

**Part I: Multiple Choice (1 mark each)**

Read and choose carefully. Circle the best answer. You may show rough work in the margin but only the answer is marked.

1. If the net force on an object were doubled while at the same time the mass of the object was halved, then the acceleration of the object is:
- A.  $\frac{1}{4}$  as great                      B.  $\frac{1}{2}$  as great  
B. 2 times greater                      D. 4 times greater                      E. unchanged

2. A ball is sitting at rest on a table in a bus that is at rest at a station. When the bus begins to move forward as it leaves the station the ball will most likely
- A. Roll backward off the table                      B. Roll sideways off the table  
C. Roll forward off the table                      D. Remain at rest

Use the following information to answer the next two (2) questions.

A crane is lowering a 275 kN cargo container onto a ship deck at a constant speed.

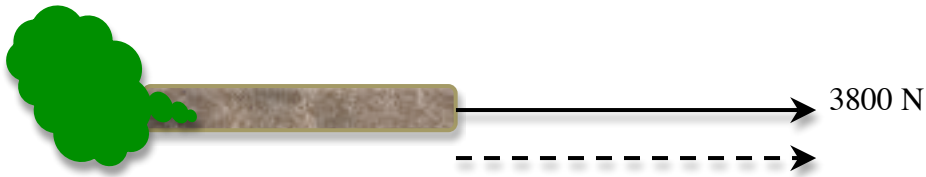
3. The tension in the crane's cable is most likely
- A. 300 kN                      B. 275 kN                      C. 250 kN                      D. Zero
4. An *action - reaction* force pair for this situation could be
- A. The cable pulls up on the container; the container pulls down on the cable  
B. The Earth pulls down on the container; the cable pulls up on the container  
C. The cable pulls up on the container; the crane pulls up on the cable.  
D. The Earth pulls down on the container; the container pulls down on the cable.

5. On a distant planet the weight of a 75 g rock is 1.6 N. The value of "g" for this planet is
- A. 120 N/kg                      B. 36 N/kg                      C. 21 N/kg                      D. 10 N/kg
6. A 62.5 N cart is on a level dynamics track. A 17.5 N of force is required to keep the cart moving at a uniform rate along the track. What is the coefficient of kinetic friction between the cart and the track?
- A. 0.357                      B. 0.280                      C. 0.175                      D. 0.140
7. Identify the situation in which *only* work against friction is done.
- A. A wooden block slides down an inclined ramp.  
B. A dragster "car" spins its tires while accelerating from rest  
C. A rocket is launched vertically into the air.  
D. A railway locomotive travels at constant speed along a level section of track.

Use the following information to answer the next two (2) questions.  
An air gun is fired such that it accelerates a 12 g bullet at a rate of  $20 \text{ m/s}^2$ .

8. The average force provided by the gun is
- A. 240 N      B. 9.8 N      C. 1.7 N      D. 0.24 N
9. The task is repeated, except that a second, 24 g bullet is fired with the same acceleration. Which of the following statements best describes the change, if any, in the average force provided by the gun?
- A. The force is increased by a factor of 4  
B. The force is increased by a factor of 2  
C. The force is decreased by a factor of 2  
D. The force remains constant.

Use the following information to answer the next three (3) questions.



A tractor pulls with a force of 3800 N against a fallen tree with a mass of 950 kg. The cable is orientated horizontally and the tractor is assumed to apply a uniform force. The drag force acting on the tree is 3600 N. The direction of motion of the tree is along the path denoted by the dotted arrow.

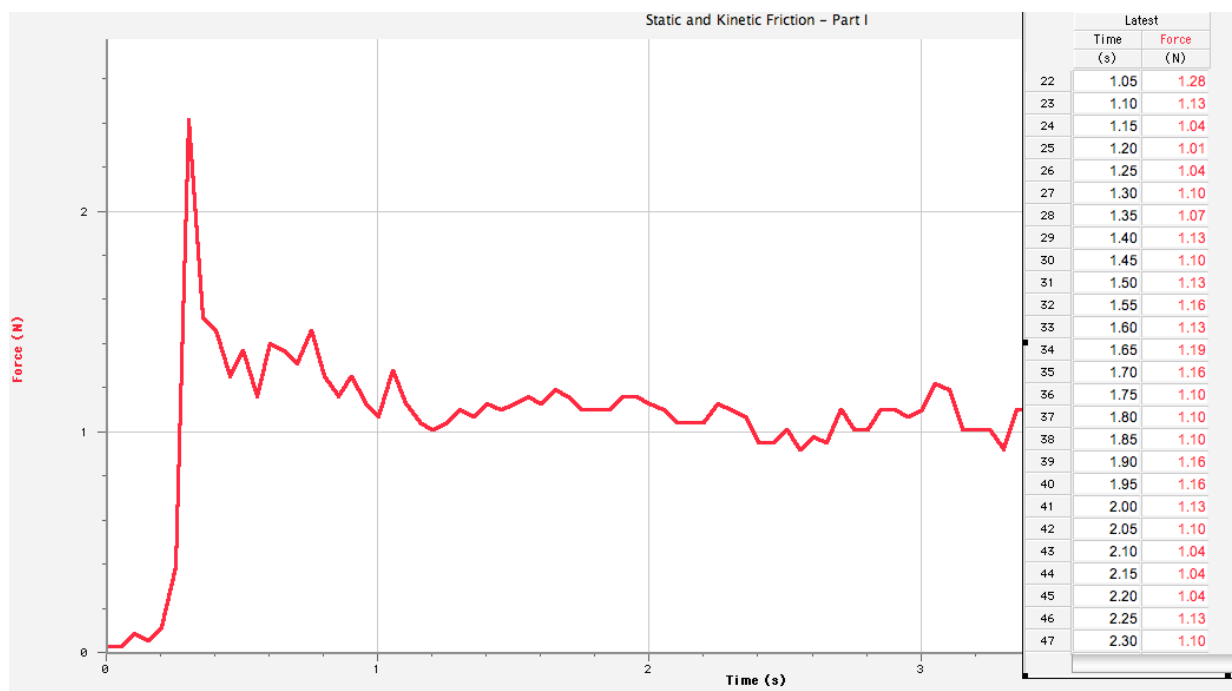
10. The normal force acting on the tree is
- A. 200 N      B. 3600 N      C. 3800 N      D. 9300 N
11. The total work done by the tractor after pulling the tree a distance of 100 m (along the path indicated by the dotted arrow) is
- A. 380 kJ      B. 368 kJ      C. 360 kJ      D. 20 kJ
12. The acceleration of the tree is
- A.  $4.0 \text{ m/s}^2$       B.  $3.8 \text{ m/s}^2$       C.  $0.21 \text{ m/s}^2$       D. zero

