INSTRUCTIONS:

For for the multiple choice questions 1–8, you will be scored only on the basis of choosing only the one correct answer for full credit. No partial credit will be given.

For questions 9–10, an answer will not be enough; understanding must be demonstrated as well. This can take the form of a clear calculation, a graph or, where appropriate, a clear written explanation. you will receive partial credit for taking the right steps towards a solution, even if you make a mistake towards the end of your work.

No books or notes are permitted in this examination. Writing instruments and a calculator are the only items that you will need.

**** READ THE QUESTIONS CAREFULLY ****

SCORE BOX	
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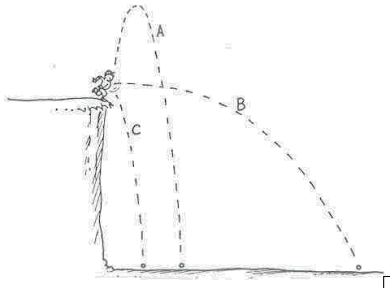
Total	(64)

1. A boy throws three identical balls off a cliff, each with the same launch speed, but with different launch angles. If air resistance is negligible, which ball hits the ground with the greatest speed?
   (a) A
   (b) B
   (c) C
   (d) They all have the same final speed.



ANSWER[ ]

(score) (4)

2. As a car skids with its wheels locked trying to stop on a road covered with ice and snow, the force of friction between the icy road and the tires will usually be

   (a) greater than the normal force of the road times the coefficient of static friction.
   (b) equal to the normal force of the road times the coefficient of static friction.
   (c) less than the normal force of the road times the coefficient of static friction.
   (d) greater than the normal force of the road times the coefficient of kinetic friction.

ANSWER[ ]

(score) (4)

3. The work expended to accelerate a car from rest to 30 km/hr is:

   (a) more than that required to accelerate it from 30 km/hr to 60 km/hr.
   (b) equal to that required to accelerate it from 30 km/hr to 60 km/hr.
   (c) less than that required to accelerate it from 30 km/hr to 60 km/hr.
   (d) may be any of the above depending on the time taken to achieve this speed.
   (e) none of these is true.

   ANSWER[ ]

   (score) (4)

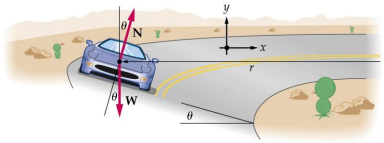
4. A box, mass *m*, is sliding down a rough ramp that is inclined at an angle θ with respect to horizontal. Which of the following expressions gives the *magnitude* of the acceleration of the box?

   (a) $g \sin\theta$
   (b) $g \sin\theta + \mu_k g \cos\theta$
   (c) $g \cos\theta - \mu_k g \sin\theta$
   (d) $g \sin\theta - \mu_k g \cos\theta$
   (e) $\mu_k g \cos\theta$

   ANSWER[ ]

   (score) (4)

5. Curves in the road are banked in order to minimize the need for friction to provide the centripetal force which keeps the vehicle in the turn. If this curve has a radius of 150 m, what is the best bank angle to accommodate a vehicle which travels around the curve at 30.0 m/s?



   (a) 25°
   (b) 31°
   (c) 39°
   (d) 51°
   (e) 59°
   (f) It depends on the mass of the car.

   ANSWER[ ]

   (score) (4)

6. A 2.0 kg stone is dropped from rest. When it has fallen a distance of 10.0 m, it has a speed of 10.0 m/s. How much work was done on the stone by the force of air resistance over this distance?

   (a) -54 J
   (b) -96 J
   (c) -100 J
   (d) -196 J

   ANSWER[ ]

   (score) (4)

7. An object of mass = m, moving with velocity = **v**, collides with a second object of mass = M which is initially at rest. In this collision:

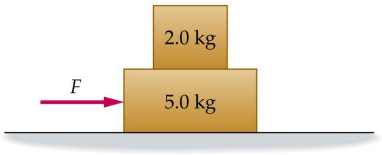
   (a) Momentum is conserved only if the two masses are equal.
   (b) Momentum is conserved only in a completely elastic collision.
   (c) Momentum is conserved, but translational kinetic energy may not be conserved.
   (d) Both momentum and translational kinetic energy are always conserved.
   (e) If the collision is inelastic, neither momentum, nor translational kinetic energy is conserved.
   (f) Translational kinetic energy is conserved if the collision is completely elastic, but momentum may not be conserved.

   ANSWER[ ]

   (score) (4)

8. Two blocks, stacked on top of one another as shown in the figure, slide along a frictionless tabletop. The surface between the blocks is rough, with static friction coefficient, $\mu_s = 0.40$. A horizontal external force, *F*, acts on the 5.0 kg bottom block as shown.

   (a) If the external force has a magnitude of 10.0 N, what is the magnitude of the frictional force that the 5.0 kg block exerts on the 2.0 kg block?



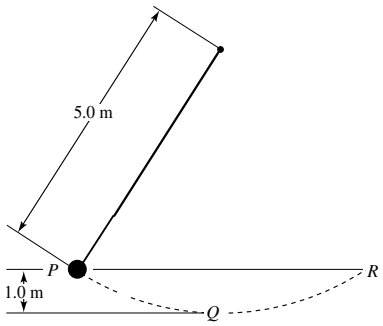
(score)	(8)

   (b) What is the maximum value *F* can have before the 2.0 kg block on top starts to slip?

(score)	(8)

9. P and R mark the highest and Q the lowest positions of a 50.0 kg ball swinging as illustrated in the figure.

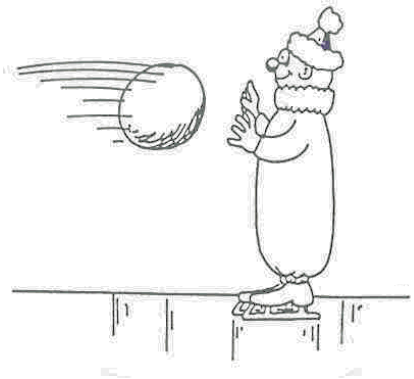
(a) What is the magnitude of the tension in the rope when the ball is instantaneously at rest at point P? (There *is* enough information here for you to find the angle the rope makes with the vertical.) Begin your work by drawing a free body diagram.



(score)	(8)

(b) What is the magnitude of the tension in the rope at point Q? Begin your work by drawing a free body diagram. Hint: Start by finding the speed of the ball at Q.

(score)	(8)

10. 

Jocko the clown, who has a mass of 60 kg, stands at rest on frictionless ice. He then catches a 20 kg ball that is thrown to him at 6 m/s. After the catch, how fast do Jocko and the ball move across the ice?

(score)	(6)