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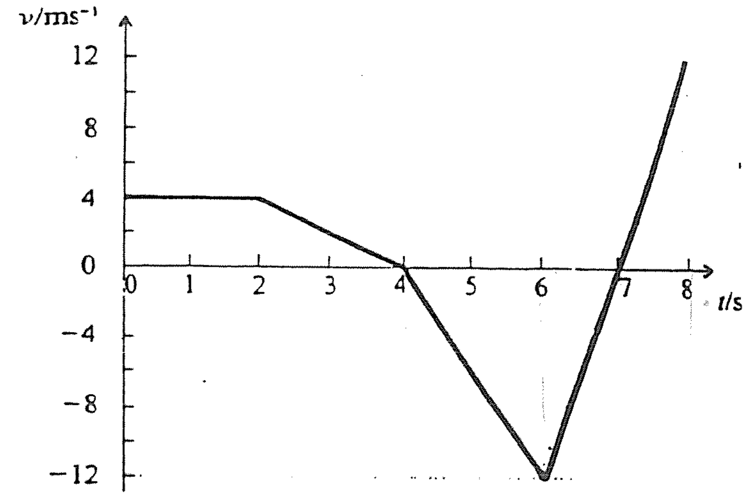
SL MIDTERM REVIEW

Kev Berke

(1) (a) Define the terms displacement and velocity. [4 marks]

d = change of position   v = change in position vs. time

(b) The graph shows a velocity-time relationship for a particle initially moving to the right.



i) $a = \frac{\Delta v}{\Delta t} = \frac{4-4}{2-0} = 0\ m/s^2$

ii) $a = \frac{v_f - v_i}{t} = \frac{12-(-12)}{2} = \frac{24}{2} = 12$

(i) Determine the average acceleration during the first 2 seconds. $0\ m/s^2$ [2 marks]

(ii) Determine the average acceleration during the time interval from 6 s to 8 s. $12\ m/s^2$ [2 marks]

(iii) Determine the displacement of the particle during the first 4 seconds. [2 marks]

area $= (2s)(4m/s) + \frac{1}{2}(2s)(4m/s) = 12\ m$

(iv) Determine the displacement of the particle during the time interval from 4 s to 7 s. area $= \frac{1}{2}(3s)(-12m/s) = -18m$ [2 marks]

(v) Will the particle arrive back at its starting position? If so, at what time does this first happen? If not, why? [2 marks]

at $t = 7\ s$ $d = -6m$
$d_{7-8} = \frac{1}{2}(1s)(12m/s) = +6m$
At t=8s, the particle returns to its starting point.

1st at 6 s
$d_{0-4} = +12m$
$d_{4-6} = -12m$
$d_6 = 0m$

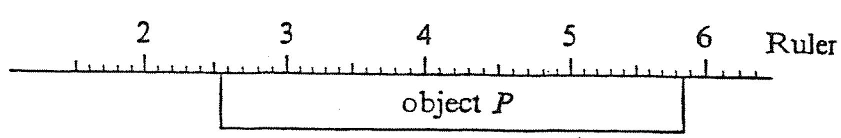
(vi) What is the average velocity of the particle over the entire 8 s? [2 marks]

$V = \frac{\Delta d}{\Delta t} = 0\ m/s$

(c) If the clock was reset to zero, and the same particle was shifted by 4 m [right] and then released to execute exactly the same motion, describe what changes there would be in the above answers. Why? [4 marks]

none - $\frac{\Delta d}{\Delta t} = v$ Δd would not change.

(2) The diagram shows a section of a metre rule which is used to measure the length of the object labelled *P*. Which one of the following best expresses the length of object *P* in centimetres?



A. 3.30

B. 3.3

(C.) 3.30 ± 0.05

D. 3.3 ± 0.1

5.76
− 2.55
3.21

(3) Which one of the following is **not a** unit of energy?

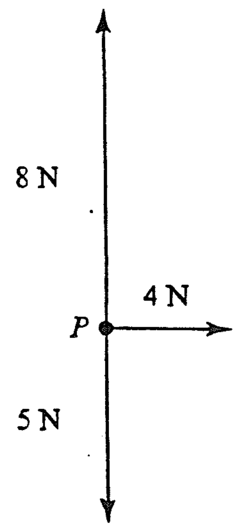
A. W s

B. $W\ s^{-1}$

C. kW h

D. $kg\ m^2\ s^{-2}$

(4) An object, P, is acted upon by three forces as shown in the diagram below.



The magnitude of the resultant force acting on P is

A. 17 N

B. 13 N

C. 5 N

D. 1 N

(5) When a cricket ball is thrown a short distance, which one of the following quantities remains constant throughout its flight?

