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QUESTION 1

Spiders can be distinguished from insects because they have:

- A. two antennae.
- B. eight legs.
- C. jointed legs.
- D. separated head, thorax and abdomen.

Correct Answer: B

QUESTION 2

A fireman of mass m slides down a vertical pole with an average acceleration a . If the acceleration due to gravity is g , what is the average frictional force exerted by the fireman?

- A. mg
- B. $m(g + a)$
- C. $m(g - a)$
- D. ma

Correct Answer: C

QUESTION 3

A hovercraft is a versatile vehicle capable of traveling over land, water, or any other essentially flat surface. The hovercraft consists of a body or hull onto which a rotor (lift fan) is mounted. The lift fan provides the vertical lift by propelling air into an area beneath the hovercraft called the skirt. The pocket of air in the skirt supports the moving hovercraft and reduces the friction between the vehicle and the ground to almost zero. As such, there is no contact between the hovercraft and the ground.

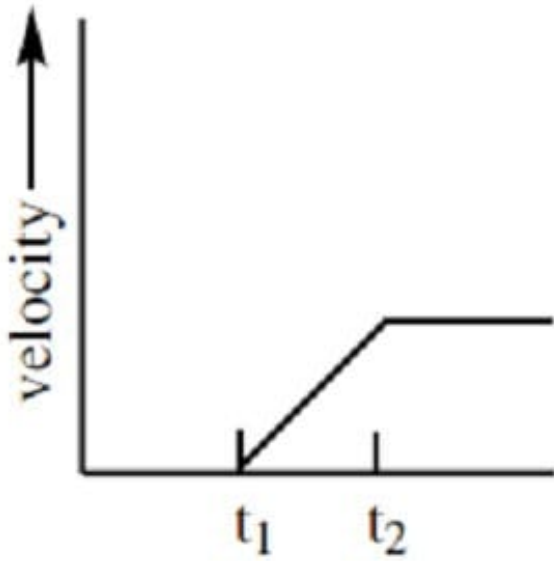
A second fan, which generates a horizontal thrust, propels the hovercraft forward. Rudders which direct the airflow from this second fan are used by the pilot to control the movement of the hovercraft. The horizontal movement of the

$$(1 \text{ atm} = 1.01 \times 10^5 \text{ Pa} = 1.01 \times 10^5 \text{ N/m}^2)$$

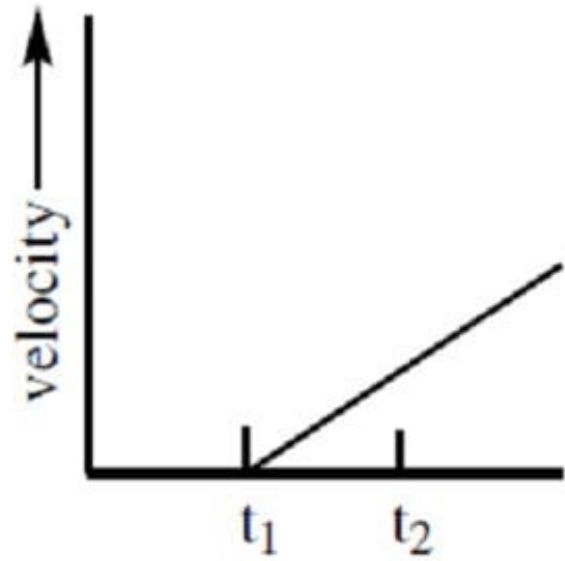
hovercraft is opposed by air resistance which generates aerodynamic drag.

The thrust fan of a hovercraft is turned on at time t_1 and turned off at time t_2 . In the absence of air resistance, which of the following graphs represents the velocity of this hovercraft as a function of time?

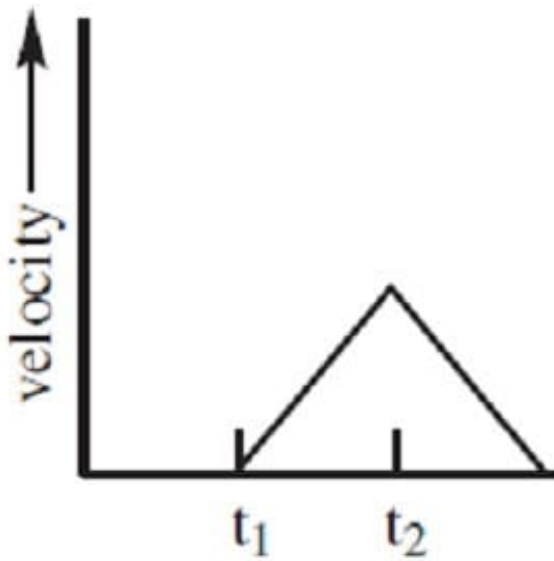
A.



