Physical science | Grade 12 revision worksheet

Forces and Newton's Laws | February 2021

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

$$F_{net} = ma \qquad W = mg$$

$$\mu_s = \frac{F_N}{f_s} \qquad \mu_k = \frac{F_N}{f_k}$$

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:

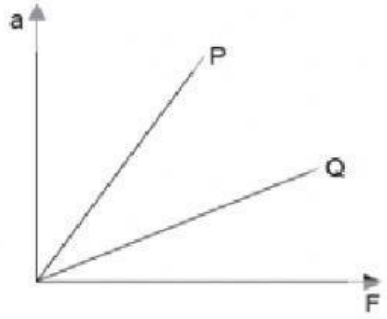
A. $F_T = F_g$

B. $F_T = F_{net}$

C. $F_T = {}^1/_2 F_g$

D. $F_T = F_g + {}^1/_2 F_{net}$

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:

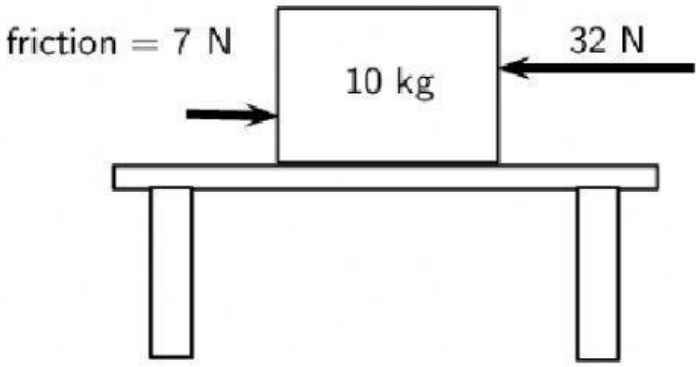


Which one of the following statements is true?

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)**

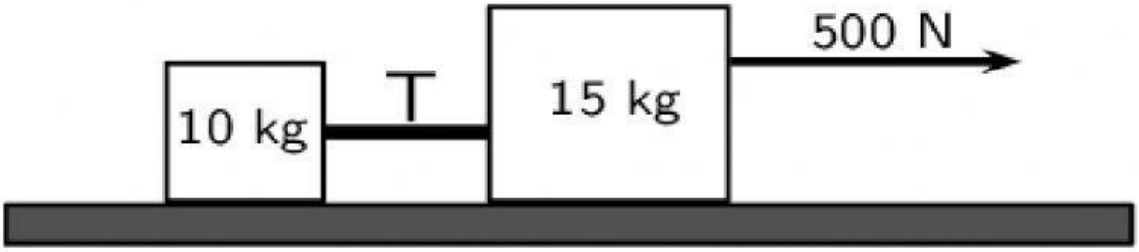
2.1 Calculate the acceleration of the box. **(4)**

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

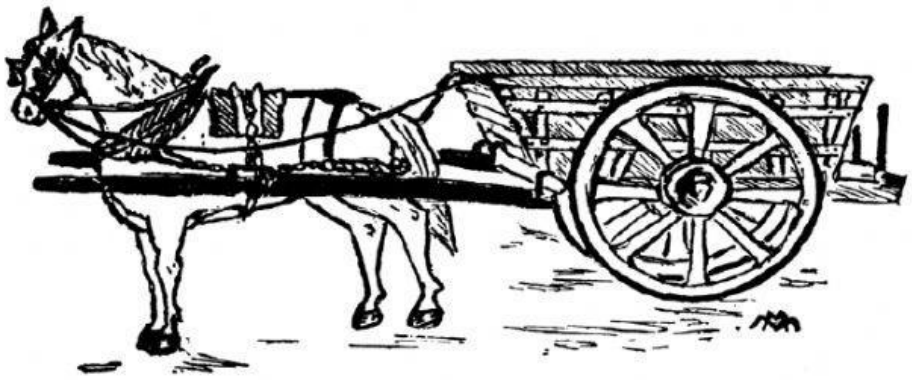
Isolate a block or look at the whole system. **(1)**

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

Ft = _____ _____

Question 4

4.1 A horse pulls a 120kg cart so that it accelerates at 1.4m.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)**

fk = _____ _____ _____

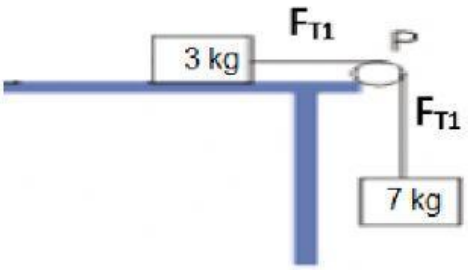
4.3 Calculate the force the horse must exert in order to accelerate at 1.4m.s^{-2} **(4)**

Fa = _____ _____ _____

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 = _____ _____ _____

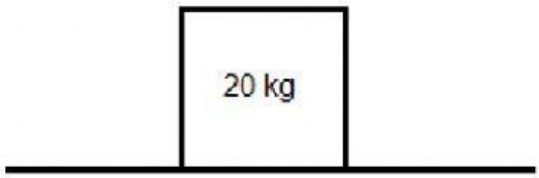
5.3 **Magnitude** of the tension in F_{T1} **(4)**