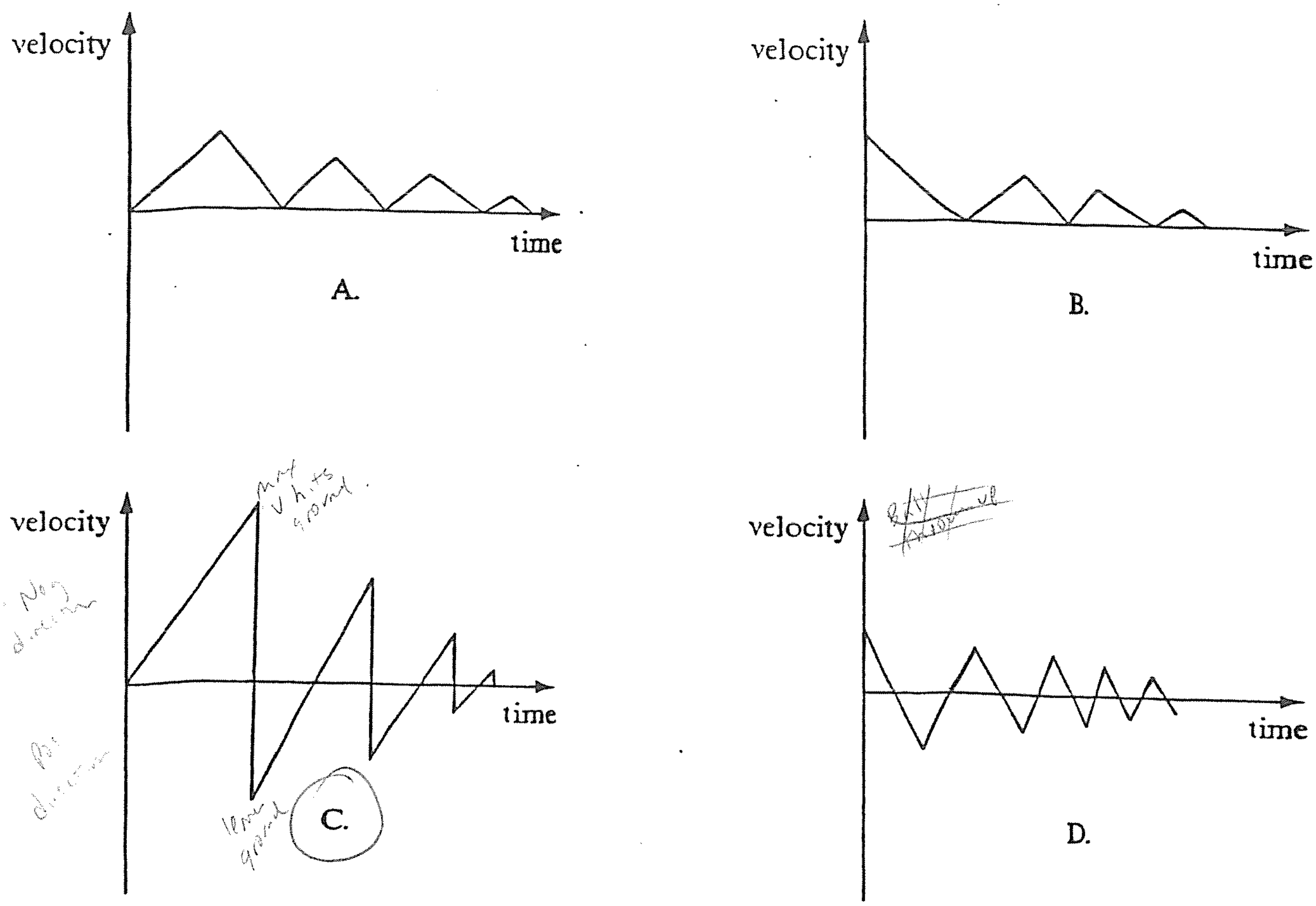
A. Potential energy

B. Momentum

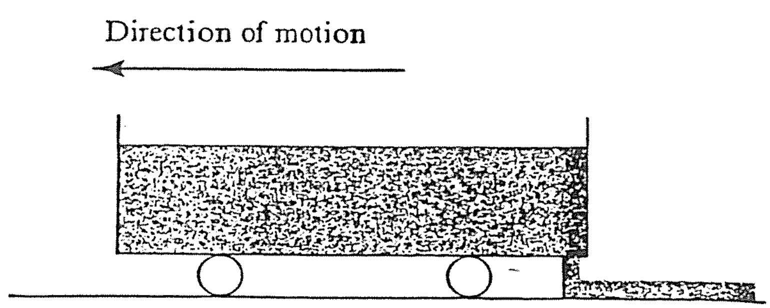
C. Kinetic energy

D. Acceleration

6. A ball is dropped on to a hard surface and makes several bounces before coming to rest. Which one of the graphs below best represents how the velocity of the ball varies with time?



7. The diagram shows a train car that is loaded with fine sand.



It is coasting at a constant speed along a long horizontal rail where frictional effects are negligible. A hole develops in the bottom of the car and sand starts spilling out onto the ground below at a constant rate. While the sand is spilling out the speed of the train car will

A. increase uniformly.

B. decrease uniformly.

C. increase non-uniformly.

D. remain constant.

8) A car is travelling forward at constant velocity. The total weight of the car and passengers is 1000 N. The resultant force on the car must be

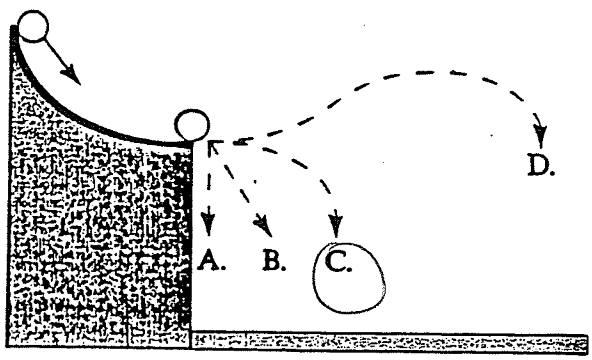
A. greater than 1000 N.

B. 1000 N.

C. between 1000 N and zero.

D. zero.

9) A ball rolls down a curved ramp as shown in the diagram below. Which dotted line best represents the path of the ball after leaving the ramp?



10) An object of mass m is pulled along a horizontal track by a constant horizontal force F_p. The frictional force between the track and the object is F_f. After the object has been moved a distance d from rest its speed will be

A. $(F_p - F_f)d/2m$

B. $2(F_p - F_f)d/m$

C. $\sqrt{2(F_p - F_f)d/m}$

D. $\sqrt{(F_p - F_f)\, d/2m}$

11) A moving ball, P, strikes an identical stationary ball, R. After the collision P is stationary and R moves off with the speed that P had immediately before the collision. In this situation, considering both ball P and ball R

A. momentum alone is conserved.

B. mechanical energy alone is conserved.

C. neither momentum nor mechanical energy are conserved.

D. both mechanical energy and momentum are conserved.

12. Of the following sets of units, which are all SI? (a) cm, s, kg, lb, μm (b) mm, μm, g, s, in. (c) fm, ns, kg, mm, μs (d) km, s, kg, μm, ft (e) none of these.

13. Which length is the largest? (a) 10^1 cm (b) 10^{-10} m (c) 1×10^2 mm (d) 1 m (e) none of these.

14. The diameter of your eyeball is about (a) 2.0×10^2 cm (b) 3.5×10^{-10} m (c) 1.5×10^2 mm (d) 2.5 cm (e) none of these.

15. The length of an unsharpened wooden pencil is about (a) 2×10^2 cm (b) 2×10^{-2} m (c) 2×10^3 mm (d) 2×10^3 nm (e) none of these.

16. Which mass is the smallest? (a) 10^5 μg (b) 10^2 g (c) 1 kg (d) 10^3 mg (e) none of these.

17. Given are four masses: (1) 10 mg (2) 1000 μg (3) 10^2 kg (4) 10^{-4} kg. These are ordered in ascending size as (a) 1, 2, 3, 4 (b) 2, 1, 4, 3 (c) 4, 3, 2, 1 (d) 2, 1, 3, 4 (e) none of these.

18. Which of the following is longest? (a) 1×10^4 cm (b) 100×10^2 mm (c) 10^6 μm (d) 10^9 nm (e) none of these.

19. A day has roughly (a) 86×10^2 s (b) 8640 s (c) 9×10^4 s (d) 1.44×10^3 s (e) none of these.

20. A year has roughly (a) 8.77×10^2 h (b) 5×10^5 min (c) 3.7×10^3 days (d) 32×10^5 s (e) none of these.

21. A cube 1000 cm on a side has a volume of (a) 10^2 cm^2 (b) 10^2 cm^3 (c) 10^6 cm^3 (d) 10^9 cm^3 (e) none of these.

22. A rectangular floor is 6.6 m by 12 m. Its area is (a) 79 m^2 (b) 18.6 m^2 (c) 7.92 m^2 (d) 79.2 m (e) none of these.

23. A femtosecond is (a) 10^{-12} s (b) -15 s (c) 10^{15} s (d) 10^{-15} s (e) none of these.

24. A 20.0-in. bar is (a) 20.0-cm long (b) 508-mm long (c) 51-m long (d) (2.54/20)-cm long (e) none of these.

25. One pound has an equivalent mass of exactly 453.592 37 g. To four significant figures, that's (a) 453.5 g (b) 453.592 3 g (c) 400.0 g (d) 453.6 g (e) none of these.

26. The product of 12.4 m and 2 m should be written as (a) 24.8 m (b) 24.8 (c) 25 m^2 (d) 0.2×10^2 m (e) none of these.

27. The product of 15.0 cm and 5 cm should be written as (a) 75 cm^2 (b) 7.5×10^1 cm^2 (c) 0.75×10^2 cm^2 (d) 0.8×10^2 cm^2 (e) none of these.

28. The weight of 1 kg on Earth is about (a) 1 lb (b) 1000 g (c) 2-1/4 lb (d) 0 (e) none of these.

29. If a bag of screws costs 10¢ per pound, a kilogram of them will cost about (a) 100¢ (b) 22¢ (c) 4.5¢ (d) $22 (e) none of these.

30. If coffee is $12 a kilogram, roughly how much will it be by the pound? (a) $26 (b) $12 (c) $5.5 (d) 55¢ (e) none of these.

31. A liter is 1000 cm^3, which means that a cube 100 cm on a side has a volume of (a) 1000 liters (b) 0.001 m^3 (c) 100 liters (d) 1000 liters^3 (e) none of these.

32. A kilometer is (a) just under half a mile (b) just over half a mile (c) about 1000 ft (d) roughly 5280 ft (e) none of these.

33 [redacted] Suppose that the average speed over some time interval is zero. Is it possible for the average speed over a still smaller segment of that interval to be nonzero? Suppose that the average velocity over some time interval is zero. Is it possible for the average velocity over a still smaller segment of that interval to be nonzero?

34 [redacted] If the tangent at a given point on the distance-time graph of some object is horizontal, what is the object's instantaneous speed at that moment? What does it mean if the tangent to the graph is vertical? Can that actually occur?

35 [redacted] Is it possible to travel from one place to another with some average speed without ever having had an instantaneous speed equal to it somewhere along the journey? Explain.

