NAME: _____ **DATE:** _____ PHYSICS

PAPER 1 REVISION

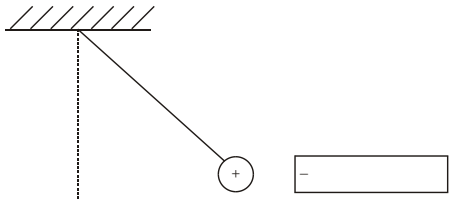
2.2 Forces and Dynamics

1. When a body is accelerating, the resultant force acting on it is equal to its

A. change of momentum.
B. rate of change of momentum.
C. acceleration per unit of mass.
D. rate of change of kinetic energy.

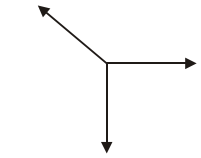
(1)

2. A small electrically charged sphere is suspended vertically from a thread. An oppositely charged rod is brought close to the sphere such that the sphere is in equilibrium when displaced from the vertical by an angle of 45°.

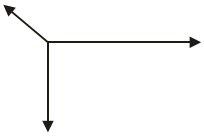


Which **one** of the following best represents the free body diagram for the sphere?

A.



B.



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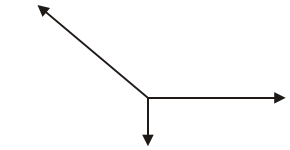

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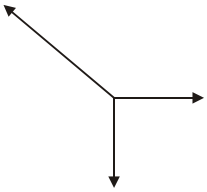
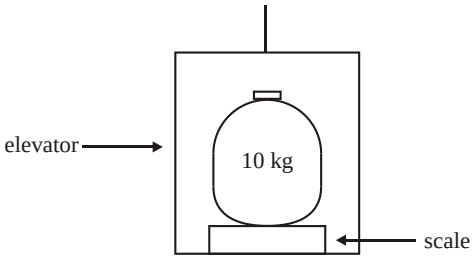


(1)

3. An elevator (lift) is used to either raise or lower sacks of potatoes. In the diagram, a sack of potatoes of mass 10 kg is resting on a scale that is resting on the floor of an accelerating elevator. The scale reads 12 kg.



The best estimate for the acceleration of the elevator is

A. 2.0 m s^{-2} downwards.
B. 2.0 m s^{-2} upwards.
C. 1.2 m s^{-2} downwards.
D. 1.2 m s^{-2} upwards.

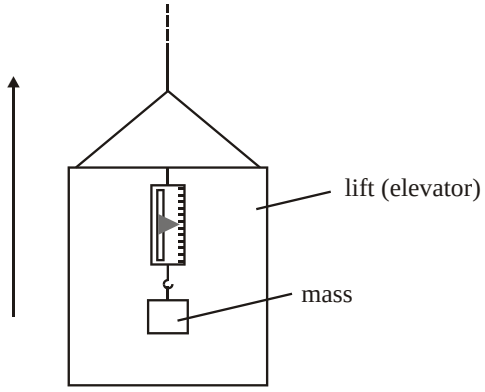
(1)

4. A truck collides head on with a less massive car moving in the opposite direction to the truck. During the collision, the average force exerted by the truck on the car is F_T and the average force exerted by the car on the truck is F_C. Which **one** of the following statements is correct?

A. F_T will always be greater in magnitude than F_C.
B. F_T will always be equal in magnitude to F_C.
C. F_T will be greater in magnitude than F_C only when the speed of the car is less than the speed of the truck.
D. F_T will be equal in magnitude to F_C only when the speed of the truck is equal to the speed of the car.

(1)

5. A mass is suspended from the roof of a lift (elevator) by means of a spring balance, as illustrated.



The lift (elevator) is moving upwards and the readings of the spring balance are noted as follows.

