

# ACP Physics Exam

## *Practice Exam*

This exam consists of a 10-question multiple-choice section worth 40 points and two problems worth 35 and 25 points respectively. Show all your work on these sheets.

You may use your calculators and a one-page summary of relevant formulae.

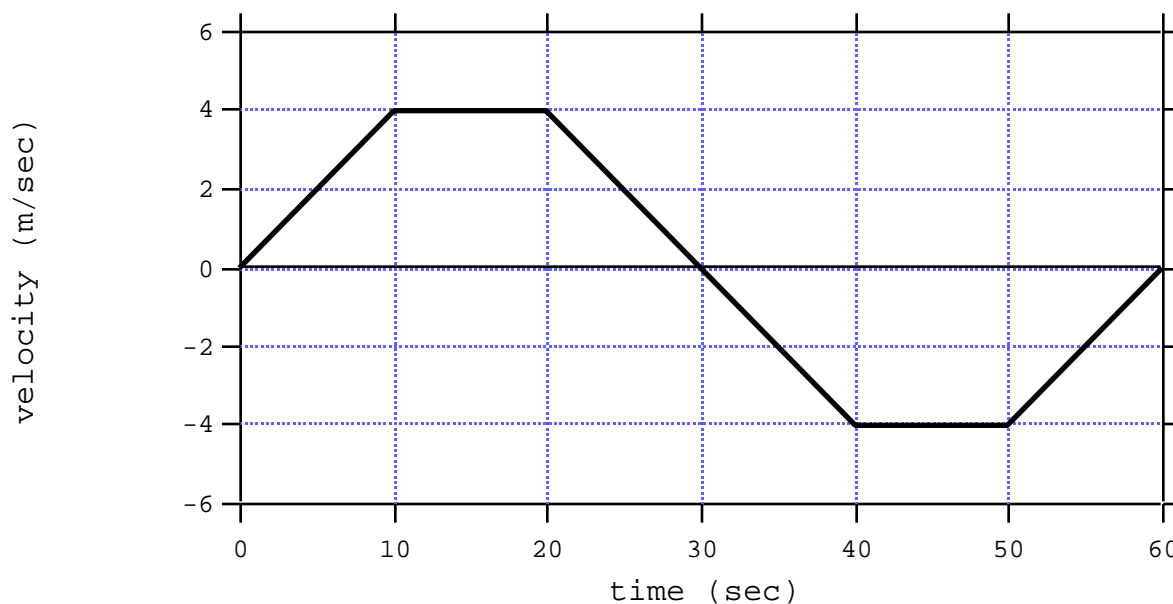
For purposes of this exam, use the approximation :  $g = 10 \text{ m/sec}^2$

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**Part I (40 points)** -Each question has 5 answers to choose from. For each question, clearly circle the letter which corresponds to the best answer.

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**The graph below applies to Questions 1 through 4.** The graph shows the dependence of velocity on time for a body which is restricted to move in one dimension, along the x-axis. At  $t = 0$  the body is at rest at  $x = 0$ .



**Question 1 (4 points)**

At  $t = 20$  sec the body is located at:

- (a)  $x = 0$  m
- (b)  $x = 40$  m
- (c)  $x = 60$  m
- (d)  $x = -60$  m
- (e)  $x = -40$  m

**Question 2 (4 points)**

At  $t = 60$  sec the body is located at:

- (a)  $x = 0$  m
- (b)  $x = 40$  m
- (c)  $x = 60$  m
- (d)  $x = -60$  m
- (e)  $x = -40$  m

**Question 3 (4 points)**

From  $t = 0$  sec to  $t = 60$  sec, the *average speed* of the body is:

- (a) 0.0 m/sec
- (b) 2.0 m/sec
- (c) 2.7 m/sec
- (d) 3.0 m/sec
- (e) 3.7 m/sec

**Question 4 (4 points)**

The acceleration is *negative* for the following time intervals:

- (a) 0 to 10 sec and 50 to 60 sec
- (b) 20 to 30 sec and 30 to 40 sec
- (c) 0 to 10 sec and 30 to 40 sec
- (d) 20 to 30 sec and 50 to 60 sec
- (e) none of the above

**Question 5 (4 points)**

At  $t = 0$  sec, a ball is thrown straight down from a height of 50 m with a velocity of 10 m/sec. There is no air resistance. The ball hits the ground at:

