

Chapter 5

Force and Newton's Laws

1. one Newton equals

- (a) m/s^2 **(b) Kg.m/s^2** (c) Kg /s^2 (d) Kg.m

2. A 32 Kg box is moving with a constant speed of 24.7 m/s- The net force on the box is:

- (a) zero** (b) 4 N (c) 5 N (d) 45 N

$$F_{\text{net}} = \text{zero} \Rightarrow \sum F = 0 \quad [a = 0]$$

3. Three forces act on a particle of mass m $\vec{F}_1 = 20\hat{i} + 0\hat{j}$ $\vec{F}_2 = 40\hat{i} + 100\hat{j}$ If the particle moves with constant speed of 4m/s. then F_3 is

- (a) $80\hat{i} + 60\hat{j}$ (b) $80\hat{i} - 60\hat{j}$ (c) $-80\hat{i} + 60\hat{j}$ **(d) $-120\hat{i} - 60\hat{j}$**

$\therefore v \rightarrow \text{Constant}$

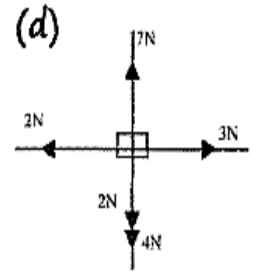
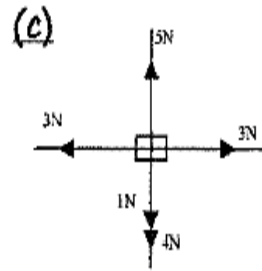
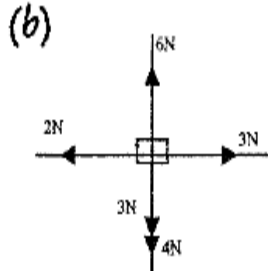
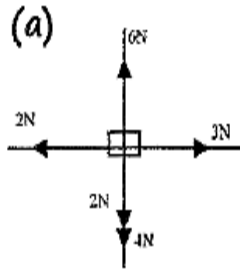
$$\therefore \sum \vec{F} = 0$$

$$\vec{F}_1 + \vec{F}_2 + \vec{F}_3 = 0$$

$120\hat{i} + 160\hat{j}$

$$\left. \begin{array}{l} \vec{F}_3 = -(\vec{F}_1 + \vec{F}_2) \\ = -120\hat{i} - 160\hat{j} \end{array} \right\}$$

4. In which figure of the following the particle moves with constant velocity?



بجمله جسم برده ثابتة هذا يكون $\sum F_y = 0$ و $\sum F_x = 0$
 و شرط هذا يتحقق من بينه فقط c

5. When a force of 10N is applied to a body its acceleration is 2m/s^2 . The mass of the body is:

- (a) 20kg (b) 10kg (c) 0.5kg **(d) 5kg**

$$\begin{array}{l}
 F = 10 \text{ N} \\
 a = 2 \text{ m/s}^2 \\
 m = ??
 \end{array}
 \quad \left| \quad
 \begin{array}{l}
 m = \frac{F}{a} = \frac{10}{2} = 5 \text{ kg}
 \end{array}$$

6. A force accelerates a 5kg particle from rest to a speed of 12 m/s in 4s. The magnitude of this force is:

- (a) 10 N (b) Zero (c) 20 N (d) 15N

$$\begin{array}{l}
 m = 5 \text{ kg} \\
 v_0 = 0 \\
 v = 12 \text{ m/s} \\
 t = 4 \text{ s}
 \end{array}
 \quad \left| \quad
 \begin{array}{l}
 v = v_0 + at \\
 12 = 0 + 4a \\
 a = 3 \text{ m/s}^2
 \end{array}
 \quad \left| \quad
 \begin{array}{l}
 F = ma \\
 = 5 \times 3 = 15 \text{ N}
 \end{array}$$

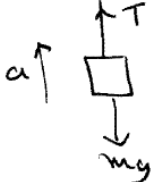
7. If the acceleration of a 1.0 kg moving particle by a force F is $a = 3i + 4j \text{ m/s}^2$, the magnitude of the acting force is:

- (a) 2.5N (b) 7.5N **(c) 5N** (d) 10N

$$\begin{aligned}
 m &= 1 \text{ kg} \\
 \vec{a} &= 3i + 4j \\
 F &=?
 \end{aligned}
 \quad \left| \quad
 \begin{aligned}
 \vec{F} &= m \vec{a} \\
 &= 3i + 4j \\
 |\vec{F}| &= \sqrt{9 + 16} \\
 &= \sqrt{25} = 5 \text{ N}
 \end{aligned}$$

8. An elevator of total mass 2000kg moves upward. The tension in the cable pulling the elevator is 24000N. the acceleration of the elevator is.