36 [redacted] When we talk about displacement vectors for travel on our planet, we assume a flat Earth, or at least trips short enough so it's approximately flat. Just for fun, suppose you were standing at the North Pole and walked on the surface (no burrowing) 10 km–SOUTH, 20 km–EAST, and 10 km–NORTH, where would you end up?

37 [redacted] Is it possible during a given interval for a graph of *distance (l) versus time* for the same object to be different from a graph of *the magnitude of the displacement (s) versus time*? Explain.

38 [redacted] If the magnitude of the displacement of a body is given by $s = (At^2 + Bt)/D(C + t)$ where A, B, C, and D are constants, (a) determine the displacement at $t = 0$; (b) find the approximate value of s when t is very much larger than C—that is, when $t >> C$. What is the approximate displacement when $t << C$?

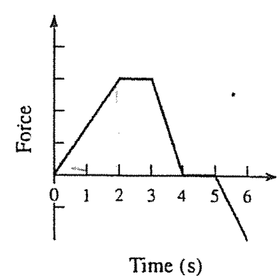


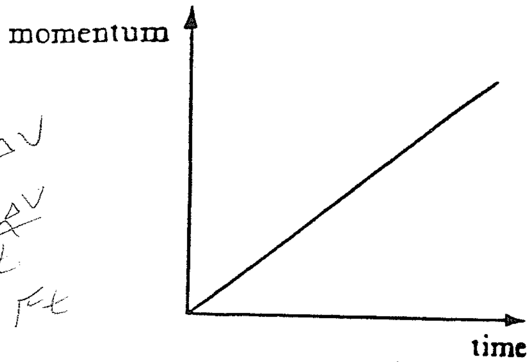
Figure MC3

39. Which interval in Fig. MC3 corresponds to the greatest change in the speed of the body? (a) 0 s to 1 s (b) 1 s to 2 s (c) 2 s to 3 s (d) 3 s to 4 s (e) 5 s to 6 s.

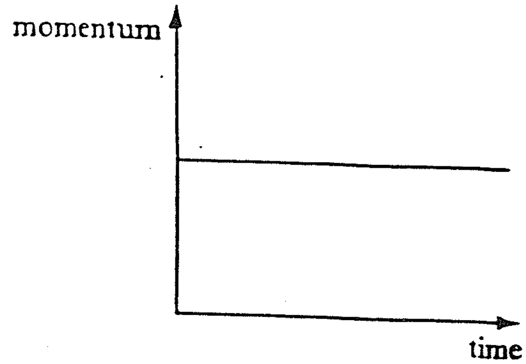
40. During which time interval in Fig. MC3 did the body decelerate? (a) 0 s to 1 s (b) 2 s to 3 s (c) 3 s to 4 s (d) 5 s to 6 s (e) none of these.

41. If L stands for length, T for time, and M for mass, the dimensions of force are (a) $[ML^2]$ (b) $[ML/T]$ (c) $[ML/T^2]$ (d) $[LT/M]$ (e) none of these.

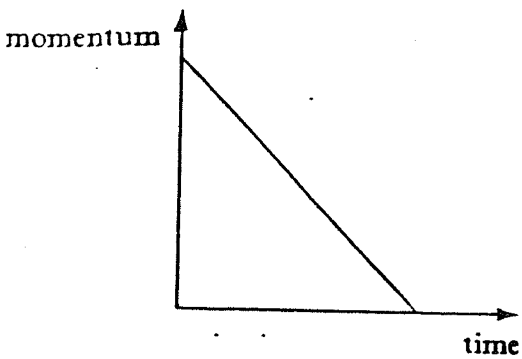
42. Which one of the graphs below best shows how the momentum of a body changes with time when it is acted upon by a constant force?



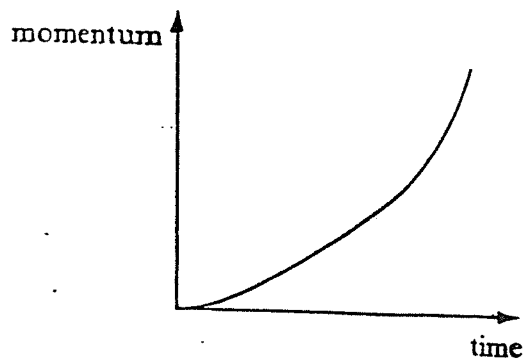
A.



B.

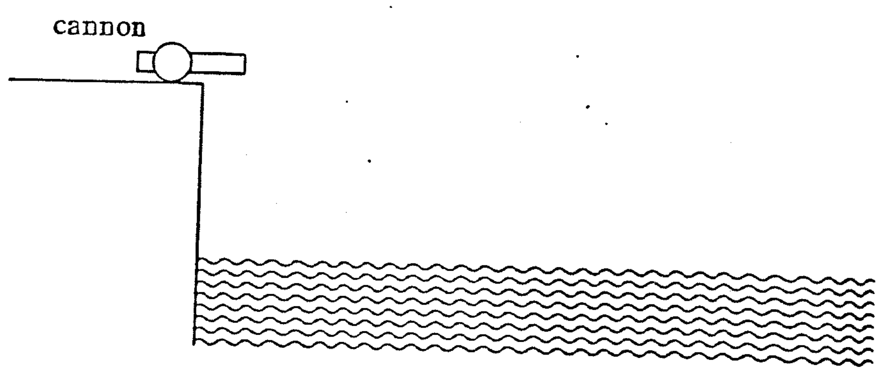


C.



D.

43. A cannonball is fired horizontally from a cannon at the edge of a cliff that overlooks the sea, as shown in the diagram below. At the same instant an identical cannonball is dropped vertically from the cliff edge.



Assuming that air resistance is negligible and the cannonballs start from the same height, which statement is correct?

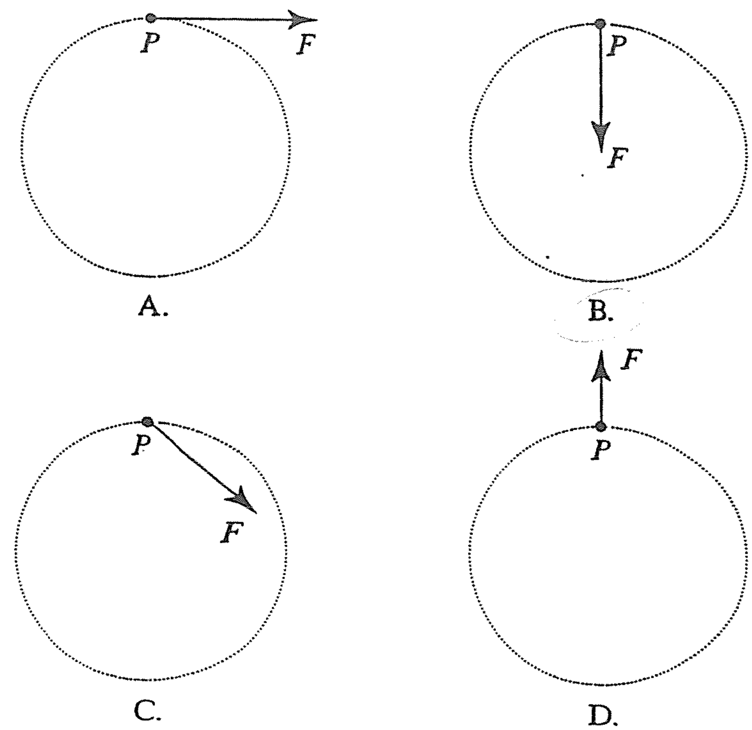
A. The cannonball that was fired horizontally hits the sea first.

B. The cannonball which dropped vertically hits the sea first.

C. Both cannonballs would hit the sea at the same time.

D. It is impossible to say which cannonball hits the sea first without knowing the speed with which the cannonball was fired and the height of the cliff.

44) A particle is moving clockwise around a horizontal circle at constant speed. Which one of the following diagrams correctly shows the force F acting on the particle when it is at point P?



