

Instructions

- Round all final answers off to 2 decimal places, unless stated otherwise
 - If any unit has an exponent, just type the exponent as a normal number, eg m.s-2
 - Always indicate direction for all vectors, unless otherwise stated (when they only ask for the **magnitude**)
 - Use a comma for decimal numbers
-

$$F_{net} = ma$$

$$W = mg$$

$$\mu_s = \frac{F_N}{f_s}$$

$$\mu_k = \frac{F_N}{f_k}$$

Question 1

Multiple choice questions: Only write the letter of the correct option:

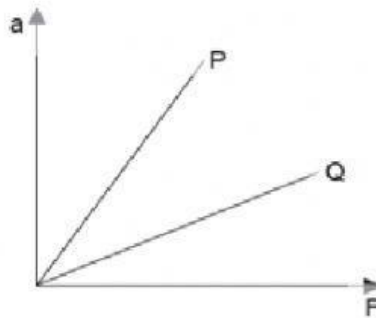
1.1 which one of the following forces is a non-contact force

- A. Tension
- B. Normal force
- C. Gravitational force
- D. Air friction

1.2 A lift is travelling at **constant** velocity. The tension in the cable is:

- A. $F_T = F_g$
- B. $F_T = F_{\text{net}}$
- C. $F_T = \frac{1}{2}F_g$
- D. $F_T = F_g + \frac{1}{2}F_{\text{net}}$

1.3 In an investigation of the relationship between acceleration (a) and net force (F) for two objects P and Q moving on frictionless surface. The following graphs were obtained:

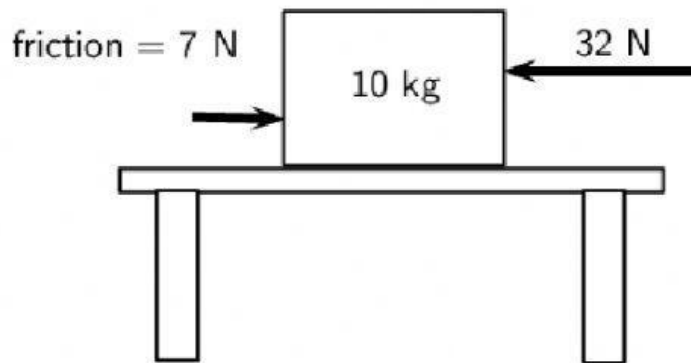


Which one of the following statements is true?

- A. Object Q is smaller than object P.
- B. Object Q has a bigger mass than object P.
- C. The gradient of the graph is not affected by the mass of the object.
- D. Object P and Q have equal mass.

Question 2

A 10kg box is placed on a table. A horizontal force of magnitude 32N is applied to the box. A frictional force of magnitude 7N is present between the surface and the box.



Draw a force diagram in your book indicating all of the forces acting on the box. (4)

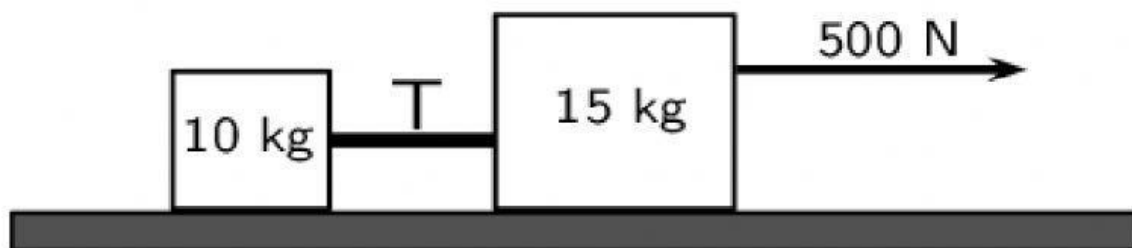
2.1 Calculate the acceleration of the box. (4)

Answer	unit	Direction

a = _____

Question 3

Two crates, 10kg and 15kg respectively, are connected with a thick rope according to the diagram. A force, to the right, of 500N is applied. The 10kg block experiences a frictional force of 150N and the 15kg block experiences a 300N frictional force.