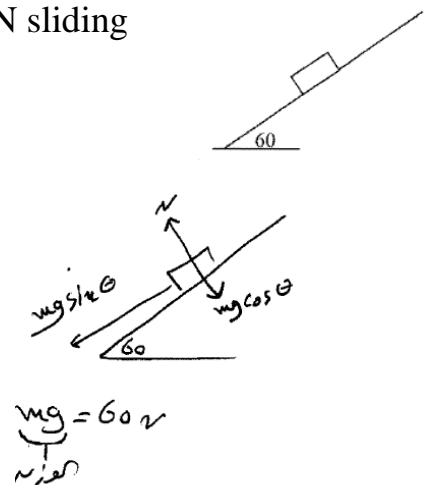
- (a) 2.2 m/s²** (b) 9.8 m/s² (c) 12m/s² (d) 4m/s²

$$\begin{aligned}
 m &= 2000 \text{ kg} \\
 T &= 24000 \text{ N} \\
 a &=?
 \end{aligned}
 \quad \left| \quad
 \begin{aligned}
 \sum F &= ma \\
 T - mg &= ma \quad \text{... لساعة (تكرار) (أعلى) فإن} \\
 a &= \frac{T - mg}{m} \\
 &= \frac{24000 - 2000 \times 9.8}{2000} = 2.2 \text{ m/s}^2
 \end{aligned}$$


9. From the figure the normal force on a block of weight 60N sliding down a frictionless plane is:

- (a) 50N (b) 30N (c) 25N (d) 40N

$$\begin{aligned}
 N &= mg \cos \theta \\
 &= 60 \cos 60 \\
 &= 30 \text{ N}
 \end{aligned}$$



10. A block of mass 4kg is pushed up a smooth 30° inclined plane by a constant force of magnitude 40N and parallel to the incline, the magnitude of the acceleration of the block is.

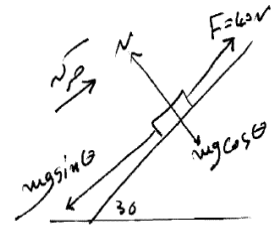
- (a) zero (b) 9.8m/s² (c) 1.2m/s² (d) 5.1m/s²

$$\Sigma F = a \Sigma m$$

$$F - mg \sin \theta = a m$$

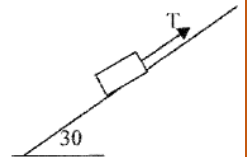
$$a = \frac{F - mg \sin \theta}{m}$$

$$= \frac{40 - 4 \times 9.8 \sin 30}{4} = 5.1 \text{ m/s}^2$$



11. if the mass of the block is 5kg. Find T if the block moves with constant velocity upward the smooth inclined plane, (or at rest)

- (a) 45N **(b) 24.5 N** (c) 42N (d) 25N

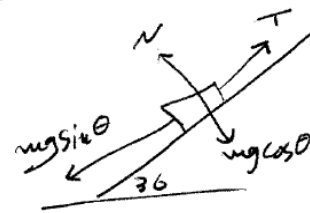


∴ جسم بقره بقره نا بقره [صدا ادا كان ساكن]

$$T = mg \sin \theta$$

$$T = 5 \times 9.8 \sin 30$$

$$= 24.5 \text{ N}$$



12. A force of 10 N is acting on an object of mass 10 kg. What is the acceleration produced in it?

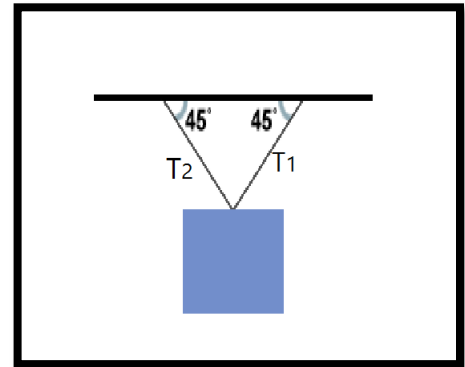
- a) 1m/s²** b) 100 m/s² c) 2 m/s² d) 10 m/s²

