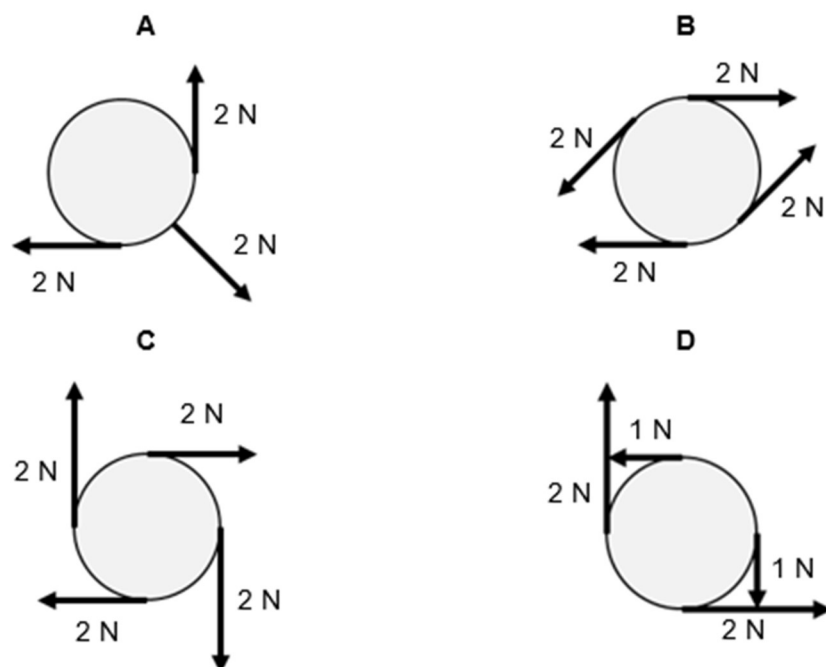
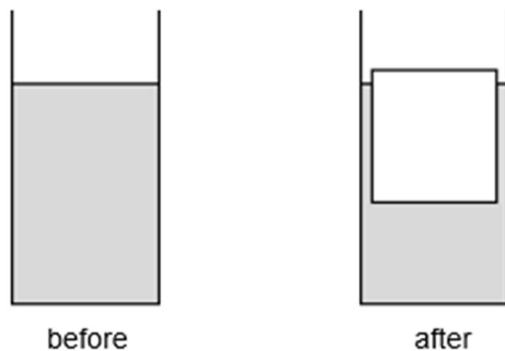


1

Which of the following diagrams shows a body in equilibrium?



2

A cup contains 100 g of water. The pressure at the bottom of the cup is P .

50 g of water is removed from the cup, frozen into ice, and added back to the cup, as shown above. 10% of the volume of the ice is above the surface of the water.

What is the new pressure at the bottom of the cup?

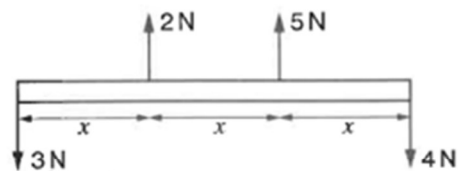
- A** $0.95P$ **B** P **C** $1.05P$ **D** $1.10P$

3

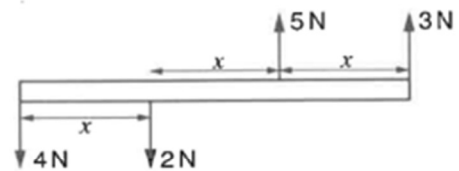
The force diagrams show all the forces acting on a beam of length $3x$.

Which force system causes only rotational motion of the beam without any linear movement?

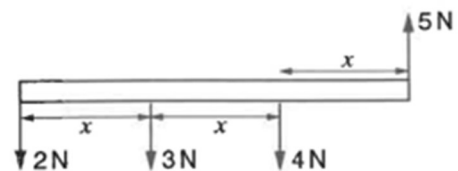
A



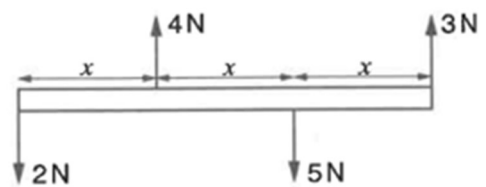
B



C



D



4

A space probe is due to be launched to one of the moons of Saturn. It is believed that the conditions on the moon are such that methane exists in liquid form and that lakes of methane may exist.

The probe is tested and it can be lowered to a depth of 64 m in a lake of water on Earth before the pressure is too high.

The following data regarding the Earth and the moon of Saturn are available:

atmospheric pressure on Earth = 100 kPa

density of water in lake on Earth = 1000 kg m^{-3}

atmospheric pressure on moon of Saturn = 35 kPa

density of liquid methane on moon of Saturn = 740 kg m^{-3}

gravitational field strength on moon of Saturn = 3.6 N kg^{-1}

What is the maximum depth the probe may be lowered to, in a lake of methane on the moon of Saturn?

