Physics 40S Exam Review #1

Sample Multiple Choice Questions

1. A projectile is launched from the ground with an initial velocity of 60.0 m/s at an angle of 30.0° above the horizontal. How far does it travel?

   (A) 152 m
   (B) 160 m
   (C) 184 m
   (D) 318 m

2. A girl throws a rock horizontally, with a velocity of 10 m/s, from a bridge. It falls 20 m to the water below. How far does the rock travel horizontally before striking the water?

   (A) 14 m
   (B) 16 m
   (C) 20 m
   (D) 24 m

Questions 3 and 4 refer to the following material.

A ball is thrown upwards with a speed of 20 m/s at an angle of 30° above the horizontal.

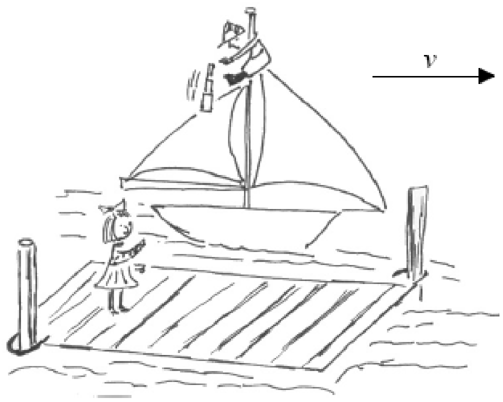
3. The velocity of the ball at the top of its path is

   (A) 20 m/s horizontal.
   (B) 20 m/s at an angle of 30 above the horizontal.
   (C) 17 m/s horizontal.
   (D) 17 m/s at an angle of 30 above the horizontal.

4. The acceleration of the ball at the top of its path is

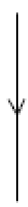
   (A) 9.8 m/s^2 down
   (B) 9.8 m/s^2 up
   (C) 0

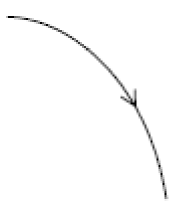
5. A sailing boat is moving at a constant velocity v to the right parallel to the dock.

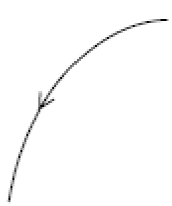


Captain Jack, up on the mast, drops his telescope at the moment he is opposite Sally who is standing on the dock. Which one of the following **best** shows the path of the falling telescope as seen by Sally?

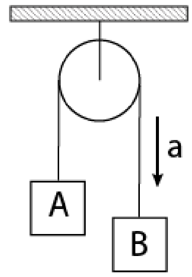
(A) 

(B) 

(C) 

(D) 

6. In the Atwood machine shown, A = 0.40 kg and B = 0.60 kg



What is the magnitude of the acceleration of the system? (Ignore friction and the mass of the pulley.)

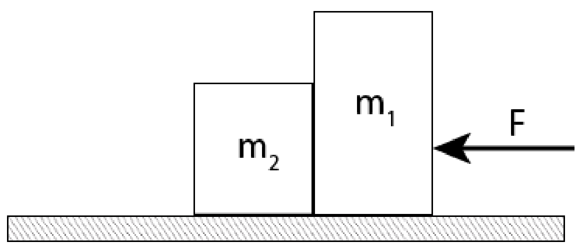
(A) 5.3 m/s^2

(B) 3.9 m/s^2

(C) 2.0 m/s^2

(D) 0.98 m/s^2

7. Two boxes of masses m_1 and m_2 are in contact with each other on a frictionless surface.



If $m_1 = 2m_2$, what is the acceleration of m_1?

(A) $\dfrac{F}{m}$

(B) $\dfrac{F}{2m}$

(C) $\dfrac{F}{3m}$

(D) $\dfrac{F}{4m}$

8. Which of the following statements about centripetal force is correct?

   (A) It is a force exerted on an object moving in a circle.
   (B) It points towards the center of the circular path.
   (C) It points towards the outside of the circular path.

9. A 1000 kg car is traveling around a curve of radius 50 m at a speed of 25 m/s. The magnitude of the centripetal force is

   (A) 12 500 N towards the center.
   (B) 12 500 N away from the center.
   (C) 500 N towards the center.
   (D) 500 N away from the center.

10. A roller coaster car (mass = M) is on a track that forms a vertical circular loop (radius = r). If the car is to just maintain contact with the track on the inside of the top of the loop, what is the minimum value for its speed at that point?