3.1 Calculate the acceleration of the 15kg block. (4)

{remember that you can look at the system as a whole here, since the motion is in a straight line}

$a =$ _____

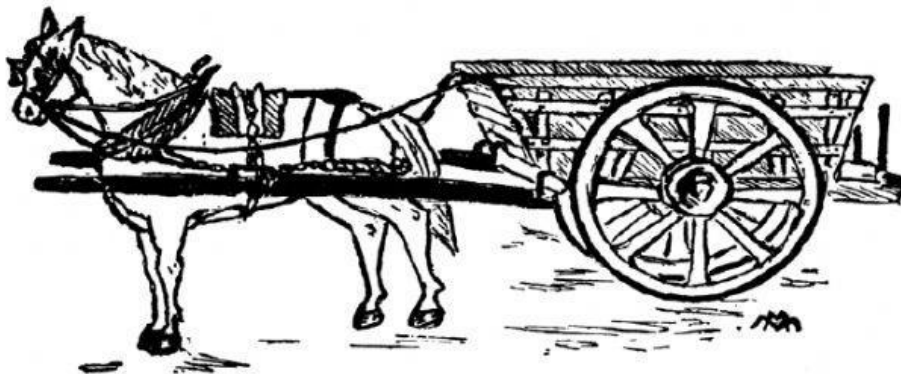
- 3.2 When determining the tension in the cable between two objects, must you isolate a block or look at the whole system. (1)

- 3.3 Calculate the **magnitude** of the tension in the rope at T. (4)

$F_t =$ _____

Question 4

- 4.1 A horse pulls a 120kg cart so that it accelerates at $1.4\text{m}\cdot\text{s}^{-2}$ to the left along a rough tar road.



- 4.1 Draw a fully labelled free body diagram in your book of the forces acting on the cart (4)
- 4.2 Calculate the kinetic friction between the cart and the road, if the coefficient of kinetic friction between the wheels and the road is 0,28. (3)

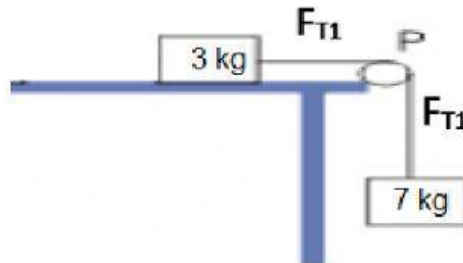
$f_k =$ _____

- 4.3 Calculate the force the horse must exert in order to accelerate at $1.4\text{m}\cdot\text{s}^{-2}$ (4)

$F_a =$ _____

Question 5

Consider the image below and calculate the following.
The 3 kg block has a kinetic frictional force of 2 N acting.



5.1

When all the blocks within a system are not all moving in the same direction, it is important to look at the system as a whole / isolate blocks and solve simultaneously

5.2 Calculate the acceleration in the system (4)

$a =$ _____

5.3 **Magnitude** of the tension in F_{T1} (4)

$F_t =$ _____

Questions focusing on Normal force:

