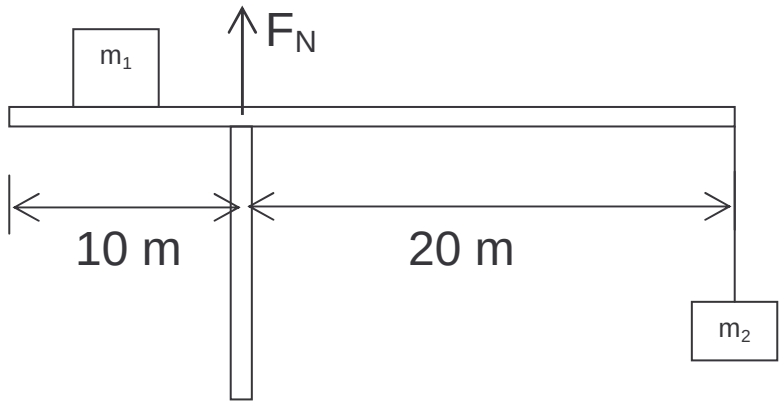
3650:291-001 **Exam 6** **SD** **04/15/05**

$\sin 30^o = \cos 60^o = \frac{1}{2}$	$\sin 60^o = \cos 30^o = \frac{\sqrt{3}}{2} \approx 0.87$	$\sin 45^o = \cos 45^o = \frac{\sqrt{2}}{2}$

1. The condition for static equilibrium is:

(a) $\sum \vec{F} = 0$ (b) $\sum \vec{\tau} = 0$ (c) $\sum \vec{F} = 0$ or $\sum \vec{\tau} = 0$ (d) $\sum \vec{F} = 0$ and $\sum \vec{\tau} = 0$

Questions 2-4. Consider a tower crane shown in the picture below. The mass of the counterweight is m_1=2000 kg, and the mass of the load is m_2= 500 kg. Ignore the mass of the beam and take g≈10 m/s^2.



2. How far from the vertical beam must the counterweight m_1 be located?

(a) 1 m (b) 2 m (c) 5 m (d) 10 m

3. What is the normal force F_N on the horizontal beam exerted by the vertical beam?

(a) 5000 N (b) 15000 N (c) 20000 N (d) 25000 N

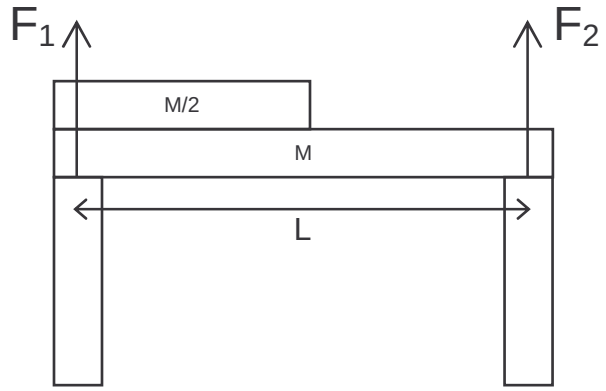
4. What is the maximum weight that can be lifted with this crane?

(a) 500 kg (b) 1000 kg (c) 2000 kg (d) 5000 kg

5. Resonance occurs when the frequency of the external (driving) force is equal or close to the natural frequency of the oscillator.

(a) True (b) False (c) cannot be answered

Questions 6-7. A uniform steel beam has a mass *M* and length *L*. On it is resting half of an identical beam, as shown below.



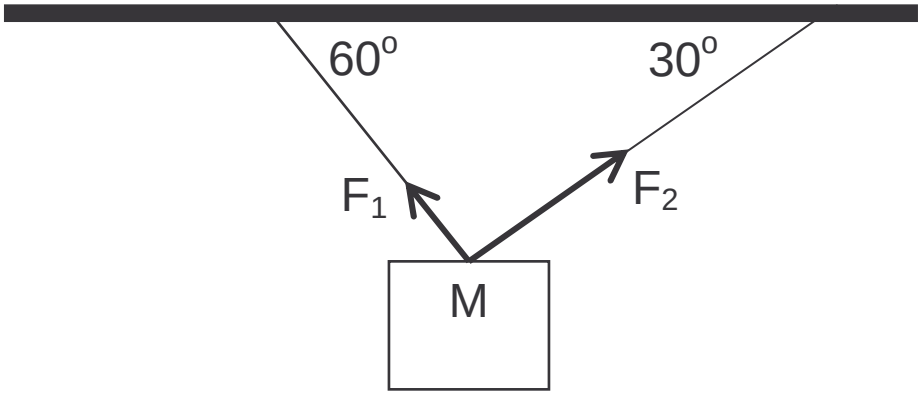
6. The magnitude of the vertical support force on the left side F_1 is:

(a) $\frac{3}{2}Mg$ (b) $\frac{3}{4}Mg$ (c) $\frac{7}{8}Mg$ (d) $\frac{5}{8}Mg$

7. The magnitude of the vertical support force on the right side F_2 is:

(a) $\frac{3}{2}Mg$ (b) $\frac{3}{4}Mg$ (c) $\frac{7}{8}Mg$ (d) $\frac{5}{8}Mg$

Questions 8-9. An object with mass M=0.5 kg is supported with two cables, as in the picture below. Take $g \approx 10$ m/s^2.