Use the following information to answer the next two (2) questions

As a bowler prepares to release a 4.50 kg bowling ball it is swung behind him and gains 60.0 J of potential energy relative to its starting position.

13. The change in height reached by the ball during its swing is
- A. 1.36 m      B. 1.31 m      C. 1.25 m      D. 1.17 m
14. Assuming all 60.0 J is transferred to kinetic energy, the maximum speed attained by the ball upon release is
- A. 3.65 m/s      B. 5.16 m/s      C. 13.3 m/s      D. 26.7 m/s

Use the following information to answer the next question.



15. Calculate an estimated value of the coefficient of kinetic friction of a 500 g mass pulled along a wooden board given the experimental data (use  $g = 10 \text{ m/s}^2$ ).
- A.  $\mu_k = 0.50$       B.  $\mu_k = 0.20$       C.  $\mu_k = 0.020$       D.  $\mu_k = 0.0020$   
 E. cannot be determined because the length of the board is not given

Use the following information to answer the next three (3) questions.

A 1000 kg car accelerates from 10 m/s to 20 m/s in order to pass another vehicle.

16. The change in kinetic energy of the car is
- A. 10 kJ      B. 50 kJ      C. 150 kJ      D. 200 kJ
17. If the power output of the car's engine is 60 kW how much time is required for the car to change speed?
- A. 5.0 s      B. 4.0 s      C. 3.3 s      D. 2.5 s
18. The car travels a distance of 30 meters as it speeds from 10 m/s to 20 m/s. The average net force acting on the car is
- A. 9.8 kN      B. 7.3 kN      C. 5.0 kN      D. 2.6 kN

**Part II: Written Response (18 marks).**

*Read carefully and answer each question in the space provided. Show all work to receive full marks. Communication skills will be marked.*

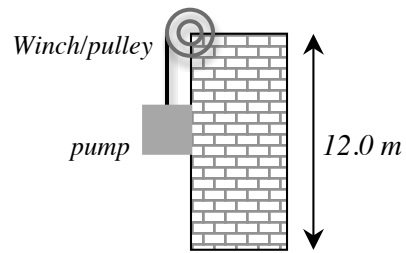
18. A dynamics cart with a mass of 1.50 kg is positioned at one end of a long level track. A force of 8.00 N is applied to the cart in order to accelerate it along the track. After traveling 2.00 m the cart has a speed of 4.00 m/s.

a. What is the average acceleration of the cart over the first 2.00 meters? **(2 M)**

b. Determine the average friction force acting on the cart as it moves along the track. **(3 M)**

c. Find the kinetic energy of the cart when it reaches the 2.00 m mark on the track. **(2 M)**

19. A pump with a mass of 24.0 kg is pulled upwards against the side of the wall by a winch and pulley system on the rooftop. As the pump is pulled up at a constant speed, the force of friction between the pump and the wall is measured to be 128N. The roof is 12.0 m above the ground.



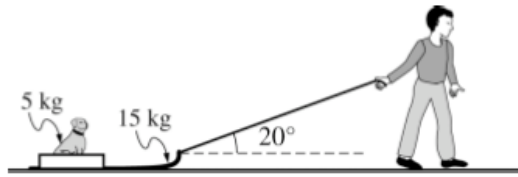
- a. On the object provided draw a free body diagram showing all forces acting on the pump as it is dragged to the roof. Label each force with its appropriate agent. **(2 M)**



- b. Calculate the total work done by the winch motor in order to lift the pump to the roof. **(3 M)**

- c. If the power rating of the winch motor is 275 W, determine the minimum time required to complete the task. **(2 M)**

20. A child pulls a 15 kg sled containing a 5 kg dog along a straight on a horizontal surface. He exerts a force of 55 N on the sled at an angle of  $20^\circ$  above the horizontal as shown in the diagram.



- a. Calculate the work done by the child's pulling force as the system moves 10.0 m. **(2 M)**

- b. Describe the change, if any, to the acceleration of the system if the dog falls off the sled. **(2 M)**

\_\_\_\_\_ Acceleration increases    \_\_\_\_\_ Acceleration decreases    \_\_\_\_\_ No change

Justify your answer.

**BONUS:** Calculate the work done on the object as it moves from 0 m to 6.0 m.