Accelerating: R_a

Constant speed: R_c

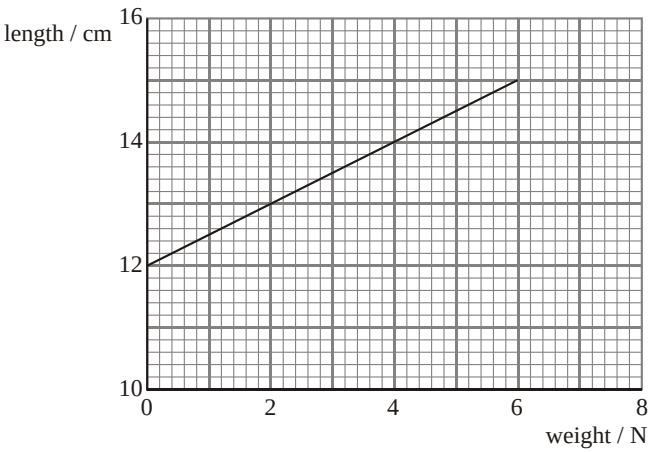
Slowing down: R_s

Which **one** of the following is a correct relationship between the readings?

A. $R_a > R_c$ B. $R_a = R_s$ C. $R_c = R_s$ D. $R_c < R_s$

(1)

6. A weight is suspended from a spring. The variation with weight of the length of the spring is shown.



What is the value of the spring constant (force constant) of the spring?

A. 0.4 N cm^{-1}

B. 0.5 N cm^{-1}

C. 2.0 N cm^{-1}

D. 2.5 N cm^{-1}

(1)

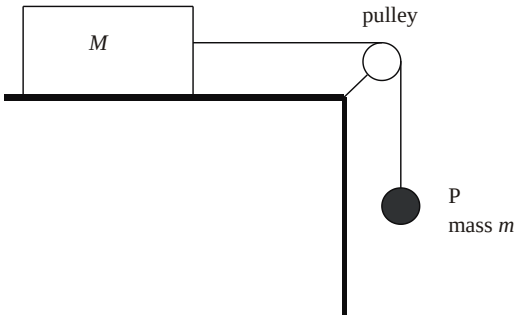
7. The velocity of a particle is changing. The rate of change of the momentum of the particle is equal to the

A. acceleration of the particle. B. net force acting on the particle.

C. work done on the particle. D. change in kinetic energy of the particle.

(1)

8. A block on a frictionless horizontal table is attached by a light, inextensible string to an object P of mass *m* that hangs vertically as shown.



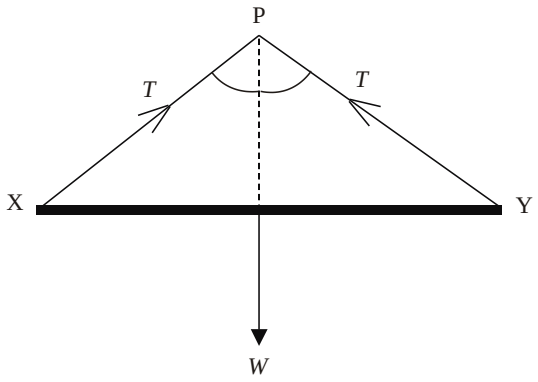
The pulley has zero friction and the acceleration of free fall is *g*. The acceleration of the block and object P is

A. g. B. $\frac{m}{M}g$.

C. $\frac{m}{m+M}g$. D. $\frac{m+M}{m}g$.

(1)

9. A uniform metal bar XY of weight W is hung from a horizontal support at point P by two wires of negligible mass. Each wire makes an angle θ with the vertical.



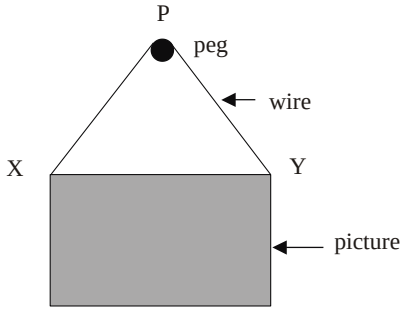
Which of the following is equal to the tension T in one of the wires?