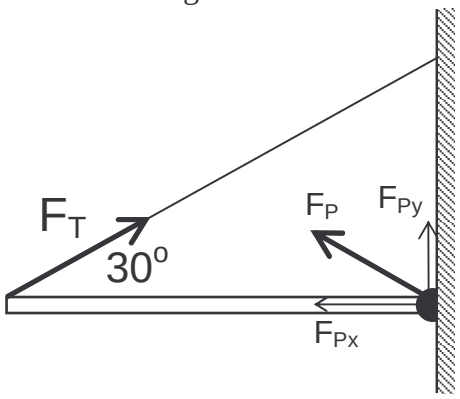
8. The magnitude of tension force F_1 is:

(a) $\frac{5\sqrt{3}}{2}$ N (b) $\frac{2\sqrt{5}}{3}$ N (c) $\frac{2\sqrt{3}}{5}$ N (d) $\frac{3\sqrt{2}}{5}$ N

9. The magnitude of tension force F_2 is:

(a) 2.0 N (b) 2.5 N (c) 3.5 N (d) 4.0 N

Questions 10-12. A uniform beam 1 m long and with mass m= 10 kg is mounted on a wall by a pin. The beam is held in a horizontal position by a cable that makes an angle $\theta=30^o$, as shown in the picture below. Take $g\approx 10$ m/s^2.



10. The magnitude of the tension force F_T is:

(a) 50 N (b) 87 N (c) 100 N (d) 141 N

11. The magnitude of the *x* component of the force that the pin exerts on the beam F_{Px} is:

(a) 50 N (b) 87 N (c) 100 N (d) 141 N

12. The magnitude of the *y* component of the force that the pin exerts on the beam F_{Py} is:

(a) 50 N (b) 87 N (c) 100 N (d) 141 N

13. Stress is defined as:

(a) $\frac{\Delta L_0}{L}$ (b) $\frac{E}{L}$ (c) $\frac{F}{A}$ (d) $\frac{F}{\Delta L_0}$

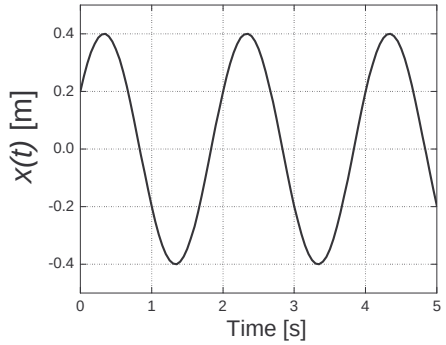
14. In the proportional region the relation between the elongation and applied force is:

(a) $\Delta L = E\frac{F}{A}L_0$ (b) $\Delta L = \frac{1}{E}\frac{L_0}{A}F$ (c) $\Delta E = \frac{1}{L_0}\frac{F}{A}\Delta L$ (d) $\Delta L = \frac{1}{E}\frac{L_0}{F}A$

15. The force of spring, as given by Hooke's law is:

(a) $F = -kx^2$ (b) $F = -\frac{1}{2}kx$ (c) $F = -\frac{1}{2}kx^2$ (d) $F = -kx$

Questions 16-17. Consider a graph of displacement versus time for a simple harmonic oscillator shown below.



16. The amplitude of oscillations is:

(a) 0.2 m (b) 0.4 m (c) 0.8 m (d) 2π m

17. The frequency of oscillations is:

(a) 0.5 Hz (b) 1 Hz (c) 1.5 Hz (d) 2 Hz

Questions 18-20. Consider a simple harmonic oscillator with the mass m= 1 kg. The displacement as a function of time is given by:

$$x(t) = (5.0m)\cos\left(\frac{2\pi}{5}t + \frac{\pi}{4}\right)$$

where *x* is in meters and *t* is in seconds.

18. The frequency of oscillations is:

(a) 0.2 Hz (b) 0.5 Hz (c) 1 Hz (d) 1.25 Hz

19. How far from the origin is the oscillator at $t = \frac{5}{24}s$?

(a) 1.5 m (b) 2.5 m (c) 3.5 m (d) 4.5 m

20. The total mechanical energy of the oscillator is:

(a) π J (b) π^2 J (c) $2\pi^2$ J (d) $4\pi^2$ J