

# Statics & Resolving Forces

## Question Paper

<b>Level</b>	International A Level
<b>Subject</b>	Physics
<b>Exam Board</b>	Edexcel
<b>Topic</b>	Mechanics
<b>Sub Topic</b>	Statics & Resolving Forces
<b>Booklet</b>	Question Paper

**Time Allowed:** 45 minutes

**Score:** /37

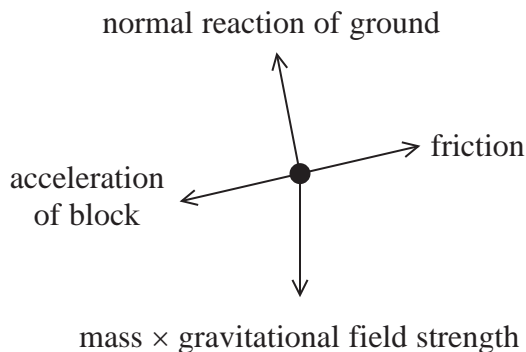
**Percentage:** /100

**Grade Boundaries:**

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

- 1 A free-body force diagram can be used to represent the forces acting on an object.

Which of the following should **not** appear on the free-body force diagram for a block sliding down a slope?

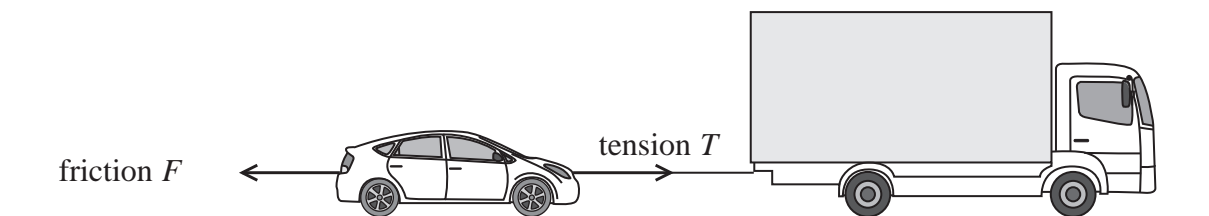


- A normal reaction of ground
- B mass  $\times$  gravitational field strength
- C friction
- D acceleration of block

(Total for Question 1 = 1 mark)

- 2 A car is towed by a truck using a rope. The car is pulled at a constant speed creating a tension  $T$  in the rope.

The horizontal forces acting on the car are shown.



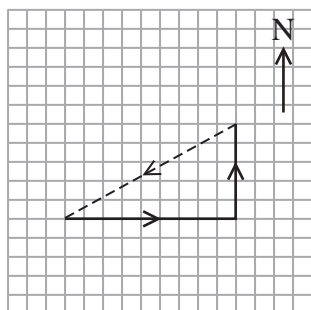
The magnitude of the force exerted by the truck on the car is

- A  $T + F$
- B  $T - F$
- C  $T$
- D zero

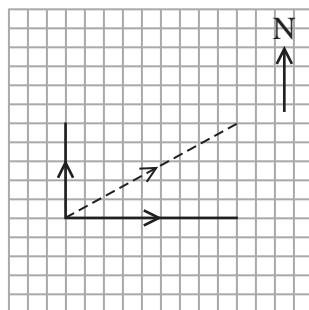
(Total for Question 2 = 1 mark)

- 3 A car travels 90 m east then 50 m north. A vector diagram is drawn with a dashed line representing the resultant displacement.

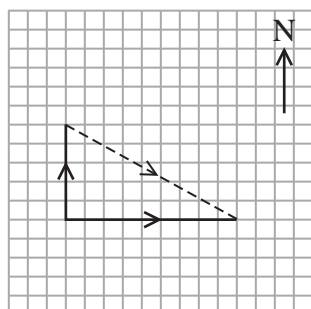
Which is a correct vector diagram for the displacement of the car?