A. $\frac{W}{\cos\theta}$ B. $\frac{W}{2\cos\theta}$

C. $\frac{W}{\sin\theta}$ D. $\frac{W}{2\sin\theta}$

(1)

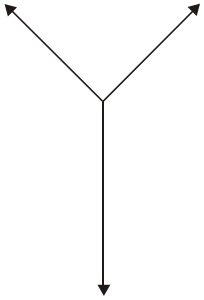
10. A picture is supported vertically by a wire that is looped over a horizontal light peg P. There is no friction between the wire and the peg.



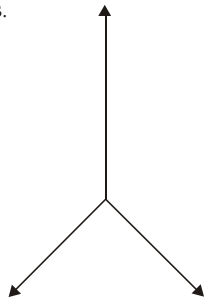
The mass of the picture is uniformly distributed and PX = PY.

Which of the following best represents the free body diagram of the forces acting on the peg?

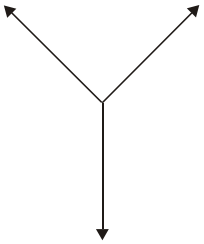
A.



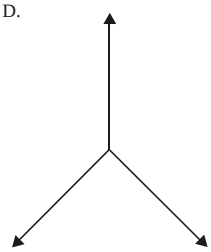
B.



C.

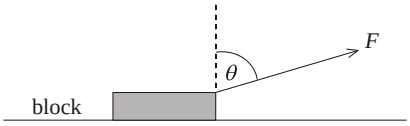


D.



(1)

11. A block of mass m is pulled along a horizontal, frictionless surface by a force of magnitude F. The force makes an angle θ with the vertical.

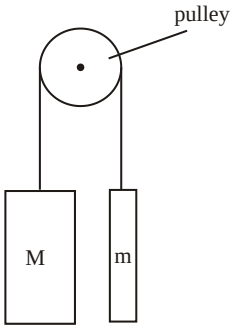


The magnitude of the acceleration of the block in the horizontal direction produced by the force F is

A. $\frac{F}{m}$. B. $\frac{F\sin\theta}{m}$. C. $\frac{F\cos\theta}{m}$. D. $\frac{F\tan\theta}{m}$.

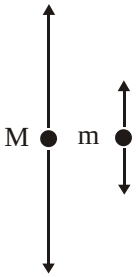
(1)

12. Two unequal masses M and m are joined by a light inextensible string. The string passes over a light frictionless pulley as shown. The masses accelerate when released.

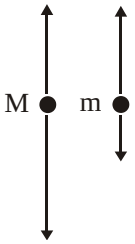


Which diagram is the correct free-body diagram for the two masses?

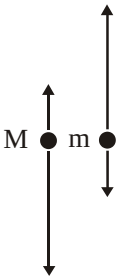
A.



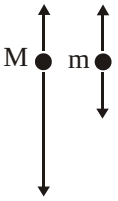
B.



C.



D.



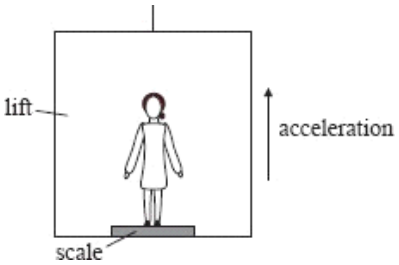
(1)

13. What is the condition for an object to be in translational equilibrium?

A. The forces acting upwards are equal to the forces acting downwards.
B. The object must be at rest.
C. The object must be moving at constant speed.
D. There is no resultant force on the object in any direction.

(1)

14. Mandy stands on a weighing scale inside a lift (elevator) that accelerates vertically upwards as shown in the diagram. 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. $R - W$.

(1)

15. 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. $2a$.
D. $4a$.

