1. A 250 N force acts at 40° above the horizontal. What is its horizontal component, in N?

   _____ N

2. A 3.0 kg toolbox rests on a shelf. How large is the upward force from the shelf, in N? Use $g = 9.81\ \dfrac{\text{m}}{\text{s}^2}$.

   _____ N

3. A particle can be in equilibrium while it is moving.

   ☐ True ☐ False

4. A 60 N push acts at right angles to a spanner, 0.30 m from the nut. What moment does it apply, in N · m?

   _____ N · m

5. An 8 m beam rests on a pin at A and a roller at B. It carries 20 kN at 3 m from A. What is the roller reaction R_B, in kN?

   _____ kN

6. A straight member that is pinned at both ends and loaded only at its joints carries only a force along its own axis.

   ☐ True ☐ False

7. The friction force on a block at rest is always $\mu_s N$.

   ☐ True ☐ False

8. A floor beam carries a uniform 3 $\dfrac{\text{kN}}{\text{m}}$ over its whole 5 m length. What is the resultant load, in kN?

   _____ kN

9. If the angle θ is measured from the **y-axis**, the x-component of the force is $F \sin\theta$.

   ☐ True ☐ False

10. You draw the free-body diagram of a beam resting on a pin at A and a roller at B. Which forces belong on it? Select all that apply.

    ☐ The roller's reaction at B

    ☐ The force the beam exerts on the pin

    ☐ The two reaction components at the pin A

    ☐ The internal force inside the beam at mid-span

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Tick every correct option.

1. **191.5 N**

   $F_x = 250\cos 40^\circ = 191.5$ N. The vertical part is $250\sin 40^\circ = 160.7$ N; swapping sine and cosine gives that trap.

2. **29.43 N**

   The box does not move, so the shelf's push balances the weight: $N = mg = 3.0 \times 9.81 = 29.4$ N.

3. **True**

   Zero resultant force means zero acceleration, not zero velocity. A particle moving in a straight line at constant speed is in equilibrium too.

4. **18 N · m**

   The push is perpendicular, so the arm is the full 0.30 m: $M = 60 \times 0.30 = 18$ N · m.

5. **7.5 kN**

   Moments about A: $R_B \times 8 = 20 \times 3$, so $R_B = 7.5$ kN.

6. **True**

   It is a two-force member, so the two end forces are equal, opposite and along the line through both pins, which is its axis.

7. **False**

   $\mu_s N$ is the most static friction can give. A block at rest feels only the friction that equilibrium needs, which reaches $\mu_s N$ only when it is about to slip.

8. **15 kN**

   The resultant is the area of the rectangle: $R = wL = 3 \times 5 = 15$ kN, acting at the middle, 2.5 m from either end.

9. **True**

   The cosine always belongs to the axis the angle is measured from. Measured from y, $F_y = F\cos\theta$ and $F_x = F\sin\theta$.

10. **The roller's reaction at B; The two reaction components at the pin A; The beam's weight at its centre of gravity**

    Only forces acting **on** the beam from outside appear. The beam's force on the pin belongs on the pin's diagram, and an internal force appears only if you cut there.

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