45)

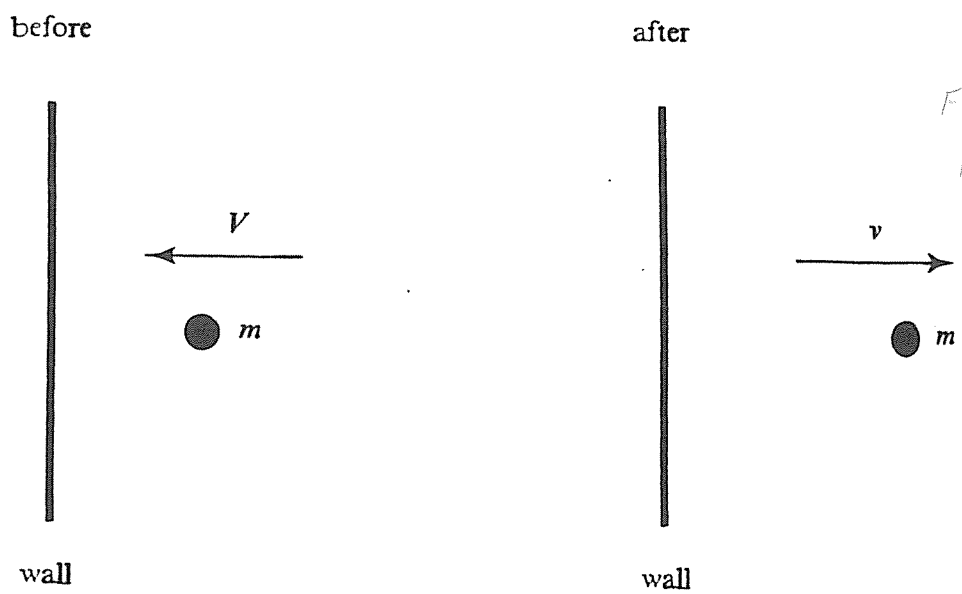


Fig. I

Fig. II

A ball of mass m is moving horizontally towards a vertical wall with speed V as shown in Fig. I. It hits the wall and rebounds with a horizontal speed v as shown in Fig. II.

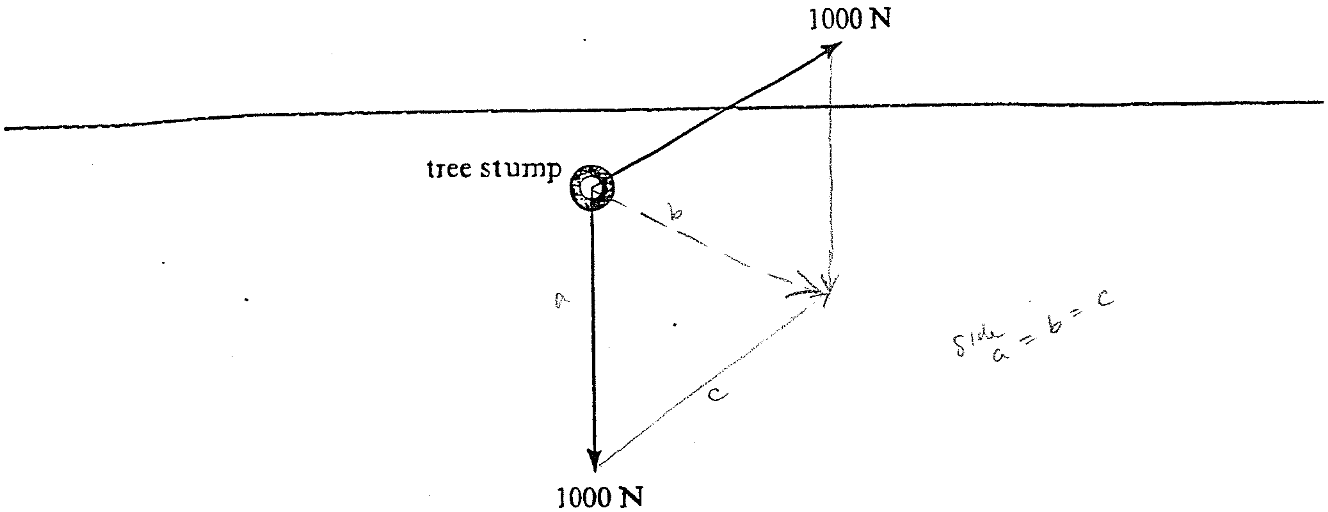
If the ball is in contact with the wall for a time Δt, the magnitude of the average force exerted by the wall on the ball during the collision is

A. $m(v+V)/\Delta t$

B. $m(v-V)/\Delta t$

C. $m(v+V)\Delta t$

(46) To pull a tree stump out of the ground, two tractors pull on ropes as shown in the diagram below. The view is from the top.



Which of the following is the best estimate for the magnitude of the resultant of these two forces?

A. 0 N

B. 1000 N

C. 1500 N

D. 2000 N

(47) Two freely moving objects collide and stick together. If they are still moving after the collision, which one of the following is correct?

$m_1 v_1 + m_2 v_2 = (m_1 + m_2) V_{final}$

$\frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 \overset{?}{=} \frac{1}{2}(m_1 + m_2) V_2^2$

	Total Kinetic Energy	Total Momentum
A.	Remains unchanged	Remains unchanged
B.	Remains unchanged	decreases
C.	decreases	decreases
D.	decreases	Remains unchanged

(48) A woman is standing on a flat section of ground. Her weight is 500 N. Newton's third law states that there must be an equal and opposite force to her weight, which is

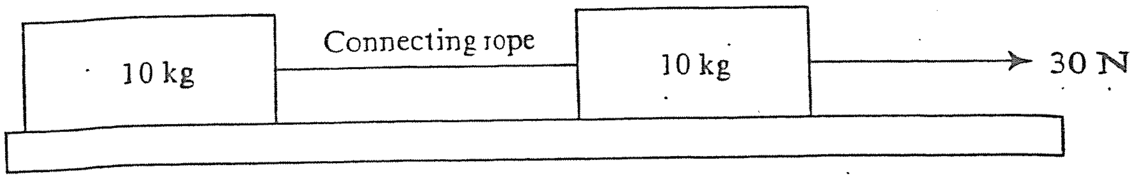
A. the Earth exerting an upward force of 500 N on the woman.

B. the woman exerting an upward force of 500 N on the Earth.

C. the woman exerting a downward force of 500 N on the Earth.

D. the Earth exerting a downward force of 500 N on the woman.

49. Two 10 kg blocks on a smooth horizontal surface are tied together. They are accelerated by a horizontal force of 30 N which acts as shown below:



If frictional effects are negligible, what is the tension in the connecting rope?