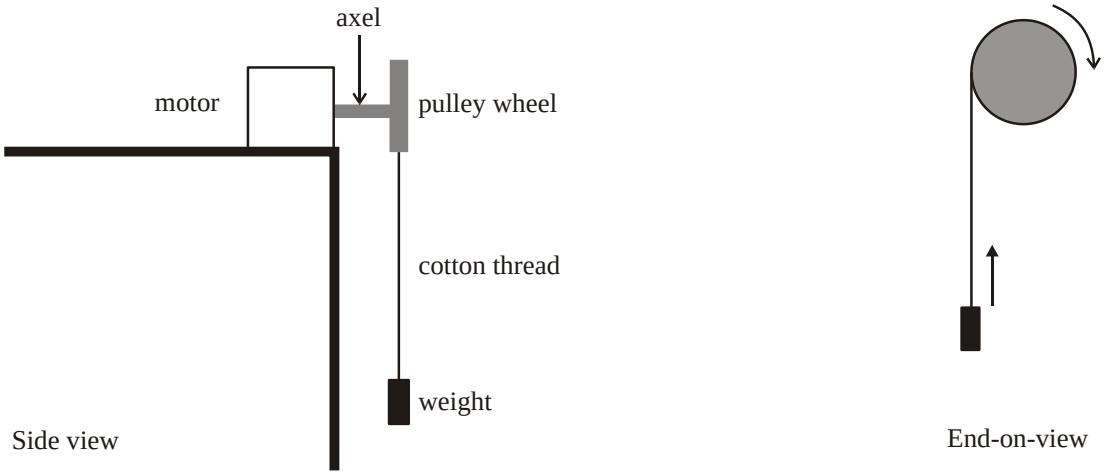
(1)

PAPER 2 REVISION

2.2 Forces and Dynamics

17. Electric motor

(a) In an experiment to measure the efficiency of a small dc electric motor, the motor is clamped to the edge of a bench. The motor is used to raise a small weight that is attached to a pulley wheel by cotton thread. The pulley wheel is rotated by the motor. The thread wraps around the pulley wheel, so raising the weight.



The time taken for the motor to raise the weight through a certain height is measured. It is assumed that the weight accelerates uniformly whilst being raised. The weight of the cotton thread is negligible.

(i) Draw a labelled free-body force diagram of the forces acting on the accelerating weight.

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(3)

(ii) The weight has a mass of 15 g and it takes 2.2 s to raise it from rest through a height of 0.84 m. Calculate the tension in the thread as the weight is being raised. (Acceleration of free fall g = 10 m s^{-2}.)

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(4)

(b) In a second experiment, the current is adjusted so that the weight of mass 15 g is raised at constant speed. The motor is connected to a 6.0 V supply and it now takes the motor 3.4 s to raise the weight through 0.84 m.

(i) Suggest how it might be determined that the weight is being raised at constant speed.

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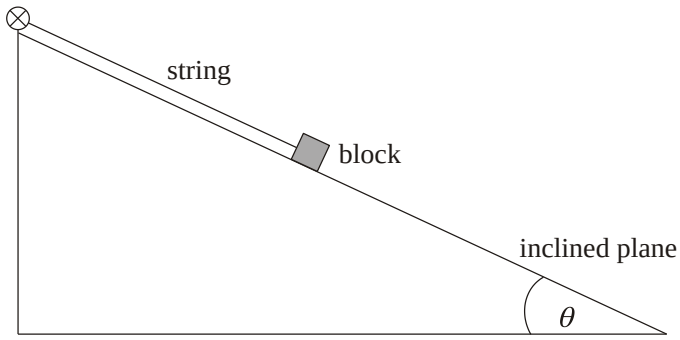
(2)

(Total 9 marks)

18. Block on an inclined plane

A block is held stationary on a frictionless inclined plane by means of a string as shown.



(a) (i) On the diagram draw arrows to represent the three forces acting on the block.

(3)

(ii) The angle θ of inclination of the plane is 25°. The block has mass 2.6 kg. Calculate the force in the string. You may assume that $g = 9.8\ \text{m s}^{-2}$.

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(2)

(b) The string is pulled so that the block is now moving at a constant speed of $0.85\ \text{m s}^{-1}$ up the inclined plane.

(i) Explain why the magnitude of the force in the string is the same as that found in (a)(ii).

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(2)

(ii) Calculate the power required to move the block at this speed.

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(2)

(iii) State the rate of change of the gravitational potential energy of the block. Explain your answer.

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(2)

(Total 11 marks)