A 220 m

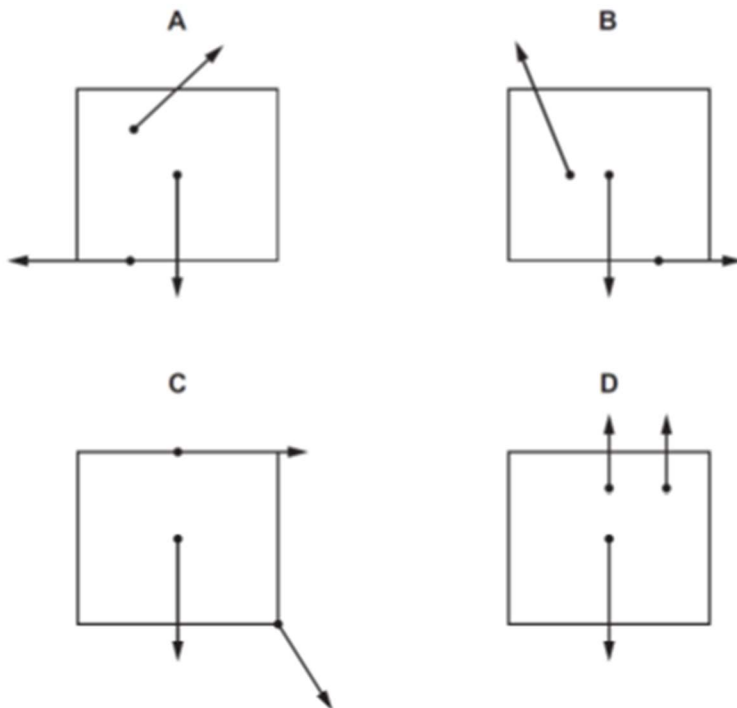
B 240 m

C 260 m

D 270 m

- 5 Three coplanar forces act on a block.

Which diagram shows the directions of the forces such that the block could be in equilibrium?



- 6 Liquid Q has twice the density of liquid R.

At depth x in liquid R, the pressure due to the liquid is 4 kPa.

At which depth in liquid Q is the pressure due to the liquid 9 kPa?

A $\frac{8x}{9}$

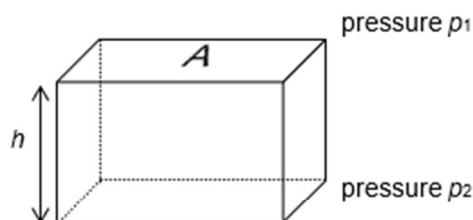
B $\frac{9x}{8}$

C $2x$

D $\frac{18x}{4}$

7

A solid block of material of density ρ , height h and horizontal surface area A is immersed in a liquid. The pressures of the liquid at the upper and lower surfaces are p_1 and p_2 respectively.

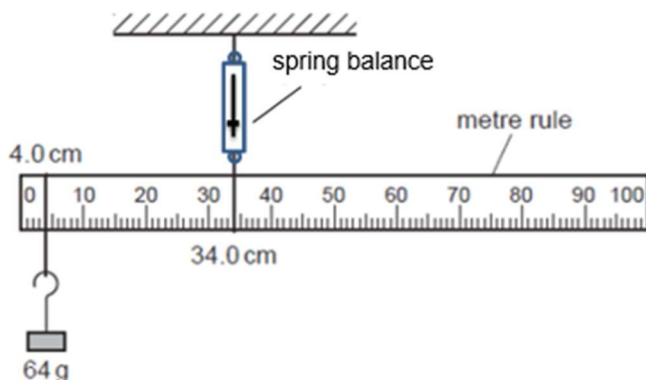


Which of the following is an expression for the upthrust on the block?

- A $Ah\rho g$
- B $Ah\rho g + p_1A$
- C p_2A
- D $p_2A - p_1A$

8

A non-uniform metre rule is pivoted at the 34.0 cm mark, as shown.

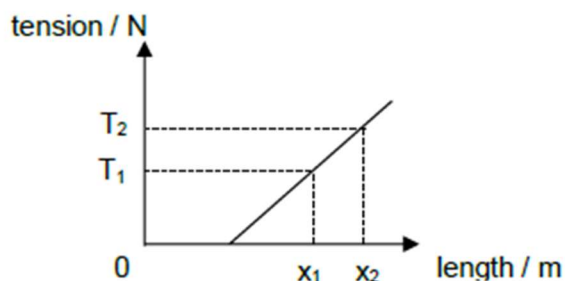


The rule balances when a 64 g mass is hung from the 4.0 cm mark and the spring balance shows a reading of 200 g.

