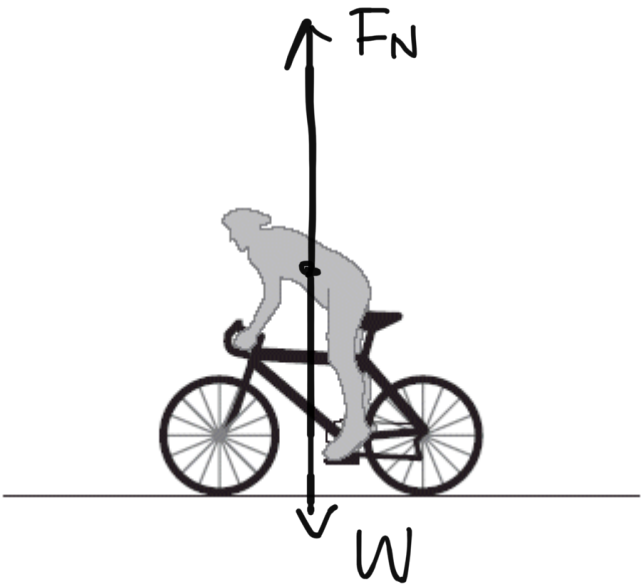
1. This question is about force and energies.

(a) A system consists of a bicycle and cyclist travelling at a constant velocity along a horizontal road.



(i) State the value of the net force acting on the cyclist.

0 N

.....

(1)

(ii) On the diagram draw labelled arrows to represent the vertical forces acting on the bicycle.

(2)

(iii) With reference to the horizontal forces acting on the system, explain why the system is travelling at constant velocity.

Op. direct

Same. Magnitude

.....

.....

.....

(2)

(b) The total resistive force acting on the system is 40 N and its speed is 8.0 m s^{-1}. Calculate the useful power output of the cyclist.

320W

(1)

(c) The cyclist stops pedalling and the system comes to rest. The total mass of the system is 70 kg.

(i) Calculate the magnitude of the initial acceleration of the system.

$a = \frac{F}{m} = \frac{40}{70} = \frac{4}{7} \approx 0.57$

(2)

(ii) Estimate the distance taken by the system to come to rest from the time the cyclist stops pedalling.

$s = \frac{v^2}{2a}$

$= \frac{8^2}{\frac{8}{7}} = 56\ m$

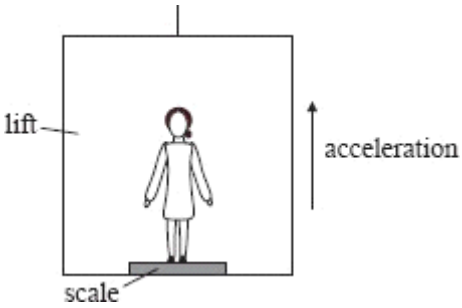
(2)

(iii) State and explain **one** reason why your answer to (c)(ii) is only an estimate.

(2)

(Total 12 marks)

2. Mandy stands on a weighing scale inside a lift (elevator) that accelerates vertically upwards as shown in the diagram below. The forces on Mandy are her weight *W* and the reaction force from the scale *R*.



The reading of the scale is

A. $R + W$.

B. W.

C. R.

D. $R - W$.

(Total 1 mark)

3. A lamp of weight *W* is suspended by a wire fixed to the ceiling. With reference to Newton's third law of motion, the force that is equal and opposite to *W* is the

A. tension in the wire.

B. force applied by the ceiling.

C. force exerted by the lamp on the Earth.

D. force exerted by the Earth on the lamp.

(Total 1 mark)

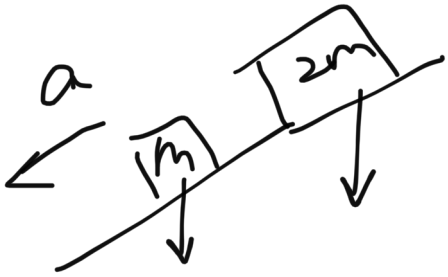
4. A frictionless trolley of mass *m* moves down a slope with a constant acceleration *a*. A second similar frictionless trolley has mass 2*m*. The acceleration of the second trolley as it moves down the slope is

