Physics 221&: Engineering Physics I Practice Final Exam

This practice exam is designed to prepare you for the actual final exam. Attempt all questions and show your work clearly. Use appropriate units where required.

1) A ship starts from rest at a port and accelerates uniformly at $2.0\frac{m}{s^2}$ for $5.0s$.
   a) What is the ship's velocity after $5.0s$?
   b) How far does the ship travel during this time?
   c) If the ship then decelerates uniformly at $-1.0\frac{m}{s^2}$, how much time will it take to come to rest?

2) A pirate launches a cannonball with an initial speed of $20.0\frac{m}{s}$ at an angle of $30°$ above the horizontal from a cliff $50.0m$ high.
   a) How long is the cannonball in the air?
   b) How far horizontally does the cannonball travel before hitting the ground?
   c) What is the speed of the cannonball just before it strikes the ground?

3) A treasure chest with mass 50.0 kg is being dragged across a horizontal surface with a coefficient of kinetic friction $\mu_k = 0.3$ by a rope exerting a force of $200.0N$ at an angle of $30°$ above the horizontal.
   a) Calculate the frictional force acting on the chest.
   b) Find the net force acting on the chest.
   c) Determine the acceleration of the chest.

4) A pirate hoists a crate of mass 20.0 kg vertically upward using a pulley system. If the tension in the rope is $250.0N$,
   a) What is the net force on the crate?
   b) What is the acceleration of the crate?
   c) How much time does it take for the crate to reach a height of $10.0m$ if it starts from rest?

5) Two ships are connected by a rope. Ship A has a mass of 2000 kg, and Ship B has a mass of 1500 kg. If Ship A exerts a force of $5000N$ on the rope,
   a) What is the force exerted by Ship B on the rope?
   b) Calculate the acceleration of the system assuming no friction or resistance.
   c) Determine the tension in the rope between the two ships.

6) A parrot with a mass of 1.5 kg is perched on a rope and is accelerating horizontally at $0.5\frac{m}{s^2}$ while the rope makes a $45°$ angle with the vertical.
   a) Find the tension in the rope.
   b) Calculate the horizontal component of the tension.
   c) Determine the net force acting on the parrot.

7) A cannonball of mass 10.0 kg is fired with a speed of $50.0\frac{m}{s}$. After striking a wall, it rebounds with a speed of $30.0\frac{m}{s}$.
   a) What is the impulse imparted on the cannonball by the wall?
   b) If the impact lasts $0.02s$, calculate the average force exerted by the wall.
   c) Discuss how the change in velocity affects the momentum of the cannonball.

8) Two treasure chests, one with mass 10.0 kg and the other with mass 20.0 kg, are pushed across a horizontal deck with a force of $100.0N$ each for a distance of $5.0m$.
   a) How much work is done on each chest?
   b) What is the change in kinetic energy of each chest?
   c) Which chest has a larger velocity after being pushed?

9) A spring-loaded trap with a spring constant $k = 500.0\frac{N}{m}$ is compressed by $0.2m$.
   a) Calculate the potential energy stored in the spring.
   b) If the spring releases its energy to propel a 2.0 kg object horizontally, find the object's velocity.
   c) Discuss how the spring force varies with compression.

10) A pirate slides down a ramp of height $5.0m$ and length $10.0m$. The ramp is frictionless.
   a) Determine the pirate's speed at the bottom of the ramp.
   b) If a frictional force of $30.0N$ acts on the pirate, calculate their speed at the bottom.
   c) Explain how friction affects the conservation of energy in this case.