Question 6

Calculate the normal force on the 20 kg block

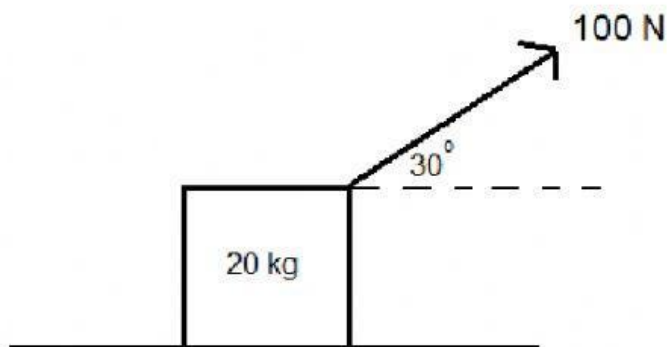


$F_n =$ _____

Question 7

7.1 Draw a free body diagram in your book of all the forces acting on the box

{Hint – break the diagonal force up into its 2 components}



7.2 Choose the correct equation that applies to the diagram

$$F_g = F_N$$

$$F_g = F_N + F_y$$

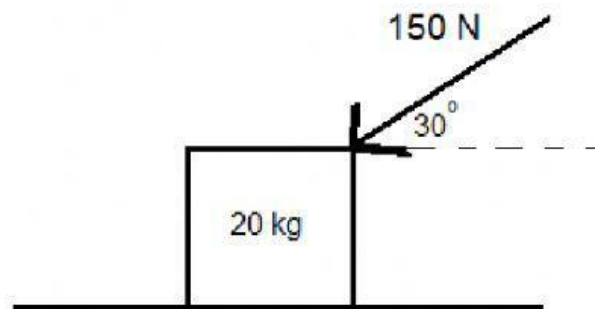
$$F_g = F_N - F_y$$

7.3 Calculate the normal force on the box below.

$F_n =$ _____

Question 8

8.1 Draw a free body diagram of all the forces acting on the box below.



8.2 Choose the correct equation below

$$F_g = F_N$$

$$F_n = F_g - F_y$$

$$F_n = F_y + F_g$$

8.3 Calculate the normal force acting on the box.

$$F_n = \underline{\hspace{2cm}}$$

Question 9

9.1 Choose the correct equation to determine the normal force on the box

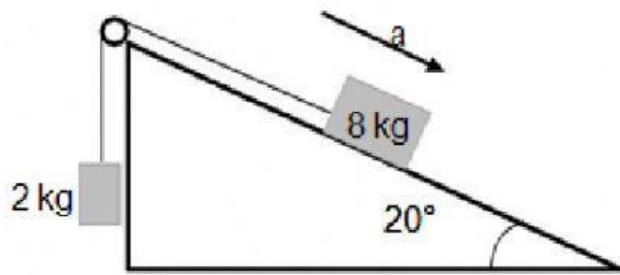
$$F_n = F_g$$

$$F_n = F_g - F_{g\parallel}$$

$$F_n = F_{g\parallel}$$

$$F_n = F_{g\perp}$$

9.2 Calculate the magnitude of the normal force acting on the block below



$F_n =$ _____

Remember:

Y sin if you can cos x

$$F_x = F \cdot \cos \theta$$

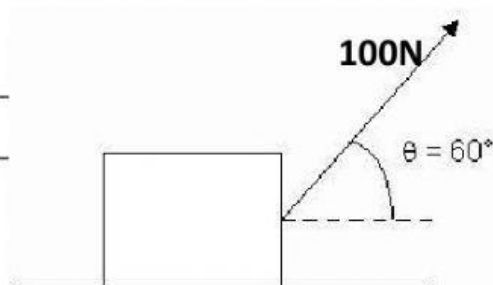
$$F_y = F \cdot \sin \theta$$

Question 10

10.1 Determine the horizontal and vertical components of the following force.

$F_y =$ _____

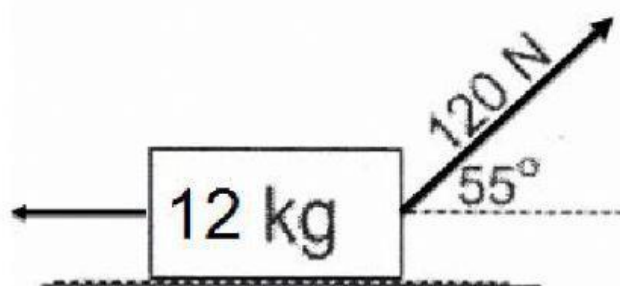
$F_x =$ _____



(4)

10.2 A 12 kg block is being pulled along a rough horizontal surface with a force of 120N, which is at an angle of 55° to the horizontal. The block experiences a frictional force of 15N.

$F_f = 15\text{N}$



10.2.1 Calculate the acceleration of the block.

(6)

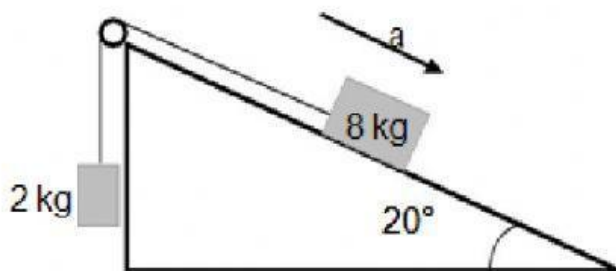
$a =$ _____

- 10.2.2 Without any calculation, state if the frictional forces will **INCREASE** / **DECREASE** or **STAY THE SAME**, if the pulling force is increased.
(Choose one) (1)

[11]

Question 11

An 8 kg wooden block is attached to a 2 kg wooden block by means of a weightless inelastic string which passes over a frictionless pulley. The block accelerates down a rough plane inclined at 20° to the horizontal as shown below.



The tension in the string is 21 N.

- 11.1 Draw a labeled force diagram of all the forces acting on the 8 kg block. (3)

- 11.2 By applying Newton's second law **separately to each block**, calculate the

- 11.2.1 The magnitude of the acceleration of the system

$a =$ _____

- 11.2.2 The coefficient of friction acting on the 8 kg block.

(round off to 3 decimal places)

(8)

$\mu_s =$ _____ {3 decimal places}