12) Consider a beam made of polysilicon with Y= 170 GPa as shown in figure having length 100 μm, width 10 μm and height 15 μm. A proof mass of 50 μg is attached to its free end resulting in guided beam kind of motion. An acceleration is applied i) in Y-direction 12m/s^2 and ii) in Z-direction (i.e., perpendicular to the side face of the beam) 15 m/s^2 . If the spring constant for a guided beam is $\frac{3EI}{l^3}$, what will be the magnitude of the deflection produced in Y and Z direction, respectively? All symbols have usual meaning *1 point*

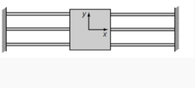


- i) 0.29 nm, ii) 0.10 nm
- i) 0.10 nm, ii) 0.29 nm
- i) 0.10 μm, ii) 0.10 μm
- i) 0.10 μm, ii) 0.29 μm
- i) 0.29 μm, ii) 0.29 μm
- i) 0.15 nm, ii) 0.23 nm

No, the answer is incorrect.
Score: 0

Accepted Answers:
i) 0.10 nm, ii) 0.29 nm

13) Suspension of an accelerometer is as shown below. There are three beams on either side of the square proof mass 50 μg mass. The beams are identical. They are 150 μm long and have an in-plane width of 8 μm and an out-of-plane thickness 2 μm. They are made of polysilicon with Y = 169 GPa. How much does the proof mass move in the y-direction for 1 g (9.8m/s^2) acceleration in that direction (in nm)?



No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Range) 1.5,1.7 *3 points*