

## Practice Mid-Term Test

*This is a Practice Test. It has the same format, style and number of questions that the actual Mid-Term Test will have. The questions on the actual test will be different, of course, but working through the problems on this practice test would probably be a helpful studying activity. Enjoy!*

This test has 7 pages. The test should take no longer than 110 minutes. You may use a calculator and one 5"×3" index card with your own hand-written notes, if you wish.

### Multiple Choice Part (18 points)

Please clearly circle the letter of the best answer.

Total:	/37
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1. A rock flies in an arc through the air. Ignore air resistance. At the highest point of the rock's flight, the vertical component of the rock's velocity is
  - A) up.
  - B) zero.
  - C) down.
  - D) Not enough information is given to determine.
2. You throw a ball straight up. Ignore air resistance. After it leaves your hand, the ball will experience
  - A) only the downward force of its weight, both before and after it reaches its maximum height.
  - B) both an upward force, and the downward force of its weight after it rises. The upward force will gradually diminish to zero at the ball's maximum height, after which the ball will experience only the downward force of its weight.
  - C) an upward force as it rises. This upward force will gradually diminish to zero at the ball's maximum height, after which the ball will experience only the downward force of its weight.
  - D) the upward force of its weight as it rises. Once the ball reaches its maximum height, it will begin to experience the downward force of its weight.
3. A hockey player hits a slap shot, and the puck travels along the ice toward the goal. After the puck leaves the player's stick, the puck is experiencing
  - A) no forward force.
  - B) a constant forward force that diminishes only when the puck hits the net after passing through the goal.
  - C) a forward force that diminishes uniformly with distance but is still strong enough to knock the net backward after the puck passes through the goal.
  - D) a forward force that diminishes uniformly with distance and reaches zero just as it hits the net behind the goal.

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4. After clearing the bar in the high jump, you land softly on a giant mattress. Landing on the mattress is much more comfortable than landing on a sand heap of equal size because
- A) you transfer less momentum to the mattress in coming to a stop than you would have transferred to the sand heap in coming to a stop.
  - B) the force that the mattress exerts on you to stop your descent is much less than the force that the sand heap would have exerted on you.
  - C) you transfer more momentum to the mattress in coming to a stop than you would have transferred to the sand heap in coming to a stop.
  - D) your velocity is less as you land on the mattress than it would have been if you'd landed on the sand heap.
5. You are riding on a playground swing. As you swing forward, there is a moment when you are directly below the pivot that supports the swing. At that moment, you are
- A) accelerating forward.
  - B) not accelerating at all.
  - C) accelerating backward.
  - D) accelerating upward.
6. You're riding on a pogo stick: a vertical stick with a spring at the bottom and foot pads on which you stand. You're holding the top of the stick tightly in your hands and you and the stick are bouncing up and down on its spring. As you land after one particularly high bounce, the spring is becoming more and more tightly compressed. Just before the spring reaches its tightest compression, your velocity is
- A) downward but your acceleration is upward.
  - B) downward and your acceleration is downward.
  - C) upward and your acceleration is upward.
  - D) upward but your acceleration is downward.
7. You are seated in the dining car of a train, facing forward so that you can watch the scenery come toward you. As you sip your coffee, the apple that has been sitting motionless on the level table suddenly rolls to your right. You know that the train
- A) is moving at constant velocity toward the right.
  - B) has accelerated toward the left.
  - C) is moving at constant velocity toward the left.
  - D) has accelerated toward the right.
8. You have always wondered how much one of your friends weighs and devise a scheme to measure his weight secretly. You have him sit in a tubular steel chair. This popular style of chair consists of a single steel tube that is bent into a frame and that supports a seat bottom and a back. The empty chair weighs 10 Newtons and is 30 cm tall. The frame acts as a spring and bends downward slightly when the chair is occupied. When you sit properly in the chair yourself, it bends downward 1 cm. When your friend sits properly in the chair, it bends downward 2 cm. From that observation, you know that your friend weighs about
- A) 300 Newtons.
  - B) twice as much as you do.
  - C) four times as much as you do.
  - D) 150 Newtons.

9. You accidentally bump into a bookcase. It tilts briefly but then returns to upright, and you breathe a sigh of relief. When you first bumped the bookcase, its center of gravity
- A) moved upward and its gravitational potential energy increased.
  - B) moved upward and its gravitational potential energy decreased.
  - C) moved downward and its gravitational potential energy increased.
  - D) moved downward and its gravitational potential energy decreased.
10. Hydrogen is half as dense as helium. Therefore, ignoring the balloon material, the weight of a hydrogen balloon is, compared to a helium balloon of the same volume, pressure and temperature,
- A) twice as big.
  - B) the same.
  - C) half as big.
  - D) one quarter as big.
11. Air mattresses are hollow, air-filled bags that are used as beds while camping or to accommodate occasional visitors at home. When you lie on a fully inflated air mattress, it supports your weight easily and the surface does not bend much. But if you stand on it, its surface bends severely and you may actually pop the air mattress. Standing on the air mattress causes the air pressure inside it to rise much more than lying on it does because
- A) you have much more kinetic energy when you are standing than when you are lying down and this kinetic energy becomes pressure potential energy in the air mattress.
  - B) you weigh more when you are standing up than you do when you are lying down.
  - C) you have much more gravitational potential energy when you're standing than when you are lying down and this gravitational potential energy becomes pressure potential energy in the air mattress.
  - D) you are supported by the mattress' air pressure and as your contact surface with the mattress decreases, the air pressure needed to support you increases.
12. Your apartment window opens 20 metres above a lemonade stand. Your friend lowers a long plastic tube out the window until its end enters the tank of delicious lemonade far below. She then begins to suck on the other end of the tube in hopes of getting a free drink. To her dismay, she never tastes a drop because
- A) atmospheric pressure cannot support a column of lemonade 20 metres tall.
  - B) lemonade is too thick to pass through a tube that long.
  - C) the tube has an average density that is larger than that of lemonade, so the buoyant force cannot support its weight.
  - D) the tube's acceleration is downward, so it prevents the lemonade's velocity from being upward.
13. When you stand in front of an open refrigerator, trying to decide which flavor of ice cream to eat, you feel cold, even though no chilled air actually touches your skin. The reason you feel cold is that
- A) the cold refrigerator is radiating cold toward you and is lowering the temperature of your skin directly.
  - B) you are radiating heat toward the refrigerator but receiving relatively little radiated heat in return.
  - C) you can sense the presence of nearby cold air, even though it is not exchanging heat with your skin.
  - D) you can sense the presence of nearby cold air, even though it is not exchanging cold with your skin.