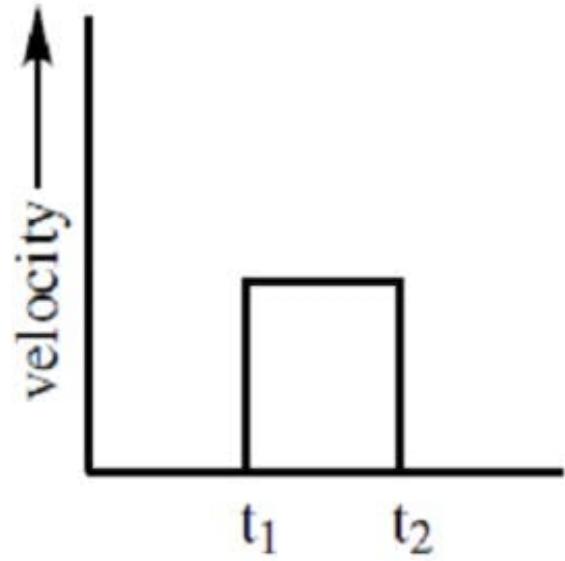
C.



B.



D.



A. Option A

B. Option B

C. Option C

D. Option D

Correct Answer: A

The thrust fan provides the force which propels the hovercraft forward. In the absence of wind resistance, it is the only (and hence net) force acting upon the hovercraft. From the time t_1 that the fan is turned on until time t_2 , the hovercraft

will experience an acceleration supplied by the thrust in accordance with Newton's second law. At the moment t_2 that the fan is turned off, the hovercraft experiences no net force and therefore no acceleration. According to Newton's first law, in the absence of a net force the hovercraft will continue in motion with constant velocity. The increasing velocity due to a constant acceleration between t_1 and t_2 is represented by the positively sloped line in graph A. The constant velocity after the fan is turned off is represented by the horizontal line of graph A. Choice B is incorrect because in the absence of air resistance, the velocity of the hovercraft would not decrease after the thrust has been turned off at time t_2 . Choice C is incorrect because according to the graph, the hovercraft undergoes constant acceleration even after t_2 . This cannot be true, as after t_2 the hovercraft experiences no net force and thus no acceleration. Choice D is incorrect as the graph shows an instantaneous change in velocity which would require an infinite acceleration.

QUESTION 4

The nuclei of certain unstable isotopes will spontaneously decay, producing a more stable nucleus and releasing a particle or quantity of energy. Alpha decay releases a helium nucleus, beta decay emits an electron, while gamma decay is the emission of a high energy photon. Each type of radioactive decay is characterized, in part, by the half-life of the radioactive material--the time required for half of the nuclei in a sample to undergo decay. Examples of such decays are shown in Figure 1.

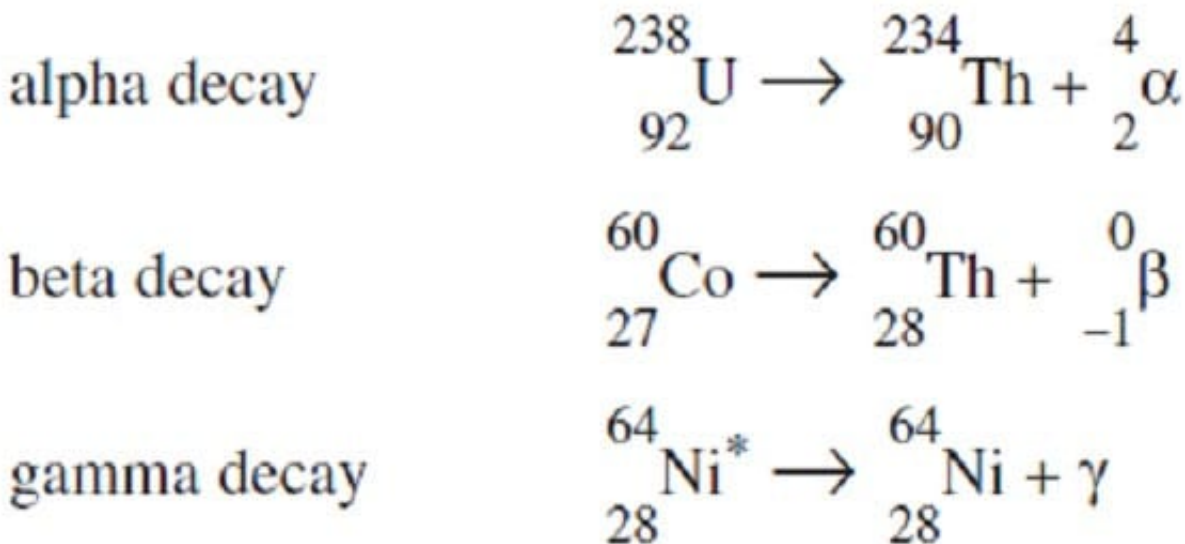


Figure 1

A Geiger counter can be used to detect the decay of radioactive materials. A simple Geiger counter consists of a hollow metal cylinder with a wire along its axis. The cylinder is filled with low pressure argon gas and a high voltage difference is