   (A) rg
   (B) $\sqrt{rg}$
   (C) $\sqrt{2rg}$
   (D) $\sqrt{\frac{rg}{2}}$

11. Two identical objects are separated by 0.5 m. If the gravitational force between them is 6.67×10^{-7} N, what is the mass of the objects?

   (A) 2500 kg
   (B) 1250 kg
   (C) 71 kg
   (D) 50 kg

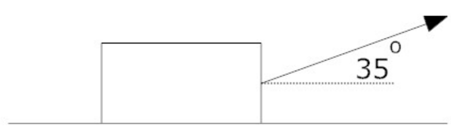
12. What is the force of gravity on a 1500 kg satellite orbiting 3000 m above the surface of the Earth?

    (A) $1.5\text{x}10^4$ N
    (B) $4.0\text{x}10^6$ N
    (C) $6.6\text{x}10^{10}$ N
    (D) $9.4\text{x}10^{10}$ N

13. A satellite revolves around the Earth in a near Earth orbit ($R_{satellite} \approx R_{Earth}$). What is the period of revolution of the satellite?

    (A) $5.1\text{x}10^3$ s
    (B) $3.3\text{x}10^6$ s
    (C) $1.6\text{x}10^7$ s
    (D) $1.8\text{x}10^{11}$ s

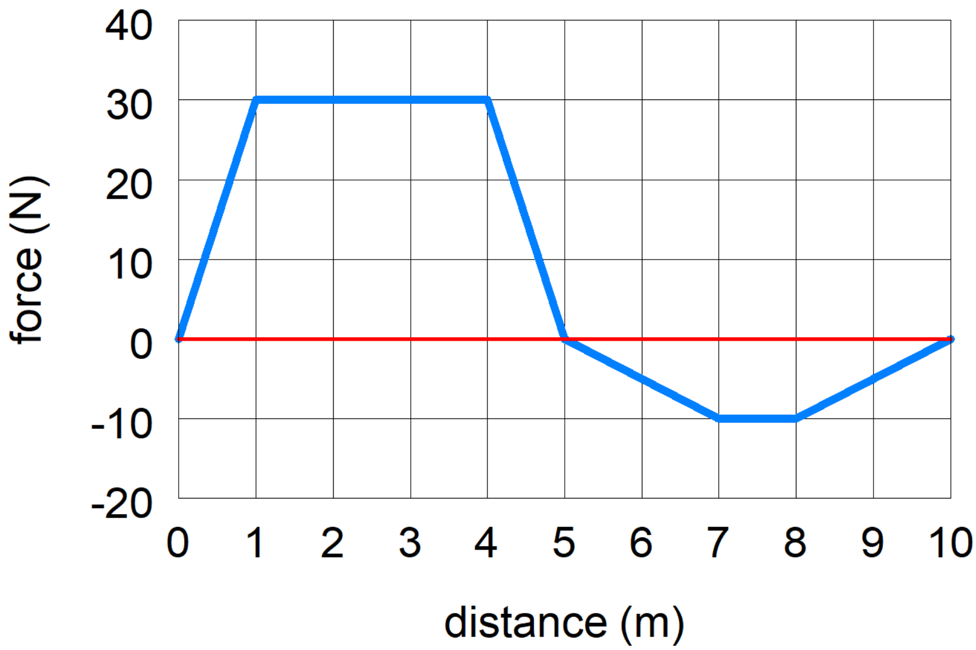
14. A box is pulled at a constant velocity with a force of 50 N at an angle of 35° with the horizontal.



    What is the work required to pull the box 10 m?

    (A) 290 J
    (B) 410 J
    (C) 500 J
    (D) 610 J

15. An object is moved horizontally 10 m by a non-uniform horizontal force as shown.



Calculate the work done by the force over the 10 m.

(A) 200 J

(B) 150 J

(C) 100 J

(D) 90 J

16. The driver of a 1000 kg car puts on the brakes. The friction in the brakes causes the car to stop in 10 m. The car was originally traveling 25 m/s. Calculate the work done by friction to stop the car.

(A) $3.1x10^5$ J

(B) $-3.1x10^5$ J

(C) $3.1x10^4$ J

(D) $-3.1x10^4$ J

17. A spring-driven dart gun propels a 10 g dart. It is cocked by exerting a force of 20 N over 5.0 cm. At what speed will the dart leave the gun, assuming the spring has negligible mass?

(A) 10 m/s

(B) 14 m/s

(C) 17 m/s

(D) 20 m/s

18. A spring is characterized by a spring constant of 60 N/m. How much potential energy does it store, when stretched by 1.0 cm?