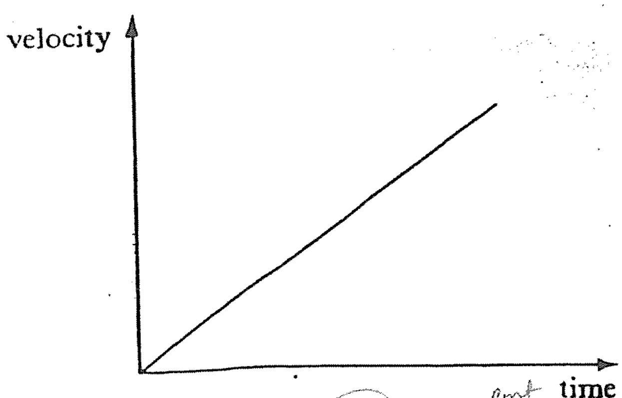
A. 30 N

B. 15 N

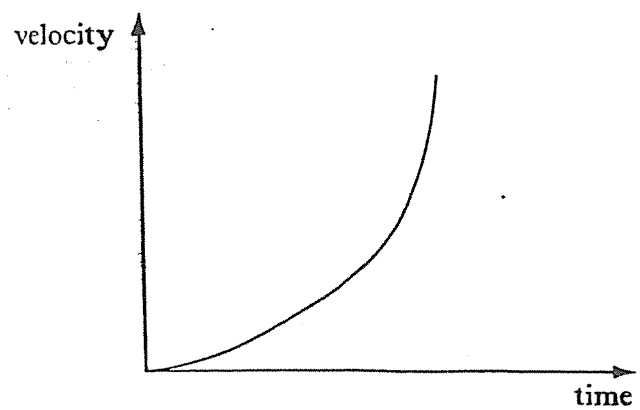
C. 10 N

D. 0 N

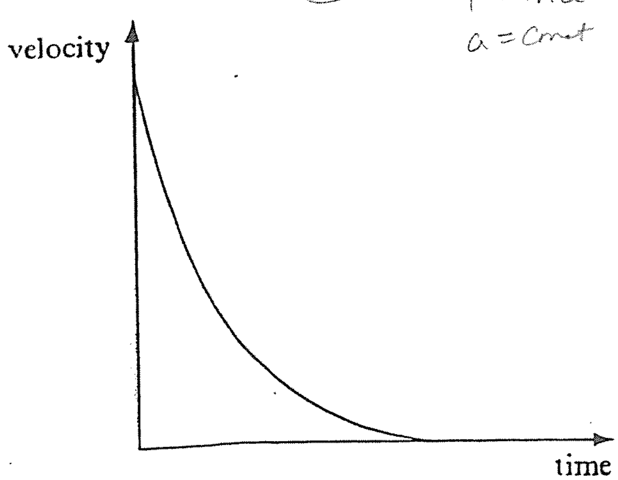
50. Which one of the following graphs best represents the velocity-time graph of an object subjected to a constant resultant force?



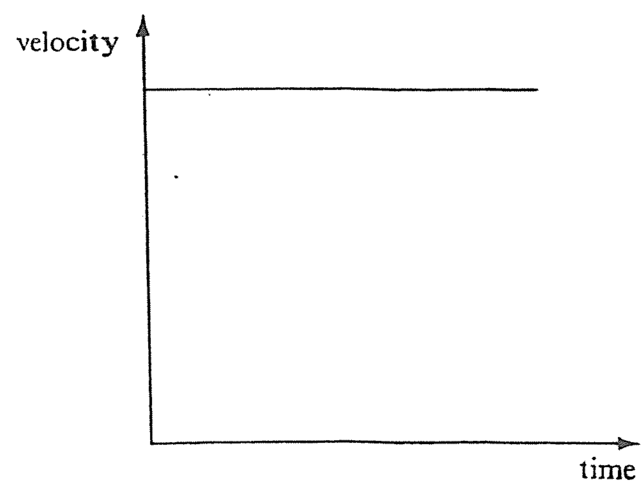
A.



B.



C.



D.

51 An object, initially at rest, is subjected to a constant resultant force. Readings are taken of its velocity v at different distances s from its starting position.

Which one of the following graphs should be plotted to yield a straight-line graph?

A. s versus v

B. s versus v^2

C. s^2 versus v

D. s^2 versus v^2

52. The mass of an astronaut on a planet where gravity is 10 times greater than Earth's gravity is (a) 10 times smaller (b) 10 times larger (c) 10g times greater (d) 10g times smaller (e) none of these.

53. Is it possible to devise a technique to push on a table without it pushing back on you? (a) Yes, out in space. (b) Yes, if someone else also pushes on it. (c) A table never pushes in the first place. (d) No. (e) None of these.

54. If a nonzero constant net horizontal force is acting on a body sitting at rest on a frictionless table, the body will (a) sometimes accelerate (b) always move off at a constant speed (c) always accelerate at a constant rate (d) accelerate whenever the force exceeds its weight (e) none of these.

55. If (with no friction) a force F results in an acceleration a when acting on a mass m, then tripling the mass and increasing the force sixfold will result in an acceleration of (a) a (b) $a/2$ (c) $2a$ (d) $a/6$ (e) none of these.

56. A bubble level can be used as an accelerometer. If the level is accelerated due east while in normal operating position aligned east-west, the bubble will (a) move west (b) move east (c) move north (d) remain at rest (e) none of these. Try it.

57. A 250-lb man holding a 30-lb bag of potatoes is standing on a scale in an amusement park. He heaves the bag straight up into the air, and before it leaves his hands, a card pops out of a slot with his weight and fortune. It reads (a) 250 lb (b) 280 lb (c) less than 250 lb (d) more than 280 lb (e) none of these.

58. Imagine that you are standing on a cardboard box that just supports you. What would happen to it if you jumped into the air? It would (a) collapse (b) be unaffected (c) spring up as well (d) move sidewise (e) none of these.

59. Imagine a flat, lightweight wheeled cart that is low to the ground and has well-oiled bearings. What will happen to it if, while standing at rest on it, you begin to walk along its length? It will (a) remain stationary (b) advance along with you (c) not enough information to say (d) move in the opposite direction (e) none of these.

60. With the previous question in mind, what would happen if you approached the cart, stepped onto it, and walked its length at a constant speed? It would (a) remain nearly stationary (b) advance along with you (c) move rapidly in the opposite direction (d) move forward then backward (e) none of these.

61. Mars has a mass of 0.1074$M_\oplus$ and is at a mean distance from the Sun that is 1.52 times larger than that of Earth. By comparison to the gravitational force exerted on Mars by our world, the force exerted on Earth by Mars is (a) 0.1074 times smaller (b) 0.1074 times larger (c) the same (d) 1.52 times less (e) none of these.

62. The asteroid Geographos (one of the Apollo group, each of which crosses the Earth's orbit on the way around the Sun) has a radius of $2.4 \times 10^{-4} R_\oplus$ and a mass of $8.4 \times 10^{-12} M_\oplus$. How does the gravitational acceleration on its surface compare to the corresponding value g_0 on the Earth? It equals (a) $2.4 \times 10^{-4} g_0$ (b) $8.4 \times 10^{-12} g_0$ (c) $1.5 \times 10^{-4} g_0$ (d) $3.5 \times 10^{-8} g_0$ (e) none of these.

63. An astronaut on the Moon has a mass that by comparison to his mass on Earth is (a) unchanged (b) six times greater (c) six times less (d) not enough information to say (e) none of these.

64. The acceleration due to gravity, as measured by a spring-balance determination of the weight of an object ($F_W = mg$), varies from place to place on Earth because (a) the mass changes (b) g is affected by the rotation of the planet only (c) g depends on the shape of the planet only (d) g depends on both the rotation and shape of the planet (e) none of these.

65. If *Martian Orbiter 1* is sailing about that planet in a circle with an orbital radius nine times that of *Orbiter 2*, whose speed is v_2, what is the speed of *Orbiter 1*? (a) $\frac{1}{3}v_2$ (b) $3v_2$ (c) v_2 (d) $81v_2$ (e) none of these.

66. Figure MC15 shows a spaceship in orbit about a star. If its speeds at the four points shown are v_A, v_B, v_C, and v_D, respectively, then (a) $v_A < v_B < v_C < v_D$ (b) $v_A > v_B > v_C > v_D$ (c) $v_A > v_B = v_D > v_C$ (d) $v_A < v_B = v_D < v_C$ (e) none of these.