- (a)  $t = 0.32$  sec
- (b)  $t = 1.32$  sec
- (c)  $t = 2.32$  sec
- (d)  $t = 3.32$  sec
- (e)  $t = 4.32$  sec

**Question 6 (4 points)**

A ball is attached to a string and the ball moves in a circle, the plane of which is vertical. The string is always taut and there are absolutely no frictional forces. Which of the following statements is most correct:

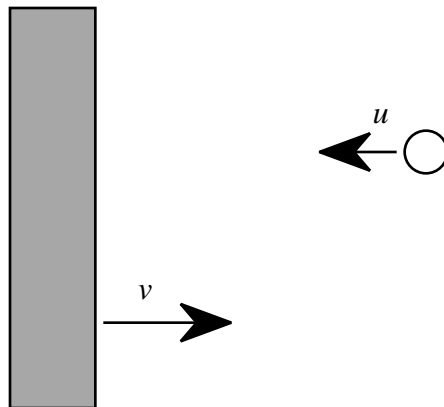
- (a) the net force on the ball is always vertical
- (b) the net force on the ball is always perpendicular to the velocity vector of the ball
- (c) the tension in the string is always constant in magnitude
- (d) the tension in the string is greatest when the ball is at its highest point
- (e) the tension in the string is greatest when the ball is at its lowest point

**Question 7 (4 points)**

Your physics teacher gives you two springs which are alike in every detail except one is twice the length of the other. You find that if you stretch the shorter spring by an amount  $d$  from its relaxed, unstretched length, the total work done by you is  $W$ . Now do the same thing with the longer spring, stretching it by the same amount,  $d$ . The work you now do is:

- (a)  $W$
- (b)  $W/4$
- (c)  $W/2$
- (d)  $2W$
- (e)  $4W$

For Question 8

**Question 8 (4 points)**

A ball is moving horizontally to the left with velocity  $u$  and a massive wall (the mass of the ball is negligible with respect to that of the wall) is moving to the right with velocity  $v$ . Eventually the ball hits the wall and the collision is *perfectly elastic*. Ignore gravity. After the collision the ball is moving to the right with velocity:

- (a)  $v$
- (b)  $u$
- (c)  $2v$
- (d)  $2u$
- (e)  $u+v$

**Question 9 (4 points)**

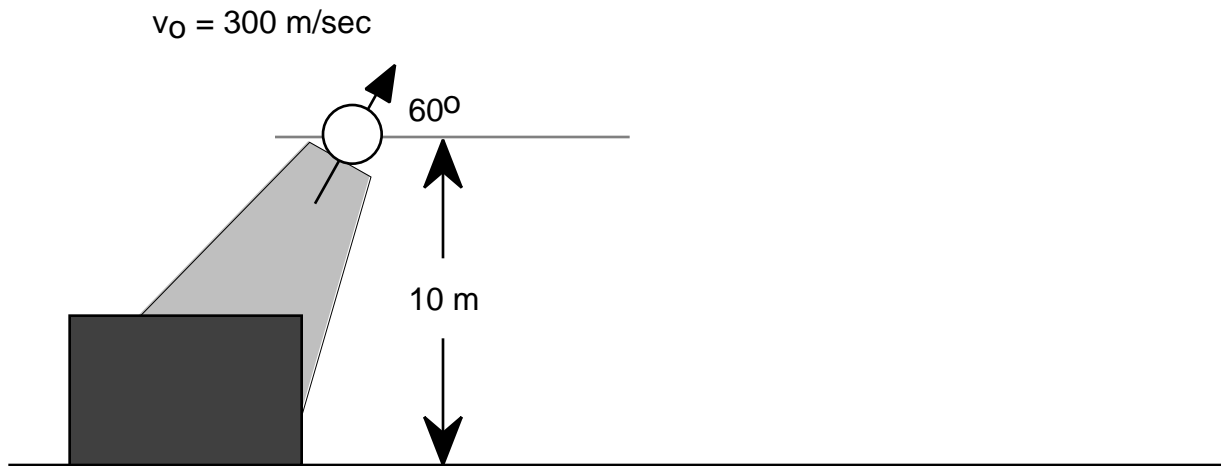
A circular disk is oriented horizontally and is initially at rest. It experiences constant angular acceleration,  $\alpha$ . After one complete turn, the angular velocity of the disk is:

- (a)  $(2\alpha)^{1/2}$
- (b)  $(2\alpha)^{1/2}$
- (c)  $(4\alpha)^{1/2}$
- (d)  $2\alpha$
- (e)  $4\alpha$

**Question 10 (4 points)**

One vector has components:  $(A_x, A_y, A_z) = (3, 1, A_z)$  and another has components  $(B_x, B_y, B_z) = (1, 3, 3)$  and their dot product is 38. The following is correct:

- (a)  $A_z = 1$
- (b)  $A_z = 3$
- (c)  $A_z = 9$
- (d)  $A_z = 13$
- (e) there is not enough information to determine  $A_z$

**Problem 1 (35 points)**

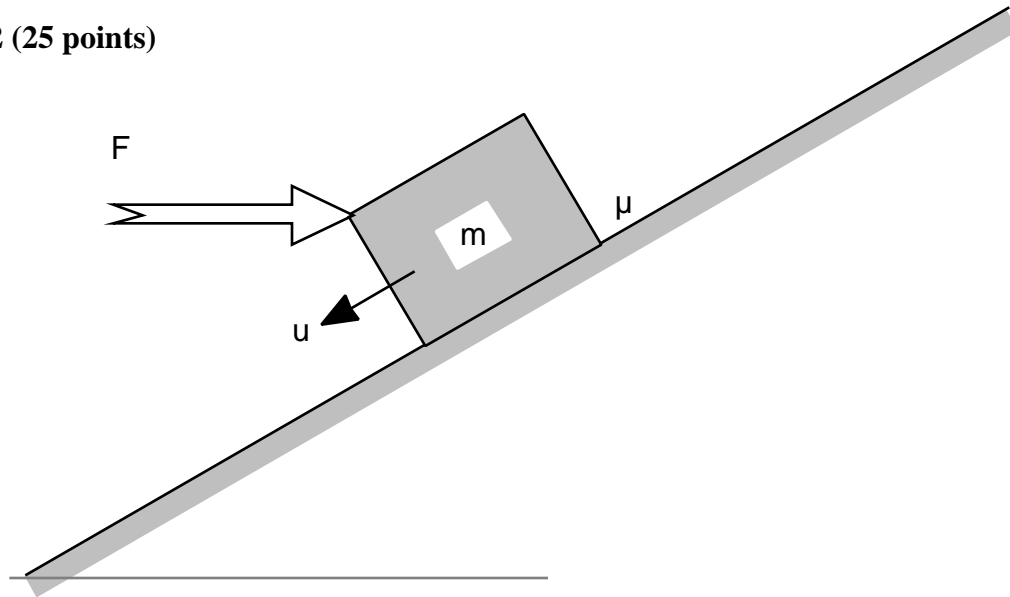
At  $t = 0 \text{ sec}$ , a cannon fires a projectile at  $300 \text{ m/sec}$  at an angle of  $60^\circ$  with respect to the horizontal and the projectile is  $10 \text{ m}$  above the ground when it leaves the cannon. Neglect air resistance.

- (a) (6 points) How long does it take for the projectile to achieve its maximum height ?
- (b) (6 points) What is the maximum height ?
- (c) (6 points) How long (measured from  $t = 0 \text{ sec}$ ) does it take the projectile to once again achieve a height of  $10 \text{ m}$  ?
- (d) (6 points) How much additional time, after achieving a height of  $10 \text{ m}$ , is required for the projectile to hit the ground ?
- (e) (6 points) What is the total horizontal distance traveled by the projectile ?

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*Clearly show all your work below*



**Problem 2 (25 points)**

A block of mass  $m$  slides down a plane inclined at angle  $\theta$  with constant velocity  $u$ . An external agent supplies a constant horizontal force ( $F$ ) as shown. The coefficient of kinetic friction between the block and plane is  $\mu$ . The acceleration of gravity is down and equal to  $g$ .

(a) (2 points) Draw all the forces acting on the block (use the figure).

In terms of the variables given, what is the power delivered to the block due to:

(b) (2 points) all the forces ?

(c) (2 points) gravity ?

(d) (2 points) friction ?

(e) (2 points) external applied force ?

(f) (15 points) Find an expression for  $F$  in terms of the other variables given.

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*Clearly show all your work below*