applied between the wire and the cylinder. When alpha, beta, or gamma radiation passes through the cylinder, it interacts with the gas particles and leads to the formation of ions which cause a discharge between the wire and the cylinder.

The consequent current may be used to drive a speaker, producing the characteristic clicking sound of the Geiger counter each time a pulse of current occurs. The Geiger counter circuitry is shown in Figure 2.

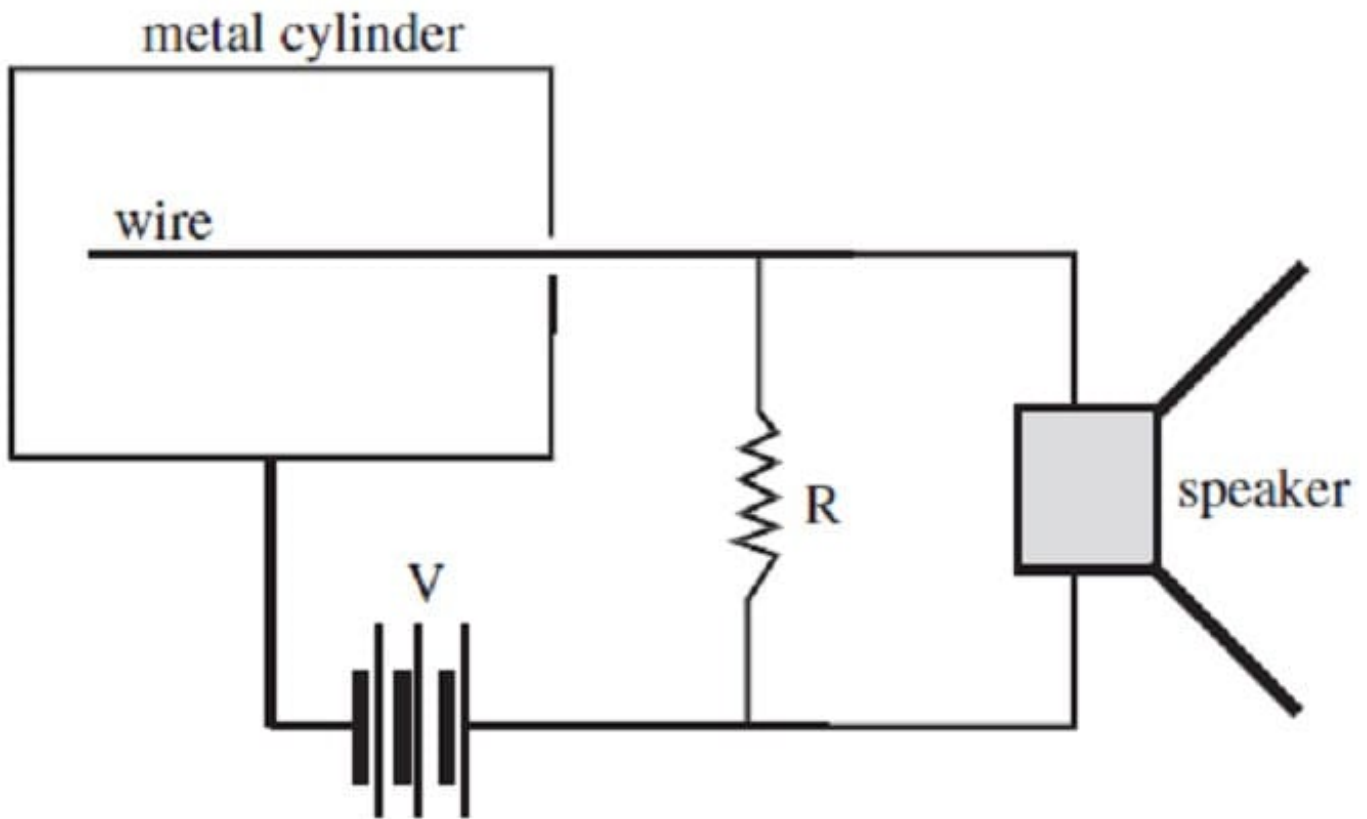


Figure 2

A Geiger counter is best suited for which of the following applications:

- A. comparing the relative magnitudes of radioactivities of two nuclear waste depositories.
- B. spatially locating a radioactive isotope injected into a patient.
- C. calculating the total energy of a radioactive particle.
- D. determining the identity of various types of radioactivity.