14. It is a hot summer day and your friend's apartment has no air conditioning. However, a brand new refrigerator lies unopened in the center of the living room. Being a creative person, your friend closes all the doors and windows of the apartment, unpacks the refrigerator, plugs it in, and turns it on. Your friend then opens the refrigerator door and uses a small fan to circulate the air past the refrigerator and throughout the room. After the refrigerator has operated for a few minutes, the average temperature in the room is
- A) lower than it was before.
  - B) higher than it was before.
  - C) the same as it was before and the temperature is uniform throughout the room.
  - D) the same as it was before, but some regions are hotter and others are colder.
15. Moments before it is ignited by the sparkplug, the mixture of fuel and air inside an automobile cylinder is compressed to very high density. During the compression process, the mixture's
- A) temperature stays the same but its pressure rises.
  - B) temperature rises dramatically and so does its pressure.
  - C) temperature drops dramatically but its pressure rises.
  - D) temperature rises dramatically but its pressure drops.
16. You place three nonflammable objects in a fire. They are identical in shape and size, but one object is black, the second is white, and the third is shiny silver. After a few minutes, all three objects are at the same temperature:  $1800^{\circ}\text{C}$ . They remain solid and are now glowing with thermal radiation. Which one is glowing most brightly?
- A) The first object (black).
  - B) They are all glowing with equal brightness.
  - C) The third object (silver).
  - D) The second object (white).
17. What is the frequency of a vibration with period 0.02 second?
- A) 0.02 Hertz
  - B) 0.02 second
  - C) 50 Hertz
  - D) 50 seconds
18. The tides are strongest near the equator because that is where the
- A) centripetal force of the earth is strongest.
  - B) earth's gravity is weakest.
  - C) centrifugal force due to the earth's rotation is strongest.
  - D) tidal bulges caused by the moon are tallest.

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**Written Answer Part (19 points)**

Please answer the following questions. Show all your reasoning and work legibly in the space provided, and draw a box around the final numerical or single-word answer where applicable. You may use the back of the page to continue an answer if needed, but be sure to indicate on the front that your answer is continued, and on the back which question you are continuing.

19. **(3 points)** You hold a basketball out in front of you, and drop it from rest. It falls for half a second without hitting the floor. At this moment, what is the ball's acceleration, speed, and how far has it fallen?
20. **(2 points)** Two cars are being tested for accident safety. They contain identical "crash-test-dummies" or mannequins with sensors designed to test what would happen to a human body during an actual collision. Both cars are driven by remote control into a brick wall at a speed of 60 km/hr. In Car A, the airbag deploys, and the dummy driver hits the airbag. In Car B, the airbag fails to deploy and the dummy hits the steering wheel.
- Compare the changes in momentum of the dummies in Cars A and B.
  - Compare the forces on the dummies in Cars A and B during the collision. Explain the reason why these forces compare in the way they do.
21. **(3 points)** A centrifuge is used in hospitals to separate donated blood into plasma and red blood cells. A certain centrifuge takes test-tubes filled with blood and spins them in a circle of radius 12 cm at a speed of 3.5 m/s.
- What is the centripetal acceleration of the test-tube while it is spinning?
  - What is the ratio of the centripetal acceleration of the test-tube to "g", the acceleration due to gravity? ( $g=9.8 \text{ m/s}^2$ )

22. **(2 points)** In a Helium balloon, how does the number of gas particles per cubic centimeter compare inside and outside the balloon? Why does it float?

23. **(2 points)** You have a table lamp with a dimmer switch. The dimmer allows you to adjust the temperature and brightness of the lamp's incandescent bulb from very dim red up to brilliant yellow-white. How does the bulb's energy efficiency depend on the dimmer's setting? (Energy efficiency is the amount of power released as visible light divided by the total power consumed by the bulb.)

24. **(2 points)** To modify the pitch of a guitar string you could change its mass, tension or length. To raise its pitch, how should you change each of these three characteristics?

25. (5 points) Please answer ONE OF the following two long questions (choose one). Circle the question you have chosen to answer.

**Question A.** How do the following objects do work, and how can they help the person using them: (1) a **ramp**, (2) a **wrench**, and (3) a **bicycle** which is set to a gear in which the back wheel rotates 3 times for every single turn of the pedal. Discuss the similarities and differences of these three objects.

**or**

**Question B.** How does a violin create sound, and what are the properties of a violin that determine the frequency of the emitted sound? What are “harmonics” as produced by a violin? How does an organ pipe produce sound, and what are the properties of an organ pipe that determine the frequency of the emitted sound?

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