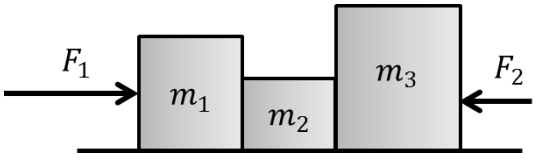
Part 1: 14 multiple choice questions, one point each.
Circle the letter of the most correct answer using a pen. Use $g = 10$ m/s^2.

Q1. When a constant non-zero net force acts on an object, the object moves with
a) a constant velocity
b) a constant acceleration
c) a constant speed
d) an increasing acceleration

Q2. Pulling up on a rope, you lift a 4 kg bucket of water from a well with an acceleration of 2 m/s^2. What is the tension in the rope attached to the bucket?
a) 8 N b) 32 N c) 40 N d) 48 N

Q3. The power required to accelerate a 1000 kg car from rest to 20 m/s in 20 s is:
a) 100 kW b) 20 kW c) 200 kW d) 10 kW

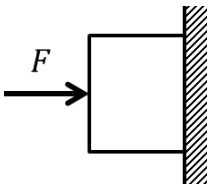
Q4. Two horizontal forces $F_1 = 15$ N and $F_2 = 3.0$ N affect three masses placed on a smooth horizontal surface as shown. The masses are $m_1 = 2$ kg, $m_2 = 1$ kg, and $m_3 = 3$ kg. The acceleration of the system is:



a) 2 m/s^2 b) 1 m/s^2 c) 2.5 m/s^2 d) 6 m/s^2

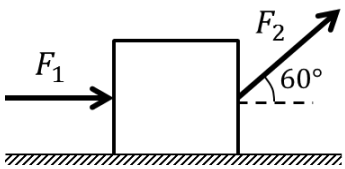
Q5. A block of mass m is placed on a ramp inclined at an angle of $\theta = 40°$ with the horizontal. The minimum required coefficient of static friction μ_s between the block and the surface if the block is not to slide down the ramp is:
a) 1.19 b) 0.64 c) 0.84 d) 0.77

Q6. In the shown figure, the force F pushes a block weighing 10 N against a vertical wall. The coefficient of static friction between the wall and the block is $\mu_s = 0.5$. What is the minimum value of the force F required to keep the block at rest?



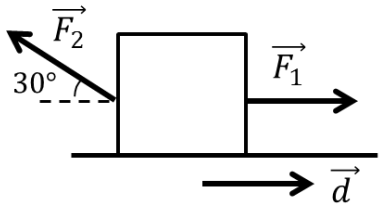
a) 10 N b) 20 N c) 5 N d) 40 N

Q7. In the shown figure, the two forces $F_1 = 10$ N and $F_2 = 5$ N are used to move a 2 kg object at a constant velocity along a horizontal floor. The magnitude of the friction force affecting the object is:



a) 10 N b) 12.5 N c) 14.3 N d) 6.25 N

Q8. Two constant forces act on an object as shown. The object undergoes a displacement of 5 m to the right while the forces are acting. What is the work done by the force F_2 if $F_2 = 12$ N?



a) -52 J b) $+52$ J c) -30 J d) $+30$ J

Q9. A student stands on a bathroom scale in an elevator. The scale reads 750 N, while the actual weight of the student is 600 N. What is the acceleration of the elevator?

a) 2.5 m/s^2 upward
b) 2.5 m/s^2 downward
c) 12.5 m/s^2 upward
d) 12.5 m/s^2 downward

Q10. A car moving at a constant speed of 20 m/s encounters a dip. The dip can be approximated as a circular arc of radius 50 m. What is the apparent weight of a 70 kg passenger when the car is at the bottom of the dip?

a) 140 N b) Zero c) 1260 N d) 1400 N

Q11. A 0.5 kg object hangs vertically from a massless spring. The resulting extension in the spring is 4 cm. What is the spring constant?

a) 8 N/m b) 1250 N/m c) 0.125 N/m d) 125 N/m

Q12. A driver applies brakes to slow down his 1200 kg car from 30 m/s to 20 m/s within a distance of 50 meters. The magnitude of the force exerted on the car is:

a) 600 N b) 1200 N c) 6000 N d) 12000 N

Q13. When you carry a 10 kg object for 30 m horizontally at a constant velocity, the work done by you is

a) 300 J b) zero c) 3000 J d) -300 J

Q14. A 100 g stone is dropped from a certain height from rest. It reaches the ground with a speed of 10 m/s. Ignoring air resistance, the work done by gravity is:

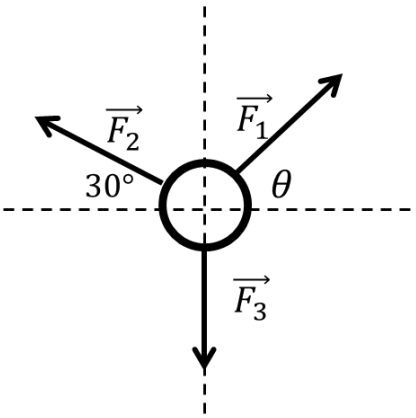
a) 5 J b) 500 J c) -500 J d) -5 J

End of part 1

Part 2: Solve the following two problems in the provided space (3 points each).
Show all your work and include the appropriate units. Use $g = 10$ m/s^2.

Q1. A ring is pulled using three forces as shown in the figure. The forces $F_1 = 5.2$ N, $F_2 = 3.0$ N. The ring is stationary. Find:

a) The direction θ of the force F_1
b) The magnitude of the force F_3.



Q2. The two masses $m_1 = 3$ kg and $m_2 = 1$ kg are connected as shown in the figure. Assuming the surfaces are frictionless and the pulley is ideal, calculate:

a) the acceleration of the system.

b) the tension in the string.