$$F = ma \rightarrow a = \frac{F}{m} = \frac{10}{10} = 1 \text{ m/s}^2$$

13. 1 newton = _____

- a) 1 kg .m /s b) 1 kg / m.s² **c) 1 kg. m / s²** d) kg .m.s

Question 14 : 5kg picture frame is held up by two ropes, each inclined 45° below vertical, as shown below. What is the tension in each of the ropes?



$$\sum F_x = 0$$

$$T_1 \cos 45 - T_2 \cos 45 = 0 \dots \dots 1$$

$$\therefore T_1 \cos 45 = T_2 \cos 45 \dots \dots 2$$

$$\sum F_y = 0$$

$$T_1 \sin 45 + T_2 \sin 45 - mg = 0 \dots \dots 3$$

From 2

~~$$T_1 \cos 45 = T_2 \cos 45$$~~

So **$T_1 = T_2$** 4

Using 4 in 3

$$T_1 \sin 45 + T_1 \sin 45 - mg = 0$$

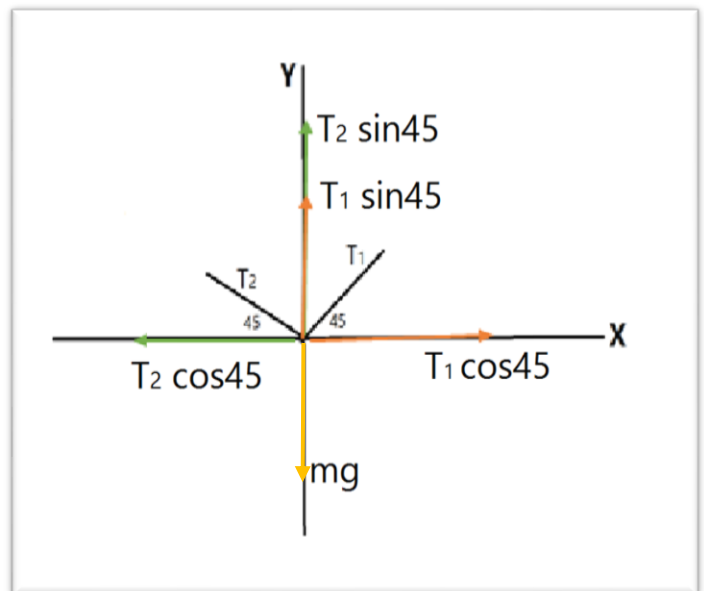
$$2 T_1 \sin 45 - mg = 0$$

$$2 T_1 \sin 45 = mg$$

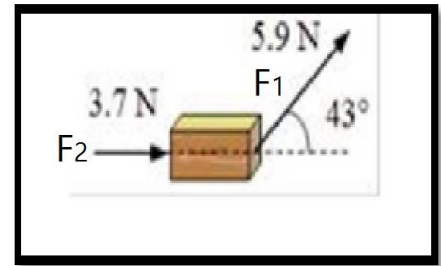
$$T_1 = \frac{mg}{2 \sin 45} = \frac{5 \times 9.8}{2 \times \sin 45} = 34.6 \text{ N}$$

By using 4 **$T_1 = T_2$**

$$T_2 = 34.6 \text{ N}$$



Question 15: Two forces act on 4.5 kg block resting on frictionless surface as shown. What is the magnitude of the horizontal acceleration of the block?