Correct Answer: A

A Geiger counter provides a largely qualitative measure of radioactivity in an area. Choice B is incorrect because a Geiger counter cannot locate radioactivity with the precision required for a radioimmuno assay. Choice C is incorrect because a

Geiger counter does not provide a quantitative measure of the energy of a particle. If the particle has enough energy to produce an ionization, it will produce a click. Any energy beyond this is not detected.

Choice D is incorrect because a Geiger counter cannot differentiate between different types of ionizing radiation.

QUESTION 5

...[TV Guide's] immediate concern was the television quiz show scandal, which had reached its climax two weeks earlier when Charles Van Doren, the appealing young man who'd taught viewers the value of learning while winning big on MCA's Twenty-one, stood before a House committee and admitted he was a fraud. But the issue went well

beyond rigged quiz shows. The charge was that through their stranglehold on talent, MCA and William Morris monopolized the medium to the detriment of their clients, the industry, and the public at large. This was why the Justice Department had launched a secret investigation of both agencies more than two years before. The Morris Agency had started the quiz show vogue in 1955, when it packaged The \$64,000 Question for Revlon and sold it to CBS. While the show won praise for its "educational" nature, the real source of its appeal was in its crapshoot format -- the idea that once contestants' winnings hit the \$32,000 mark, they had to decide whether to go double or nothing on the final, \$64,000 question, or play it safe and go home. The response was tremendous. Within weeks, the show knocked I Love Lucy out of the number-one slot in the ratings. Casinos in Vegas emptied out when it went on the air. Bookies took odds on whether the first contestant to go for the big one -- a marine captain whose specialty was cooking -- would get the answer right. (He did.) Revlon sold so much Living Lipstick that its factory was unable to meet the demand. The \$64,000 Question quickly inspired imitators, among them an MCA package called Twenty-one. Based on the card game, more or less, Twenty-one was a dismal failure at first. "Do whatever you have to do," the sponsor ordered angrily, so the producers put the fix in. In December 1956, when Charles Van Doren, a boyishly attractive English instructor at Columbia University, beat Herb Stempel, a short, squat, nerdy grad at City College, Van Doren became the first intellectual hero of the television age. Honors and acclaim poured in -- the covers of Time, letters by the hundreds, offers of movie roles and tenured professorships and a regular guest spot on The Today Show. But Herb Stempel didn't like being told to lose, especially to some Ivy League snot. He went to the press. The DA's office started to investigate. The walls began to close in. Meanwhile, the show's producers agreed to sell the rights to NBC for \$2 million. One of them started to feel queasy about selling the show without letting the network know the score, so he went to Sonny Werblin, MCA's top man in New York, and asked his advice. Werblin, the man behind such hits as The Ed Sullivan Show and The Jackie Gleason Show, ran the television department as if it were a football team coached by Attila the Hun. "Dan," he asked the producer, "have I ever asked you whether the show was rigged?" No, he hadn't. "And has NBC ever asked you whether the show is rigged?" No, they hadn't either. "Well," Werblin concluded, "the reason that none of us has asked is because we don't want to know." And with good reason. Not only was Twenty-one an MCA package and Van Doren himself an MCA client; Werblin had a special relationship with NBC's president, Robert Kintner. Kintner had been president of ABC until...ABC's chairman forced him out in his determination to move the network out of third place. MCA used its influence to place him at NBC, where he proved an extremely pliant customer. In the spring of 1957, when the networks were putting together their schedules for the next season, Werblin went to a meeting of NBC programming executives led by Kintner and his boss, RCA chairman Robert Sarnoff. "Sonny, look at the schedule for next season," Kintner said when he walked in, "here are the empty slots, you fill them."

Which of the following is neither supported nor contradicted in the passage?

- A. Charles Van Doren received assistance that enabled him to win.
- B. Sonny Werblin was the sole creator of The Ed Sullivan Show.
- C. The \$64,000 Question quickly dethroned I Love Lucy from the top of the television ratings.
- D. Robert Kintner had worked with another network before NBC.

Correct Answer: B

Werblin is described as the man behind "The Ed Sullivan Show," but there is no evidence either for or against the claim that he is the ONLY creator. Choice A is contradicted by the passage which makes it obvious that there was an arrangement made to make sure that Van Doren would win. Choice C is clearly supported by information given in the second paragraph. Choice D is also supported by the passage which states that Kintner had been the president of ABC.

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