A. $\frac{1}{2}a$.

B. *a*.

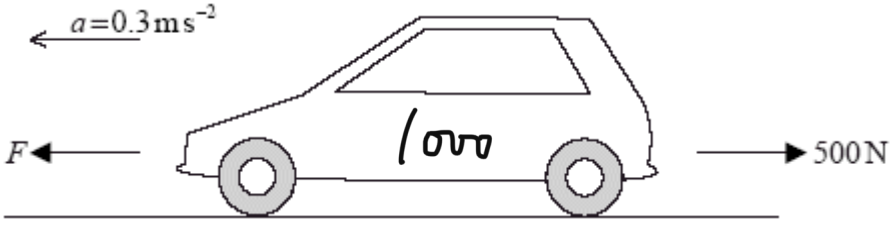
C. 2*a*.

D. 4*a*.



(Total 1 mark)

5. A car of mass 1000 kg accelerates on a straight, flat, horizontal road with an acceleration $a = 0.3\ \text{m s}^{-2}$.
The driving force *F* on the car is opposed by a resistive force of 500 N.



The net (resultant) force on the car is

A. 200 N.

B. 300 N.

C. 500 N.

D. 800 N.

F = 300

(Total 1 mark)

6. A student is sitting on a chair. One force that is acting on the student is the pull of gravity. According to Newton's third law, there must be another force which is

A. the upward push of the chair on the student.

B. the downward force on the student.

C. the downward push of the chair on Earth.

D. the upward force on Earth.

(Total 1 mark)

7. A skydiver of mass 80 kg falls vertically with a constant speed of 50 m s^{-1}. The upward force acting on the skydiver is approximately

A. 0 N.

B. 80 N.

C. 800 N.

D. 4000 N.

(Total 1 mark)

8. Which of the following is the condition for a body to be in translational equilibrium?

A. The resultant force on the body in any direction is zero.

B. The velocity of the body in any direction is zero.

C. No external force is acting on the body.

D. No work is done on the body.

(Total 1 mark)

9. A force *F* is applied to a body moving along a straight line. A resistive force *f* acts on the body. Both forces act along the same straight line as the motion of the body. The rate of change of momentum of the body is equal to

A. $F - f$.

B. F.

C. $F + f$.

D. f.

$M = mv$

$= \frac{F}{a} v$

$= Ft$

(Total 1 mark)

10. A wooden block is sliding down an inclined plane at constant speed. The magnitude of the frictional force between the block and the plane is equal to

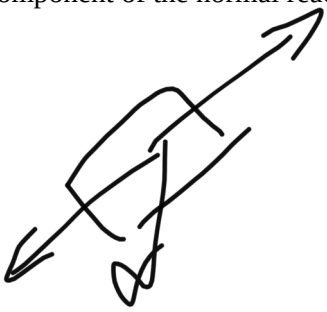
A. zero.

B. the magnitude of the weight of the block.

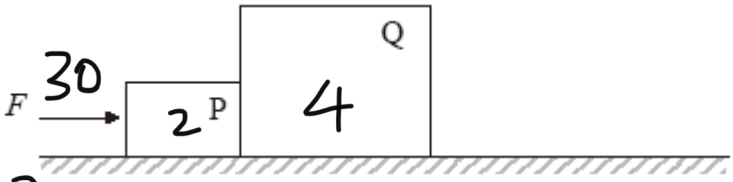
C. the magnitude of the component of weight of the block parallel to the plane.

D. the magnitude of the component of the normal reaction parallel to the plane.

(Total 1 mark)



11. Stephen pushes two boxes P and Q, that stay in contact, along a rough table, with a force *F* of 30 N.
Box P has a mass of 2.0 kg and box Q has a mass of 4.0 kg. Both boxes move with constant speed.



The resultant force on box Q is

A. 0 N.

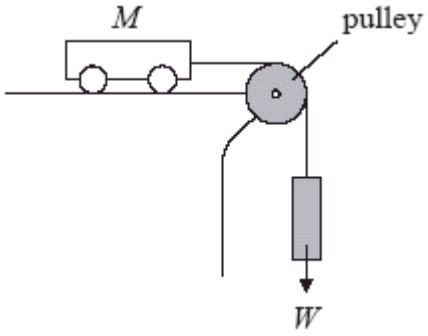
B. 5.0 N.