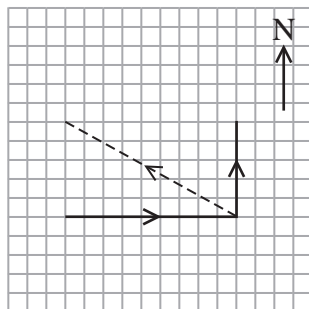
A



B



C

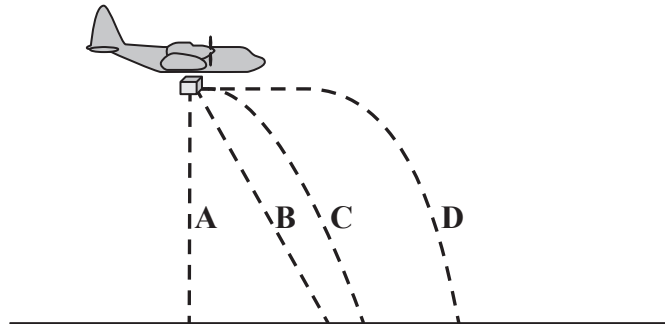


D

---

(Total for Question 3 = 1 mark)

- 4 A plane is travelling horizontally at a constant speed. It releases a package of supplies when in the position shown.



Which of the following shows the path of the package after release?

- A
- B
- C
- D

---

(Total for Question 4 = 1 mark)

5 A small steel ball is released at the surface of some oil of known viscosity and begins to sink. The diagrams show the forces acting on the ball shortly after its release and when it has reached terminal velocity.



Steel ball shortly after release



Steel ball at terminal velocity

(a) Identify forces X, Y and Z.

(3)

X is .....

Y is .....

Z is .....

(b) A student uses Stokes' law to calculate force Y.

State the measurements the student should make to calculate force Y acting on the ball when it is moving at terminal velocity.

(2)

.....

.....

.....

.....

.....

.....

.....

.....

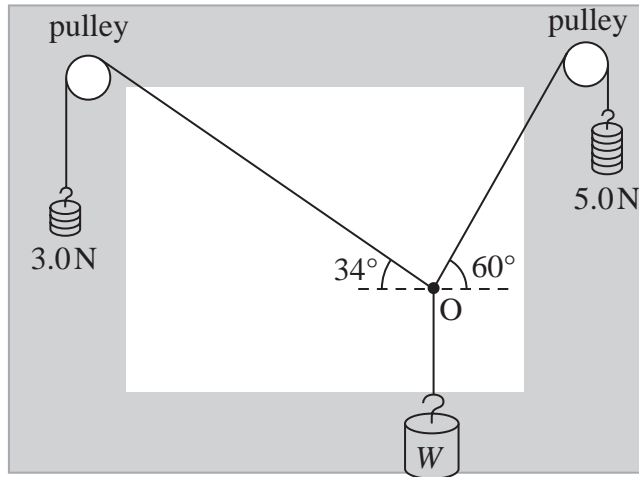
.....

.....

(Total for Question 5 = 5 marks)

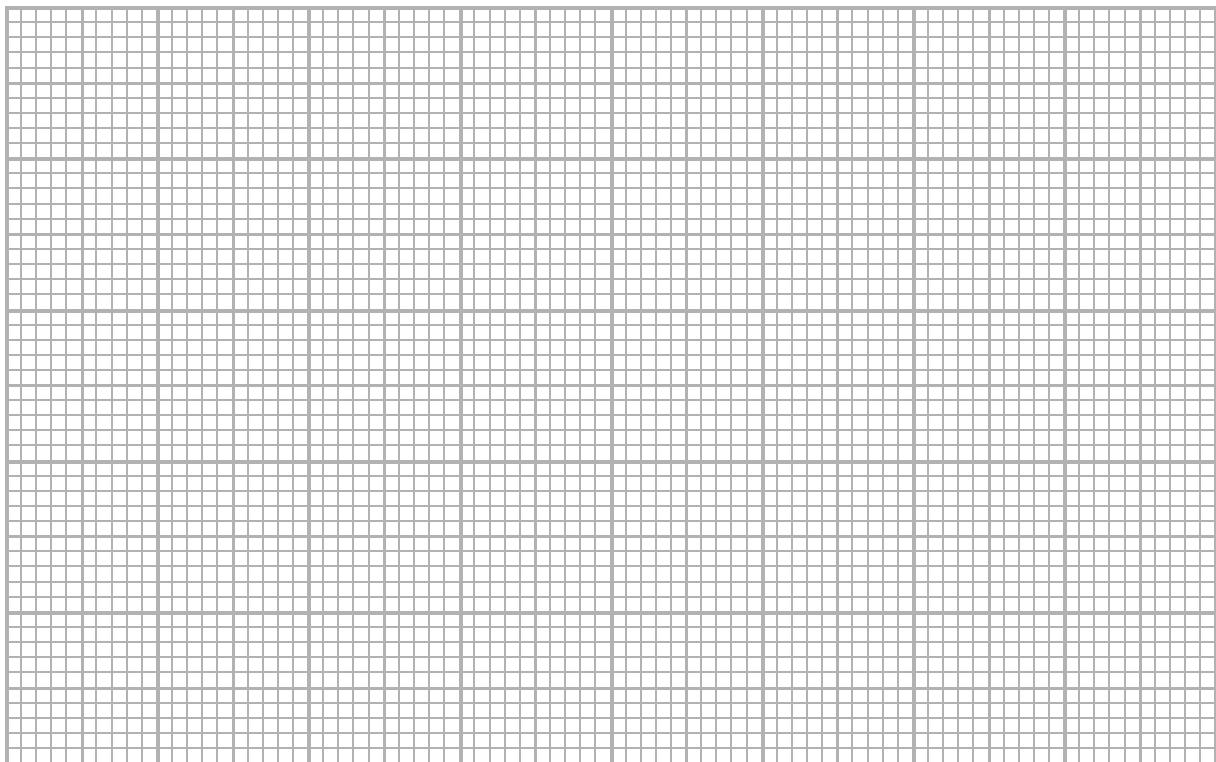
- 6 The diagram shows the apparatus that can be used to determine the weight of a given body using vector addition.