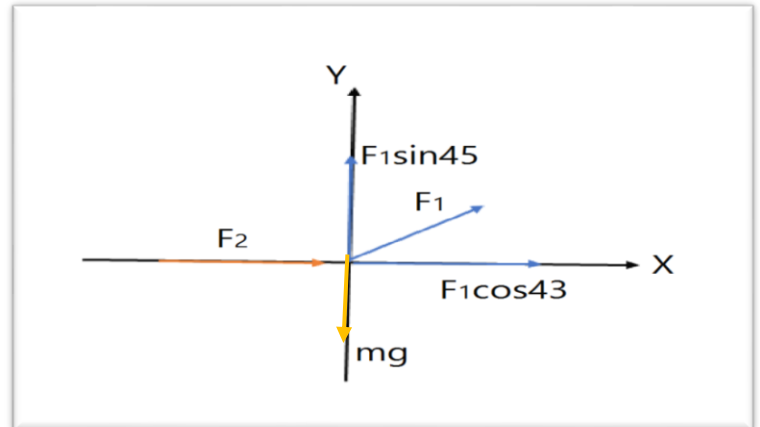
$$\sum F_x = ma$$

$$F_1 \cos 43 + F_2 = ma$$

$$5.9 \cos 43 + 3.7 = ma$$

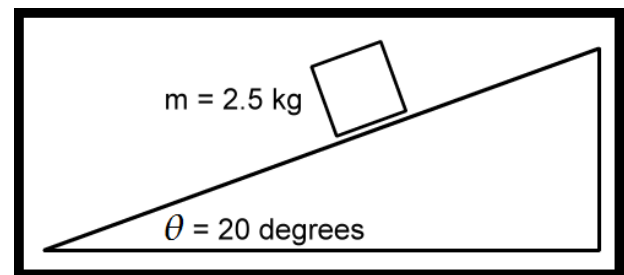
$$a = \frac{5.9 \cos 43 + 3.7}{4.5}$$

$$a = 1.78 \text{ m/s}^2$$



Question 16 : A block with a mass of 2.5 kg is placed on an inclined plane. The angle of the incline is 20 degree.

Determine the acceleration of the block as it slides down the plane ?

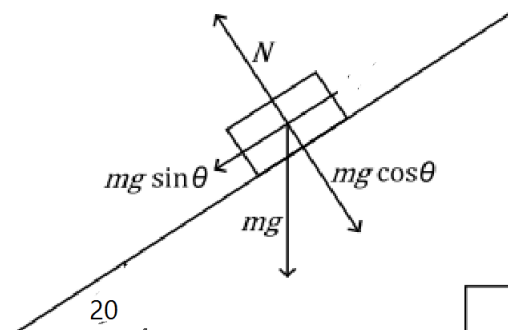


$$\sum F_x = ma$$

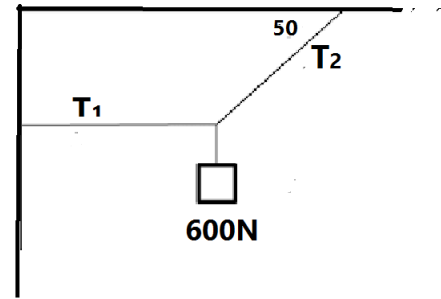
$$-mg \sin 20 = ma$$

$$a = -g \sin 20 = -9.8 \times \sin 20$$

$$a = -3.4 \text{ m/s}^2$$



17 – In Figure , a block weighing 600 N hung by two strings. What are the tensions in the two strings?



$$\sum F_x = 0$$

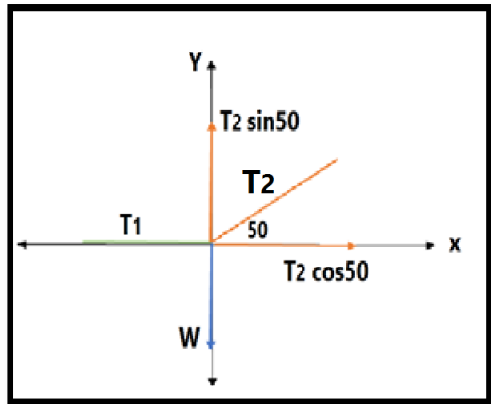
$$T_2 \cos 50 - T_1 = 0 \dots\dots\dots 1$$

$$T_1 = T_2 \cos 50 \dots\dots\dots 2$$

$$\sum F_y = 0$$

$$T_2 \sin 50 - w = 0$$

$$T_2 = \frac{W}{\sin 50} = \frac{600}{\sin 50} = 783 \text{ N}$$



So we can find T_1 by using equation 2

$$T_1 = 783 \cos 50 = 503 \text{ N}$$

18- Two forces, F_1 and F_2 , act on a 5-kg mass. If $F_1 = 20$ N and $F_2 = 15$ N, Find the acceleration in (a) and (b) of the Figure