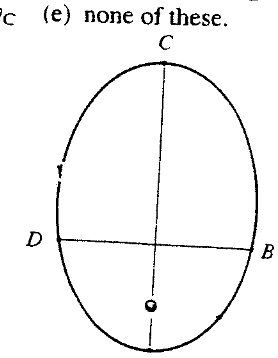
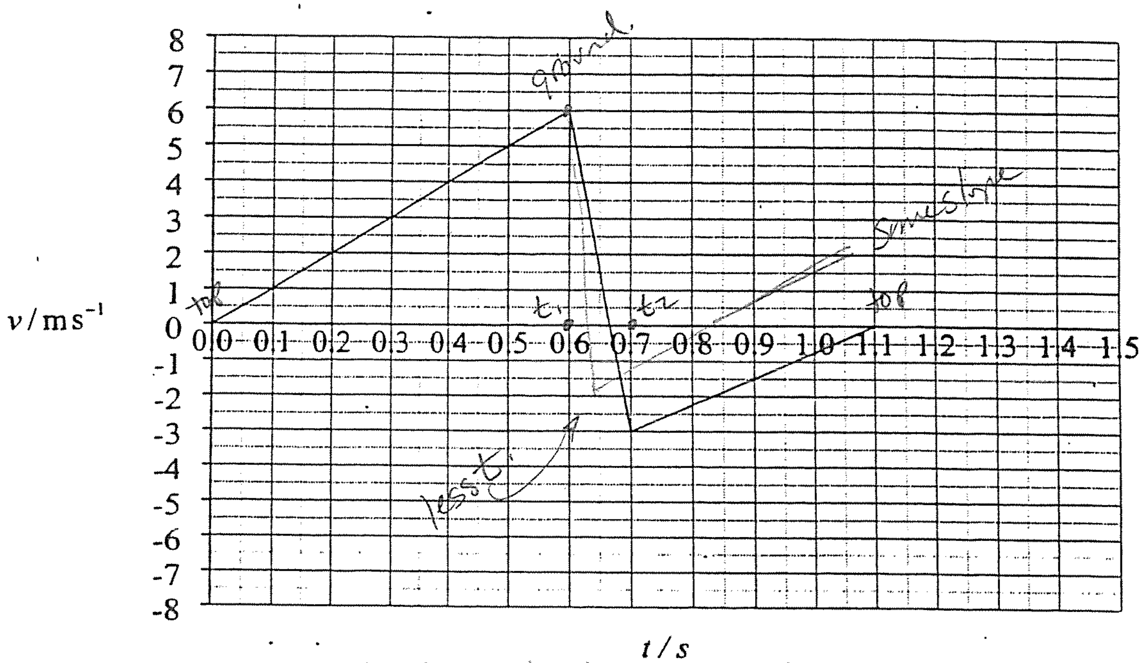


Figure MC15

HW.

(67) This question is about a bouncing ball.

A soft rubber ball of mass 0.20 kg is dropped from rest on to a flat horizontal surface and it is caught at its maximum height of rebound. A sonic data logger is used to record the velocity of the ball as a function of time. The graph below shows how the velocity of the ball varies with time t from the instant it is released to the instant that it is caught.



Ans. (g) must be lower t_2 b/c F ↑, 1st section No change, Final slope must be the same

(a) Mark on the graph above the time t_1 where the ball hits the surface and the time t_2 where it just loses contact with the surface. [2]

(b) Use data from the above graph to determine

(i) the acceleration due to gravity. [3]

$t = 0.6$ m $V_f = V_i + at$ a = slope of V vs t

$V_i = 0$ m/s 6 m/s $= 0 + g(.6$ m$)$

$V_f = 6$ m/s 10 m/s$^2 = g$

or pick a pt and use $V_f = V_i + at$

(ii) the height to which the ball rebounds. [3]

Energy Cons.

~~PE+KE = PE+KE~~

$\frac{1}{2}mv^2 = mgh$

$\frac{1}{2}(.2)(9) = (.2)(10)h$

$4.5 = 10h$

$.45 = h$

if realize can get appropriate ...

OR $\bar{V} = \frac{d}{t}$

$\bar{V}t = d$

$(1.5$ m$)(.4) = .6$ m

$V_o = 3$ m/s
$V_f = 0$ m/s
$t = 1.1 - 0.7 = 0.4$ sec

(This question continues on the following page)

OR

$x = V_i t + \frac{1}{2}at^2$ or −10

$= 3(.4) + \frac{1}{2}(-7.5)(.4)^2$

$= .6$ m

Note graph signs are reversed

(67) cntd

(c) Use data from the graph opposite to find the change in momentum of the ball between t_1 and t_2. [3]

at t_1 = −6 m/s   at t_2 = +3 m/s

m = .2 kg

$\Delta p = m\Delta v = (.2\,kg)(-3 - 6\,m/s)$

= +1.8 kg m/s

(d) Determine the magnitude of the average force that the ball exerts on the surface. [4]

$F\Delta t = m\Delta v$

$F = \frac{m\Delta v}{t} = \frac{1.8\,kg\,m/s}{.1\,s} = 18\,N$

(e) Explain how the collision between the ball and the surface is consistent with the principle of momentum conservation. [2]

p of the ball changes

but

p is transferred to the ground

(f) Is the magnitude of the force that the surface exerts on the ball greater than, smaller than or equal to the force that the ball exerts on the surface? Explain: [3]

Forces are equal + opposite

Newton's 3rd Law

(g) A hard rubber ball of the same mass as the soft rubber ball is dropped from the same height as that from which the soft rubber ball was dropped.

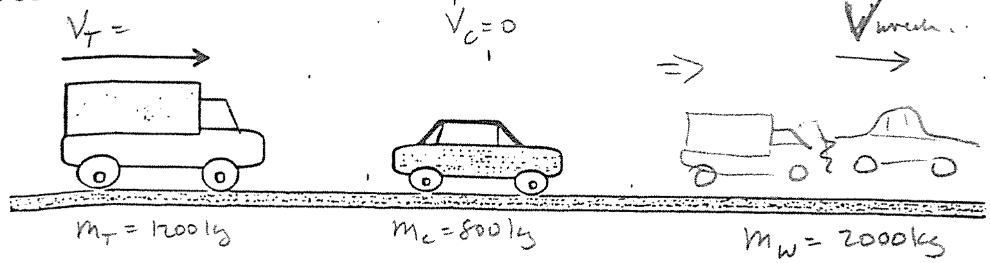
Given that the hard rubber ball exerts a greater force on the surface than the soft rubber ball, sketch on the graph opposite how you think the velocity of the hard rubber ball will vary with time. *(Note that this is a sketch graph; you do not need to add any values.)* [5]

See graph

(68) This question is about the application of physics principles to a traffic accident.

HW.

In the accident, a moving van ran into the back of a car which was stationary with its handbrake on. The vehicles then moved straight onwards, remaining in contact, but came to rest after a certain distance.



$V = 0$, $d = 15 m$

Suppose you are brought in as a scientific consultant to determine the speed at which the van must have been travelling when it hit the car. You gather the following information.

- There are skid marks on the road, 15 m long, made by the car's rear tyres after the collision, but no skid marks for the van.
- The car's handbrake acts only on the rear wheels.
- The frictional force on the car's skidding rear tyres is 30% of the car's weight. $F_f = .3 (800 kg)(10 m/s^2) = 2400 N$
- The masses of the van and car are 1200 kg (m_T) and 800 kg (m_c) respectively.

(a) Using this information and principles of physics, determine the speed of the van just before it hit the car. You may take $g = 10 m s^{-2} = 10 N kg^{-1}$. [12]

(Hint: there are two stages to consider, namely the collision and skidding to a halt after the collision.)

Collision: $(mV)_T + (mV)_c = (mV)_W$

(EQN 1) $1200 V_T + 0 = 2000 V_W$

Braking + Skidding to a stop: Find this: $V_{initial}$ for the braking + skidding

$F_{net} = ma$

$-2400 N = 2000 kg (a)$

$-1.2 m/s^2 = a$

$V_f^2 = V_i^2 + 2ad$

$0 = V_0^2 + 2(-1.2 m/s^2)(15 m)$

$\sqrt{36} = V_0$

$6 m/s = V_0$

OR $\frac{1}{2}mv^2 = F \cdot d$

Sub into EQN 1

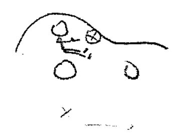
$1200 V_T + 0 = 2000 (6 m/s)$

$V_T = 10 m/s$ ✓

(68) contd

(b) The driver sitting in the car was wearing a safety belt and had a headrest behind her head. Explain whether or not the safety belt and/or headrest could serve a protective function in this particular accident. Refer to the sequence of events and to principles of physics in your answers.