Three pieces of string are tied together at point O. Two of the strings pass over frictionless pulleys and weights of 3.0 N, 5.0 N and an unknown weight  $W$  are attached as shown, so that the system is in equilibrium.



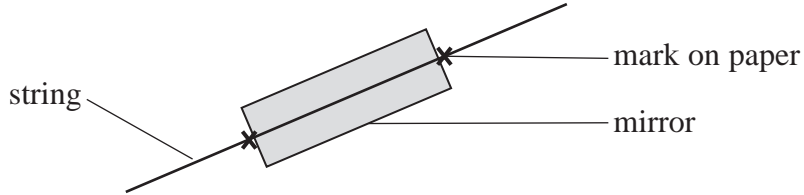
- (a) Draw a scaled vector diagram, on the grid below, of the forces acting on point O. Use your diagram to determine the magnitude of the unknown weight  $W$ .

(4)



Magnitude of  $W$  = .....

- (b) The angles are determined by marking the positions of the strings on a sheet of paper behind the strings. To improve accuracy, a mirror is placed behind each string.



Explain how the use of the mirror improves the accuracy of this experiment.

(2)

.....

.....

.....

.....

.....

.....

---

**(Total for Question 6 = 6 marks)**

- 7 A man is walking at a constant horizontal velocity of  $1.2 \text{ m s}^{-1}$  in the rain. To the man the rain appears to be falling vertically at a velocity of  $1.8 \text{ m s}^{-1}$ .

Draw a labelled vector diagram, to scale, and use it to determine the actual velocity of the rain.

(5)

Magnitude of the actual velocity of the rain = .....

Angle of the rain to the vertical = .....

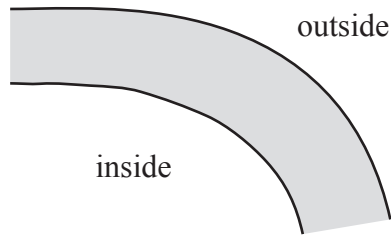
---

**(Total for Question 7 = 5 marks)**



8 Along a river there are changes in the speed of the water due to natural obstacles such as bends and rocks.

(a) At a bend, the water on the inside of the bend is shallower than the water on the outside of the bend.



Suggest why the speed of the water is lower at the inside of the bend than at the outside of the bend.

(1)

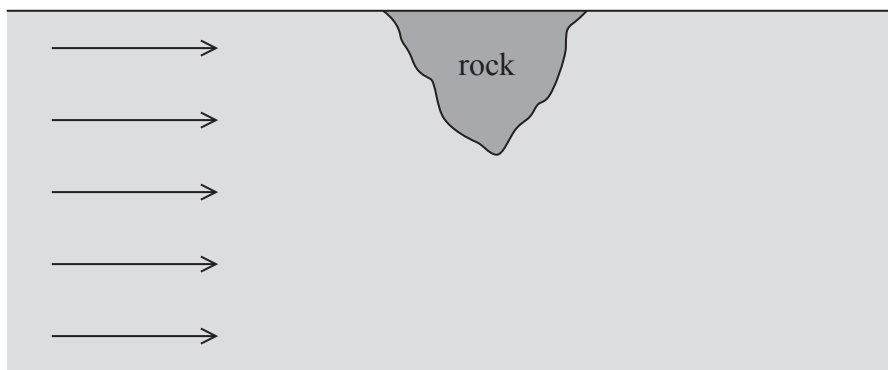
.....