At which mark is the centre of mass of the rule located?

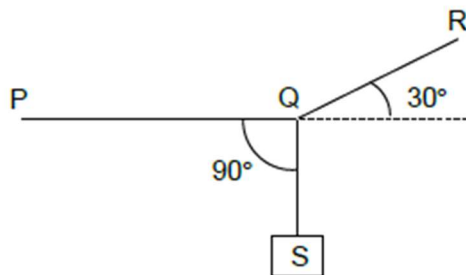
- A 48.1 cm
- B 50.0 cm
- C 64.1 cm
- D 66.0 cm

- 9 The graph below shows how the length of a wire changes with the tension in the wire.



What is the extra energy stored in the wire when the tension is increased from T_1 to T_2 ?

- A $\frac{1}{2} (T_2 + T_1)(x_2 - x_1)$
B $\frac{1}{2} (T_2 + T_1)(x_2 + x_1)$
C $\frac{1}{4} (T_2 + T_1)(x_2 - x_1)$
D $\frac{1}{4} (T_2 + T_1)(x_2 + x_1)$
- 10 In the diagram below, a body S of weight W hangs vertically by a thread tied at Q to the string PQR.



If the system is in equilibrium, what is the tension in the section PQ?

- A $W \cos 30^\circ$ B $W \cos 60^\circ$ C $W \tan 30^\circ$ D $W \tan 60^\circ$

- 11 A cylindrical block of wood has a cross-sectional area A and weight W . It is completely immersed in water with its axis vertical. The block experiences pressures p_t and p_b at its top and bottom surfaces respectively.

Which of the following expressions is equal to the upthrust on the block?

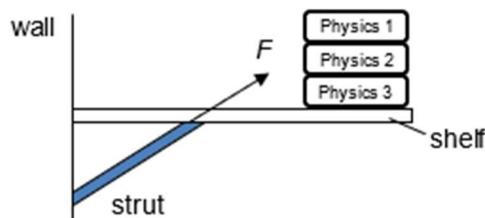
- A $(p_b - p_t)A + W$
- B $(p_b - p_t)$
- C $(p_b - p_t)A$
- D $(p_b - p_t)A - W$

- 12 The engine of a boat supplies a constant power of 110 kW to propel the boat forward. The boat attains a maximum speed of 21.0 m s^{-1} .

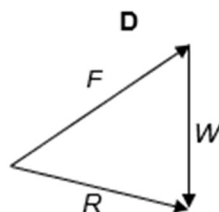
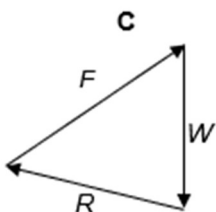
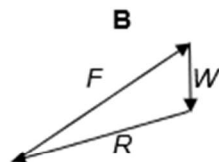
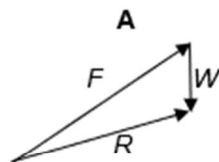
If the magnitude of the resistive force acting on the boat is proportional to the square of the boat's speed, what is the resultant force acting on the boat when it is moving at the instant when its speed is 15.0 m s^{-1} ?

- A 2.7 kN
- B 3.6 kN
- C 4.7 kN
- D 7.3 kN

- 13 The figure below shows a light wall-mounted shelf supported by a strut. The shelf experiences a force F due to the strut along the axis of the strut, as well as a force R due to the wall. A stack of Physics Revision Packages of weight W is placed near the edge of the shelf.



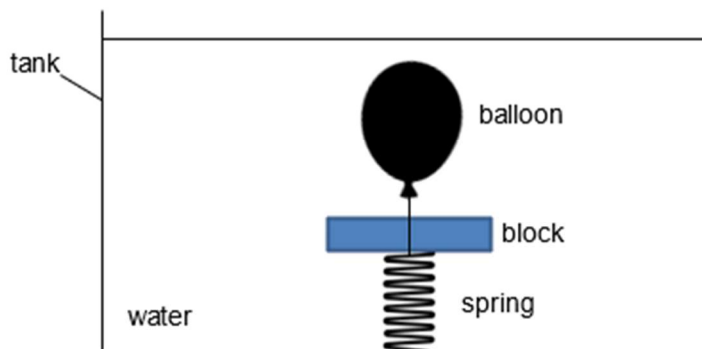
Which vector diagram correctly shows the forces acting on the shelf?



14

A uniform plastic block with a light balloon attached to its centre is supported by a spring that is fixed to the bottom of a tank. The tank is completely filled with water of density 1000 kg m^{-3} as shown.