Car V_0 = at rest
Car is hit foward



Safety belt: [3]

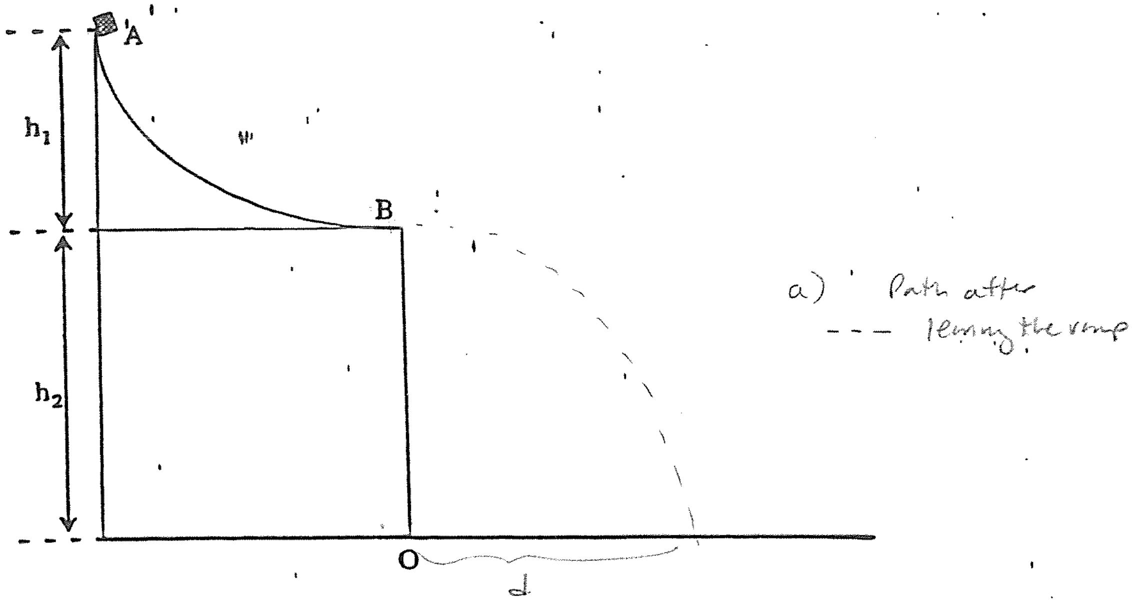
Does Not Serve a protective function. According to N. 1st Law body at rest will remain at rest. So the back of the seat pushes into the body it does not "fly" foward.

Headrest: [3]

Yes it does serve a protective function. Newton's 1st law the body at rest will remain at rest as the car gets hit the seat of the car pushes into the body. While the body is pushed foward by the seat the headrest pushes the head foward preventing neck injuries.

Class last day of review

(69) A body slides with negligible friction from point A down a smooth curved ramp, starting from rest. The end of the ramp is horizontal at point B. The end of the ramp is a height h_1 below A and a height h_2 above the floor, as shown in the diagram.



(a) On the diagram above sketch in the shape of the path taken by the body after it leaves the ramp. [1]

(b) Show that the body will hit the floor at a distance d from point O given by $d = 2\sqrt{h_1 h_2}$ [6]

X | Y

d_x = range

$d_x = V_x t$

$V_x = ?$

rel to B. $(PE + KE)_A = (PE + KE)_B$

$mgh_1 = \frac{1}{2} m v_B^2$

$\sqrt{2gh_1} = V_B$

$d_y = V_{y0} t + \frac{1}{2} a t^2$

$-h_2 = \frac{1}{2}(g) t^2$

$\sqrt{\frac{2(h_2)}{g}} = t$

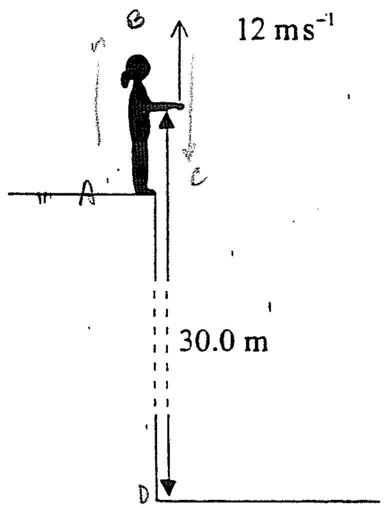
$d_x = \sqrt{2gh_1} \sqrt{\frac{2h_2}{g}}$

$d_x = 2\sqrt{h_1 h_2}$

yes!

(7c)

A girl stands on the edge of a vertical cliff and throws a stone vertically upwards. The stone eventually lands in the sea below. The stone leaves her hand with a speed of 12 m s^{-1} at a height of 30.0 m above the sea.



Taking the acceleration due to gravity to be 10 m s^{-2} and ignoring air resistance determine

(a) the maximum height, measured from sea-level, reached by the stone. [2]

$V_f^2 = V_o^2 + 2ad$

$0^2 = (12\frac{m}{s})^2 + (2)(-10)(d)$

$\frac{-144}{-20} = d$

$d = 7.2$ m

as measured from sea level

$h_{max} = 7.2m + 30m$

$= 37.2m$ ✓

(b) the time that it takes the stone to hit the sea after leaving the girl's hand. [5]

$d_y = V_{y_o}t + \frac{1}{2}at^2$

1st: $V_f = V_o + at$

$-12 m/s = +12 m/s + (-10 m/s^2)t$

$\frac{-24}{-10} = t = 2.4s$

2nd: $V_f^2 = V_o^2 + 2ad$

$V_f^2 = (-12 m/s)^2 + (2)(-10 m/s^2)(-30m)$

$V_f = \sqrt{744} = -27.3 m/s$

$V_f = V_o + at$

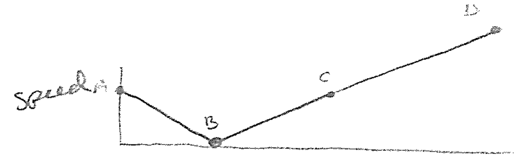
$-27.3 m/s = -12 m/s + (-10 m/s^2)t$

$t = 1.5s$

(This question continues on the following page)

$t_{total} = 2.4 + 1.5 = 3.9s$ ✓

(70) cont'd



(c) In the space provided below sketch a graph to show how the speed of the stone varies with time from the moment it leaves her hand to just before it hits the sea. *(Note that this is a sketch graph; you do not need to add values to the axes.)* *[2]*

71. A 10-kg mass is held 1.0 m above a table for 25 s. How much work is done during that period? (a) none (b) 10 J (c) 250 J (d) 9.8 J (e) none of these.

72. The net work done on an object moving along a closed path in a force field is zero when it returns to the origin. The force is (a) conservative (b) nonconservative (c) impossible (d) liberal (e) none of these.

73. A typical adult male's heart pumps about 160 milliliters of blood per beat. It beats around 70 times per minute and does roughly 1 J of work per beat. How much work does it do in a day? (a) 10^5 J (b) 10^6 J (c) 70 J (d) 70×10^3 J (e) none of these.

74. Which of the following is not a measure of the same quantity as the others? (a) newton-meter per second (b) kilogram-meter^2 per second^3 (c) joule per second (d) watt (e) none of these.

75. If a 20-kW engine can raise a load 50 m in 10 s, how long will it take for it to raise that same load 100 m? (a) 20 s (b) 40 s (c) 5.0 s (d) not enough information (e) none of these.

76. If a 25-hp motor can raise an elevator 10 floors in 20 s, how long will it take a 50-hp motor to do the same? (a) 40 s (b) 10 s (c) 20 s (d) 5.0 s (e) not enough information.

77. Which of the following is not a measure of the same quantity as the others? (a) foot-pound (b) newton-meter (c) watt (d) joule (e) none of these.

78. If this book is placed on an ordinary table and slid along a path that brings it back to where it started, (a) no net power will have been required (b) work will certainly have been done (c) assuming a conservative gravitational field, no net work will be done (d) not enough information is given to say anything about the work done (e) none of these.