.....

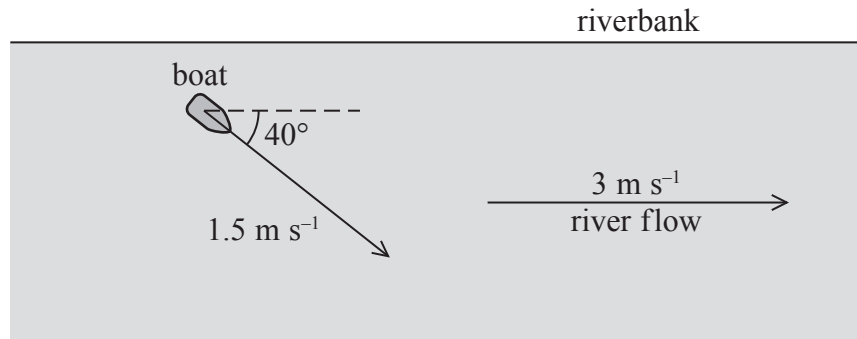
.....

(b) On a straight section of the river, the water becomes very turbulent around a large rock. Complete and label the diagram below to show the flow of the water around the rock.

(2)



- (c) The river is flowing at a speed of  $3 \text{ m s}^{-1}$ . A boat is pointed at an angle of  $40^\circ$  to the riverbank and paddled at a speed of  $1.5 \text{ m s}^{-1}$ , as shown in the diagram.



In the space below, draw a vector diagram to scale and use it to determine the magnitude of the actual velocity of the boat.

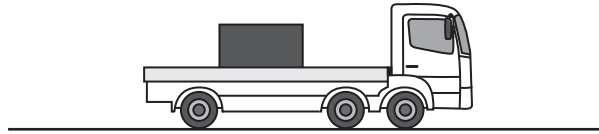
(3)

Magnitude of actual velocity = .....

**(Total for Question 8 = 6 marks)**

---

- 9 (a) A lorry gradually accelerates from rest. There is a box of mass 200 kg on the back of the lorry. The box is not tied to the lorry.



- (i) The lorry accelerates from rest to a speed of  $15 \text{ m s}^{-1}$  over a distance of 39 m.

Show that the acceleration of the lorry is about  $3 \text{ m s}^{-2}$ .

(2)

.....

.....

.....

.....

- (ii) The maximum frictional force between the lorry and the box is 630 N.

Explain why this limits the maximum acceleration that the lorry can have without the box falling off. Your answer should include a calculation.

(3)

.....

.....

.....

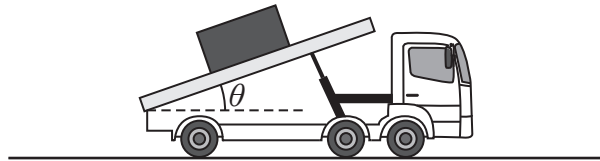
.....

.....

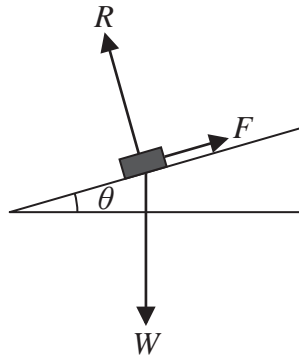
.....

.....

- (b) Once the lorry has reached its destination, the back of the lorry is tilted at an angle  $\theta$  to the horizontal.



Three forces act on the box: the weight  $W$ , the normal contact force  $R$  and the frictional force  $F$ .



- (i) State expressions for the components of the weight of the box parallel to the back of the lorry and perpendicular to the back of the lorry.

(2)

$W_{\text{parallel}} = \dots\dots\dots$

$W_{\text{perpendicular}} = \dots\dots\dots$

- (ii) The angle  $\theta$  is increased until the box is just about to slide.

Given that  $F = 0.32R$ , calculate the value of  $\theta$  at which the box is just about to slide.

(4)

.....

.....

.....

.....

.....

$\theta = \dots\dots\dots$

**(Total for Question 9 = 11 marks)**