Ft = _____ _____

Questions focusing on Normal force:

Question 6

Calculate the normal force on the 20 kg block

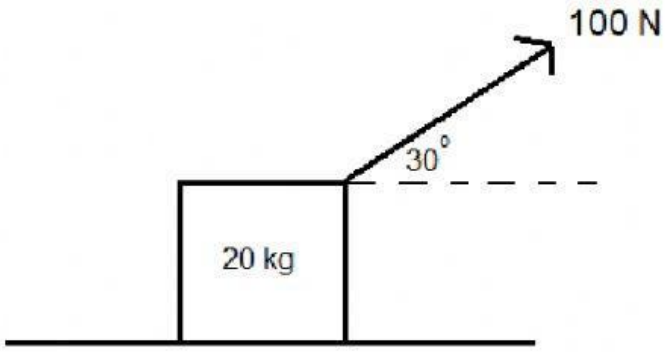


Fn = _____ _____

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

$F_g = F_N$

$F_g = F_N + F_y$

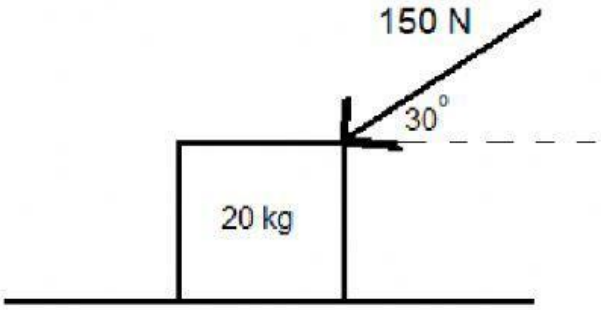
$F_g = F_N - F_y$

7.3 Calculate the normal force on the box below.

Fn = _____ ____ _____

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

$F_g = F_N$

$F_n = F_g - F_y$

$F_n = F_y + Fg$

8.3 Calculate the normal force acting on the box.

Fn = _____ ____ _____

Question 9

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

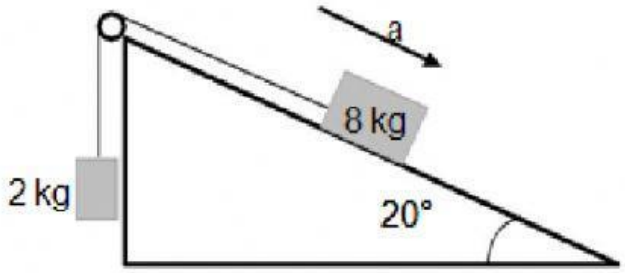
Fn = Fg

Fn = Fg – Fgll

Fn = Fgll

Fn = Fg⊥

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



Fn = _____ ____

Remember:

Y sin if you can **cos x**

Fx = F.cosΘ

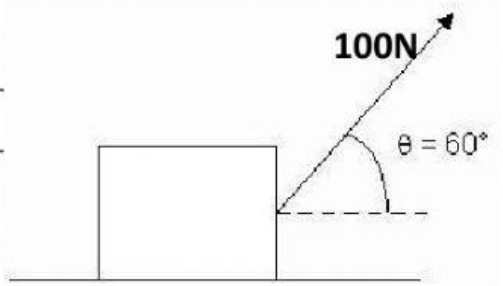
Fy = F.sin Θ

Question 10

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

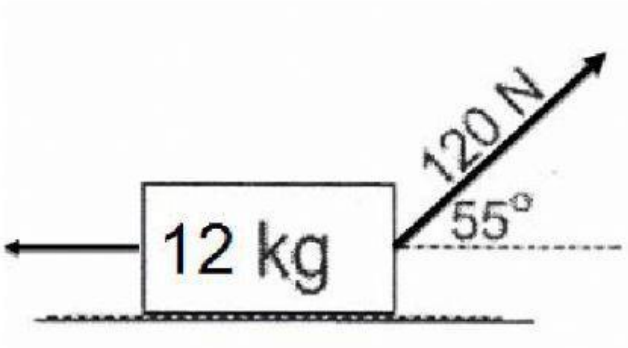
Fy = _____ ____ ___

Fx= _____ _____ ___



(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 = 15N

10.2.1 Calculate the acceleration of the block. **(6)**

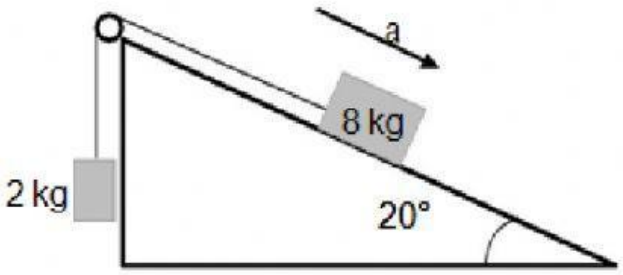
a = _____ ____ _____

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 frictional acting on the 8 kg block.

(round off to 3 decimal places) (8)

μs = _____ {3 decima places}