79. A fairly small asteroid (1000 kg) out in deep space is to be accelerated from rest up to 10 m/s. Inasmuch as it is weightless, will work have to be done on it during the acceleration and, if so, how much? (a) no (b) yes, 10 000 J (c) yes, 50×10^3 J (d) yes, 10 000 N (e) yes, 50×10^3 N

80. Work is done on an object far out in space where it has negligible *gravitational*-PE. If in the process there is no net change in its KE, we can conclude (a) that friction *may* have been operative (b) that this situation is impossible (c) that the energy of the object has decreased (d) that the object's speed decreased (e) none of these.

81. A rocket coasting along in space at some speed v fires its engines thereupon doubling its speed, but at the same time it jettisons some cargo, reducing its mass to half its previous value. In the process, its KE is (a) doubled (b) tripled (c) quadrupled (d) unchanged (e) none of these.

82. A kid in a wagon rolls from rest down a hill reaching the bottom at 12 m/s. On the next run, she gets a push and starts down at 5.0 m/s. At what speed does she now arrive at the bottom? (a) 12 m/s (b) 17 m/s (c) 7 m/s (d) 13 m/s (e) none of these.

83. Two equal-mass bullets traveling with the same speed strike a target. One of the bullets is rubber and bounces off: the other is metal and penetrates, coming to rest in the target. Which exerts the greater impulse on the target? (a) the rubber bullet (b) the metal bullet (c) both exert the same (d) not enough information (e) none of these.

84. An open railroad car filled with coal is coasting frictionlessly. A girl on board starts throwing the coal horizontally backward straight off the car, one chunk at a time. The car (a) speeds up (b) slows down (c) first speeds up and then slows down (d) travels at constant speed (e) none of the above.

85. A tank car coasting frictionlessly horizontally along the rails has a leak in its bottom and dribbles several thousand gallons of water onto the roadbed. In the process it (a) speeds up (b) slows down (c) gains momentum (d) loses momentum (e) none of the above.

86. What happens to the momentum of a body of constant mass if while it's traveling its kinetic energy is doubled? (a) it doubles (b) it remains the same (c) it increases by a multiplicative factor of $\sqrt{2}$ (d) it decreases by a multiplicative factor of $\sqrt{2}$ (e) none of the above.

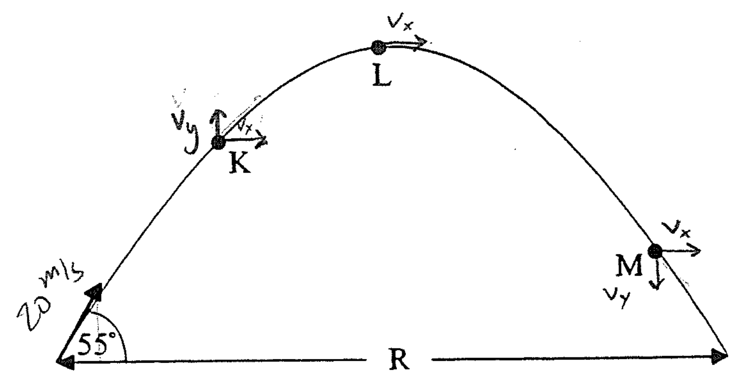
87. A bomb hanging from a string explodes into pieces of different sizes and shapes. After the explosion (a) the vector momentum of each piece is identical (b) the total momentum is increased (c) the momentum of all the pieces, exhaust, and smoke adds up to zero (d) not enough information to comment (e) none of the above.

88. A can of whipped cream floating in space develops a hole in the bottom from which it squirts backward a mess of gas and cream at a constant speed with respect to the can. The can thereupon (a) accelerates forward throughout the squirting (b) moves forward at a constant speed (c) remains at rest (d) first speeds up, and then slows down when the gas runs out (e) none of the above.

(89)

This question is about particle trajectories.

The diagram below shows a trajectory for a projectile launched at an angle of 55° to the horizontal with a speed of $20\,\text{m s}^{-1}$. Air drag has been neglected. The arrow represents the initial velocity vector for the projectile. The distance marked R is the range of the trajectory.



(a) The points K, L and M label the position of the projectile for different times in its trajectory. On the above diagram, draw the horizontal and vertical components of the projectile's velocity at these points. [3]

(b) Calculate the time taken for the projectile to reach its maximum height. [ ]

$t_{up} = ?$ $V_f = V_0 + at$ $V_{y_0} = (\sin 55°)\,20\,\text{m/s} = 16.4\,\text{m/s}$

$0\,\frac{m}{s} = (16.4\,\text{m/s}) + (-9.8\,\text{m/s}^2)(t)$

$t_{up} = 1.7\,s$

(c) Calculate the range R of this projectile. [3]

total time $= 2t_{up} = 3.3\,s$ $V_x = (\cos 55°)(20\,\text{m/s}) = 11.5\,\text{m/s}$

$d_x = V_x t$

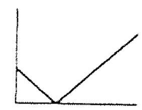
$= (11.5\,\text{m/s})(3.3\,s)$

$d_x = 38\,m$

SL Physics Midterm Review Packet Key

Note: sig figs not observed

1) a) displacement is the straight-line length between two points; velocity is the change in displacement divided by the change in time
   b) i) 0 m/s^2
      ii) 12 m/s^2
      iii) 12 m
      iv) –18 m
      v) Yes, at 6 s (and 8 s)
      vi) 0 m/s
   c) No effect
2) C
3) B
4) C
5) D
6) C
7) D
8) D
9) C
10) C
11) D
12) C ("SI" = metric)
13) D
14) D
15) E
16) A
17) B
18) A
19) C
20) B
21) D
22) D
23) D
24) B
25) D
26) D
27) D
28) C (use #25's information)
29) B (use #25's information)
30) C (use #25's information)
31) A
32) B
33) No; Yes
34) 0 m/s; ∞ m/s; No
35) No
36) North Pole
37) Yes
   a) 0 (b) (At+B)/D
   (c) (At^2+Bt)/DC
      = (t/C)[(At+B)/D] → 0
39) C
40) D
41) C
42) A
43) C
44) B
45) A
46) B
47) D
48) B (A could be argued)
49) B
50) A
51) B
52) E
53) D
54) C
55) C
56) B
57) D
58) A
59) D
60) C or D (depending on how you climbed on)
61) C
62) C
63) A
64) D
65) A
66) C
67) a) 0.6 s & 0.7 s
   b) i) 10 m/s^2 (using 0-0.6 s)
         12 m/s^2 (using 0.7-1.1 s)
      ii) 0.6 m (using the area under the curve);
         0.45 m (using –3 m/s & 10 m/s^2)
   c) –1.8 kg m/s
   d) 18 N
   e) $p_{ball} + p_{table}$ is constant
   f) Equal: Newton's 3rd Law
   g) 0-0.6 s: unchanged
      0.6-0.7 s: steeper
      0.7-1.1 s: same slope
68) a) F_f = 2400 N
      → a=1.2 m/s^2 → v_f=6 m/s
      → v_i = 10 m/s
   b) Safety belt: slows the impact she experiences as a result of being pushed forward
      Head rest: Once the safety belt pulls her back, the head rest reduces neck-whipping
69) a) Parabola (see in #9)
   b) Conservation of energy from A to B gives you v_x
      Δt is a function of h_2
      Combine Δt & v_x to get the result
70) a) 37.2 m
   b) 3.9 s
   c)



71) A
72) A (A "conservative" force is one where you'd do no work if you go back to the beginning. Gravity is conservative; friction isn't.)
73) B
74) E
75) A
76) B
77) C
78) B
79) E (W = KE)
80) A
81) A
82) D
83) A
84) A (*not* the same as #7)
85) E (*is* the same as #7)
86) C
87) C
88) A
89) a) Diagram
   b) 1.67 s
   c) 38.3 m
90) a) i) The have a v_i big enough that your deceleration due to F_g will never make you come back
      ii) PE = m*V (see notes);
         At ∞, PE & KE each equal 0 J;
         PE + KE = 0 J at launch → v result
   b) 7.3 m/s
   c) i) 5.2 m/s
      ii) Go ~¾ of the way around