(A) 3.0×10^{-3} J

(B) 0.30 J

(C) 60 J

(D) 600 J

19. An object slides down a frictionless inclined plane. At the bottom, it has a speed of 9.80 m/s. What is the vertical height of the plane?

(A) 19.6 m

(B) 9.80 m

(C) 4.90 m

(D) 2.45 m

20. A pendulum of length 50 cm is pulled 30 cm away from the vertical axis and released from rest. What will be its speed at the bottom of its swing?

(A) 0.50 m/s

(B) 0.79 m/s

(C) 1.2 m/s

(D) 1.4 m/s

21. An arrow of mass 20 g is shot horizontally into a bale of hay, striking the hay with a velocity of 60 m/s. It penetrates to a depth of 20 cm before stopping. What is the average stopping force acting on the arrow?

(A) 45 N

(B) 90 N

(C) 180 N

(D) 360 N

22. A 60 kg skier starts from rest from the top of a 50 m high slope. If the work done by friction is 6.0×10^3 J, what is the speed of the skier on reaching the bottom of the slope?

(A) 20 m/s

(B) 28 m/s

(C) 34 m/s

(D) 31 m/s

23. A 10 N force is needed to move an object with a constant velocity of 5.0 m/s. What power must be delivered to the object by the force?

(A) 0.50 W
(B) 10 W
(C) 50 W
(D) 100 W

24. Two point charges, separated by 1.5 cm, have charge values of 2.0 μC and -4.0 μC, respectively. What is the magnitude of the electric force between them?

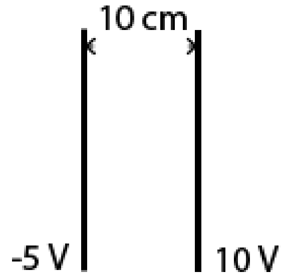
(A) 400 N

(B) 360 N

(C) 320 N

(D) 160 N

25. Two parallel plates, 10 cm apart, are charged as shown.



What is the electric field between the plates?

(A) 1.5 V/m

(B) 50 V/m

(C) 100 V/m

(D) 150 V/m

26. A wire with resistivity ρ, length L, and cross-sectional area A has a resistance R. A second wire with identical resistivity has a length 2L and cross-sectional area 0.5A. What is the resistance of the second wire?

(A) 0.5R

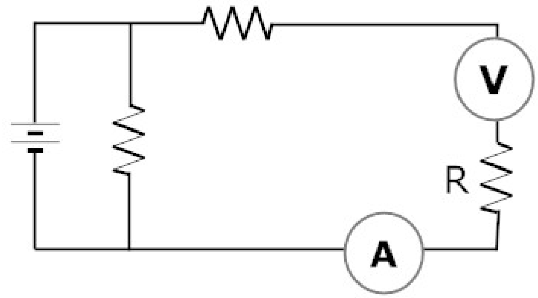
(B) R

(C) 2R

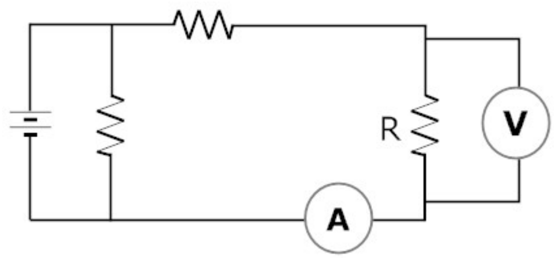
(D) 4R

27. Which of the following circuits correctly demonstrates how to measure the voltage across and the current through resistor R?

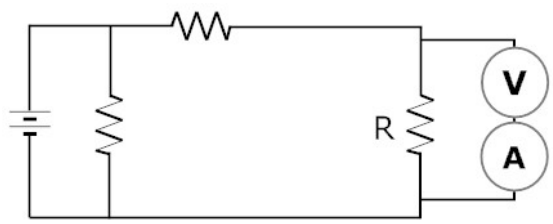
(A)



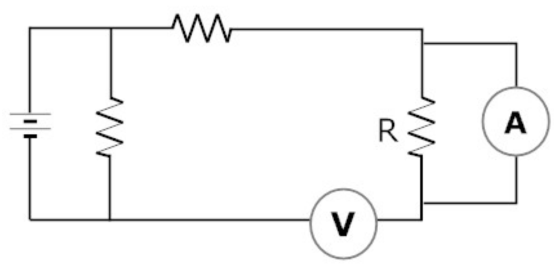
(B)



(C)

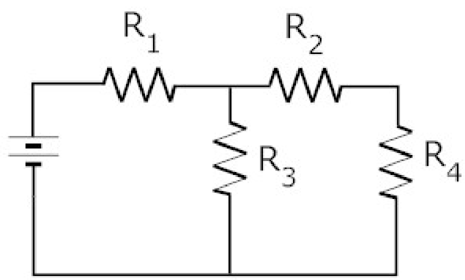


(D)



Questions 28 and 29 refer to the following material.