C. 15 N.

D. 30 N.

(Total 1 mark)

12. A cart of mass *M* is on a horizontal frictionless table.



The cart is connected to an object of weight *W* via a pulley. Which of the following is the acceleration of the cart?

A. $\dfrac{M + \dfrac{W}{g}}{W}$

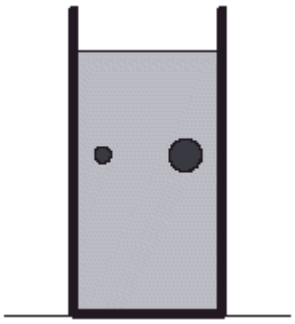
B. $\dfrac{W}{M + \dfrac{W}{g}}$

C. $\dfrac{Mg}{W}$

D. 0

(Total 1 mark)

13. Two steel balls, of mass *M* and 2*M*, fall at constant speeds in a tube filled with oil.



Which of the following correctly compares the magnitudes of the net force and of the drag (resistance) force on the two balls?

	Net force	Drag force
A.	same	same
B.	same	different
C.	different	same
D.	different	different

(Total 1 mark)

14. The diagram shows a girl attempting (but failing) to lift a heavy suitcase of weight *W*. The magnitude of the vertical upwards pull of the girl on the suitcase is *P* and the magnitude of the vertical reaction of the floor on the suitcase is *R*.

Which equation correctly relates *W*, *P* and *R*?

A. $W = P + R$

B. $W > P + R$

C. $W < P + R$

D. $W = P = R$

(Total 1 mark)

15. Objects *A* and *B* collide together. They end up joined together and stationary. During the collision, a force $+F$ is exerted on object *A* by object *B*. According to Newton's third law, there will also be a force of

A. $-F$ acting on object *B*.

B. $-F$ acting on object *A*.

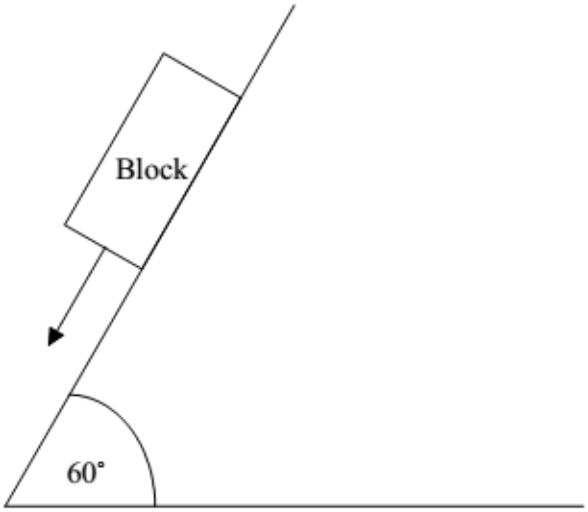
C. $+F$ acting on object *B*.

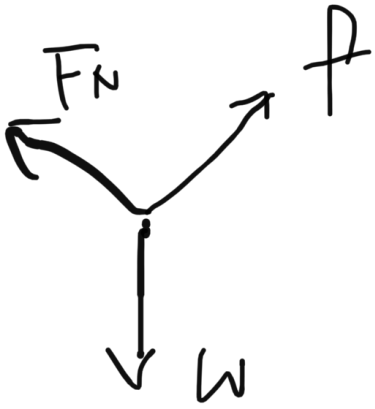
D. $+F$ acting on object *A*.

(Total 1 mark)

This question is about a wooden block sliding down a rough inclined plane (slope).

The diagram below shows a wooden block sliding down a rough plane. In the position shown the block is accelerating.





(a) Draw a free-body diagram representing the forces acting on the block.

The plane makes an angle of 60° with the horizontal, the weight of the block is 5.0 N and the coefficient of kinetic (dynamic) friction between the block and the plane is 0.30.

(b) (i) Determine the magnitude of the frictional force acting on the block.

$\frac{1}{2} \times \frac{3}{2} = \frac{3}{4}$ N

$= 0.75$ N

(ii) Determine the acceleration of the block down the plane.

$$\frac{\frac{\sqrt{3}}{2} - 0.75}{0.5}$$

7.16