The block is in equilibrium and has a weight of 60 N and a volume of $5.0 \times 10^{-3} \text{ m}^3$. The spring has a spring constant of 5000 N m^{-1} . The balloon displaces 0.015 m^3 of water.



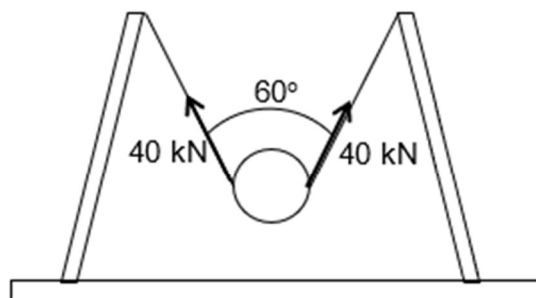
What is the extension of the spring?

- A** 0.0076 m **B** 0.017 m **C** 0.027 m **D** 0.051 m

15

In reverse bungee jumping, passengers in a spherical cage are pulled upwards by a pair of elastic cords attached to the side of the cage as shown.

The weight of the passengers and the cage is W .

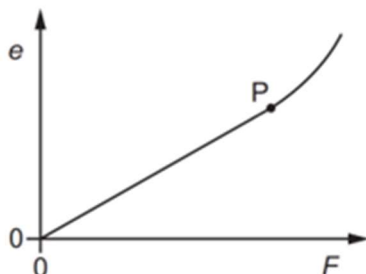


What is the maximum value of W if the passengers and the cage are flung upwards with an acceleration of g ?

- A** 20 kN **B** 35 kN **C** 46 kN **D** 69 kN

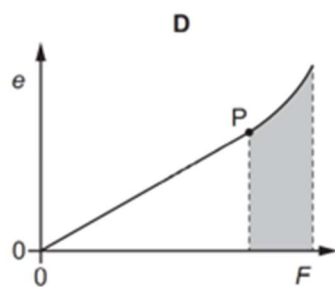
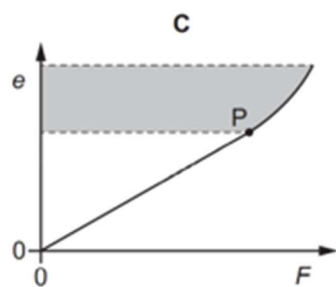
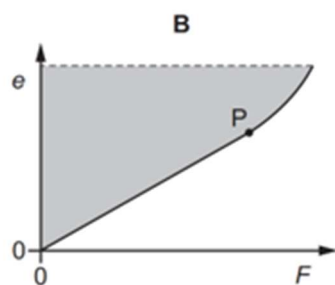
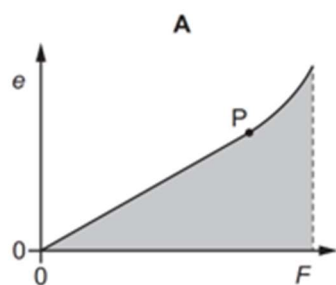
16

Forces are applied to the ends of a rod so that its length increases. The variation with force F of the extension e of the rod is shown.



The point P is the elastic limit. Plastic deformation occurs when the rod is extended beyond point P, causing it to be permanently distorted.

Which shaded area represents the work done during the plastic deformation of the rod?



17

A man, carrying a large rock, sits in a boat on a lake. He drops the rock into the lake. Assume the total volume of the water in the lake is constant, the water level of the lake

- A** increases because the density of the rock is larger than water hence the upthrust acting on it would be larger for equilibrium to occur.
- B** decreases because the density of the rock is larger than water and hence displaces a smaller volume of water as compared to when it was on the boat.
- C** remains the same because the total mass of all the objects in the lake remains the same.
- D** remains the same because the rock will sink to the bottom of the lake and experience a normal contact force.

18

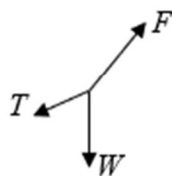
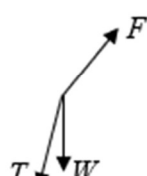
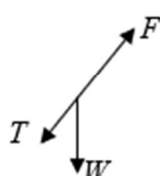
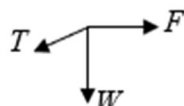
A thin plastic bag is found to have a mass m when empty and pressed flat. When the bag is filled with air at atmospheric pressure and re-weighed on a weighing scale, the mass is again found to be m .

What is the correct reason?

- A** The gravitational field strength is constant at 9.81 N kg^{-1} .
- B** The density of air inside and outside the bag is the same.
- C** The upthrust experienced by the flat and the inflated plastic bag is the same.
- D** The weight of the bag when flat and when inflated is the same.

19

A kite is held stationary under the influence of three forces: the tension T in the string, the force F of the wind and the weight W of the kite. Which one of the following force diagrams could be correct?

**A****B****C****D**