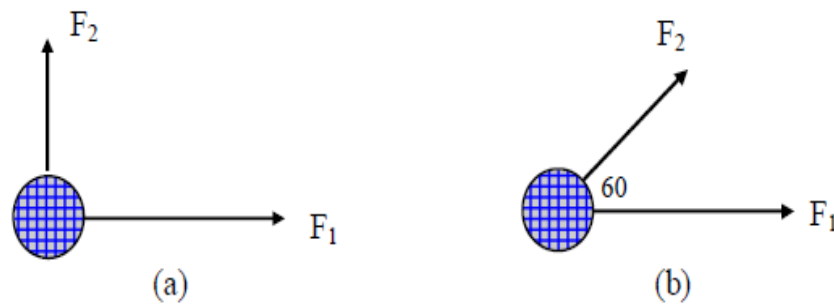


Figure 3.1

$$(a) \Sigma F = F_1 + F_2 = (20i + 15j) \text{ N}$$

$$\Sigma F = ma \quad \therefore 20i + 15j = 5a$$

$$a = (4i + 3j) \text{ m/s}^2 \quad \text{or} \quad a = 5 \text{ m/s}^2$$

$$(b) F_{2x} = 15 \cos 60 = 7.5 \text{ N}$$

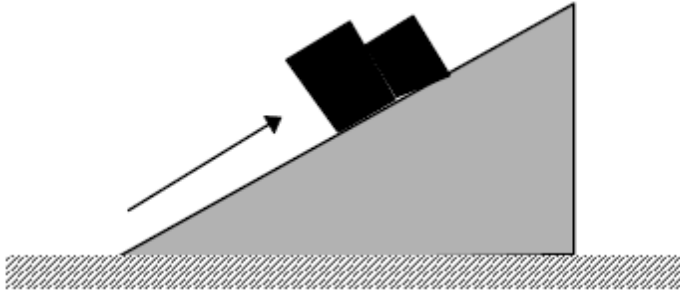
$$F_{2y} = 15 \sin 60 = 13 \text{ N}$$

$$F_2 = (7.5i + 13j) \text{ N}$$

$$\Sigma F = F_1 + F_2 = (27.5i + 13j) = ma = 5a$$

$$a = (5.5i + 2.6j) \text{ m/s}^2 \quad \text{or} \quad a = 6.08 \text{ m/s}^2$$

19- Two blocks having masses of 2 kg and 3 kg are in contact on a fixed smooth inclined plane as in Figure. (a) Treating the two blocks as a composite system, calculate the force F that will accelerate the blocks up the incline with acceleration of 2m/s^2 ,

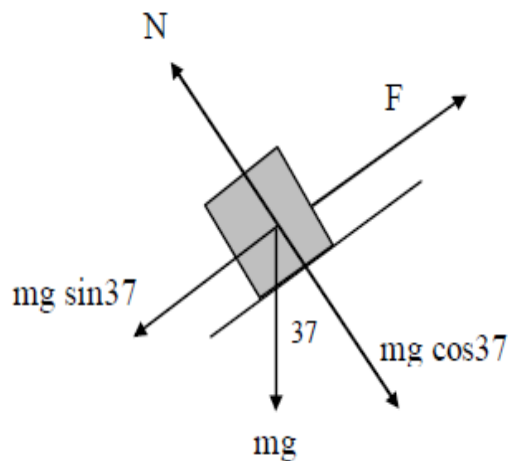


We can replace the two blocks by an equivalent 5 kg block as shown in Figure 3.3. Letting the x axis be along the incline, the resultant force on the system (the two blocks) in the x direction gives

$$\Sigma F_x = F - W \sin(37^\circ) = m a_x$$

$$F - 5(0.6) = 5(2)$$

$$F = 39.4 \text{ N}$$



20-Choose the correct answer

1 .Mass of object is quantitative measure of its inertia stated law is newton's

- A. first law**
- B. second law
- C. third law
- D. fourth law

2 .Every action has an equal and opposite reaction'' is newton's

- A. first law
- B. second law
- C. third law**
- D. fourth law

3. The S.I. unit of force is

- 1.erg
- 2.joule
- 3.newton**
- 4.dyne

4. What is the force acting on an object of mass 10 kg moving with a uniform velocity of 10 m/s ?

- 1.100 N
- 2.10 N
- 3.0**
- 4.1 N