A circuit is designed with four identical 20 Ω resistors as shown.



The current in R_4 is 0.05 A.

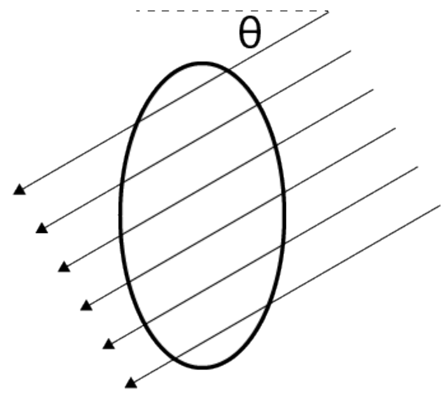
28. Calculate the voltage drop across R_3.

(A) 4 V
(B) 2 V
(C) 1 V
(D) 0.05 V

29. Calculate the potential difference of the battery.

(A) 7 V
(B) 5 V
(C) 4 V
(D) 2 V

30. A magnetic field of 1.5×10^{-5} T passes through a circular loop of radius 20 cm as shown.



What is the magnetic flux passing through the coil when $\theta = 35^{o}$?

(A) 1.5×10^{-6} Wb
(B) 1.9×10^{-6} Wb
(C) 2.5×10^{-6} Wb
(D) 3.0×10^{-6} Wb

31. According to Lenz's law, the direction of an induced current in a conductor will be that which tends to produce which of the following effects?

(A) enhance the effect which produces it
(B) produce a greater heating effect
(C) produce the greatest voltage
(D) oppose the effect which produces it

32. A coil is wrapped with 200 turns of wire on a square frame with sides 18 cm. A uniform magnetic field is applied perpendicular to the plane of the coil. If the field changes uniformly from 0.50 T to 0 in 8.0 s, find the average value of the induced emf.

(A) 2.1 mV
(B) 4.1 mV
(C) 0.21 V
(D) 0.41 V

33. A transformer is a device used to

(A) transform an alternating current into a direct current.

(B) transform a direct current into an alternating current.

(C) increase or decrease an ac voltage.

(D) increase or decrease a dc voltage.

34. 2.0 A in the 100-turn primary of a transformer causes 14 A to flow in the secondary. How many turns are in the secondary?

(A) 700

(B) 114

(C) 14

(D) 4

35. A transformer has an input voltage of 120 V and an output voltage of 6 V. If the transformer has 5000 primary coil turns, how many turns are on the secondary coil?

(A) 250

(B) 500

(C) 2500

(D) 5000

Sample Free Response Questions

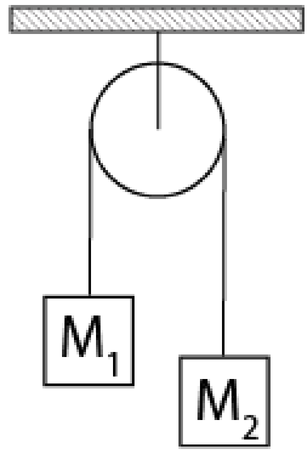
1. An arrow is fired horizontally at the center of a target 20 m away. The arrow leaves the bow with a speed of 30 m/s.

   (a) Calculate the length of time for the arrow to reach the target.

   (b) Calculate the displacement of the arrow from the center of the target.

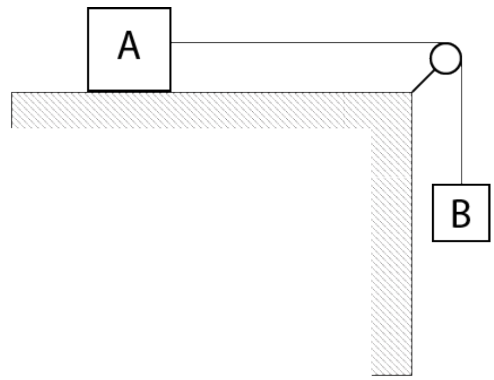
   (c) Explain what you would do so that you hit the center of the target.

2. Two masses are attached across a frictionless pulley as shown.



M_1 is 10 kg and M_2 is 5 kg. Calculate the tension in the rope.

3. Blocks A and B are connected by a string over a frictionless pulley as shown.



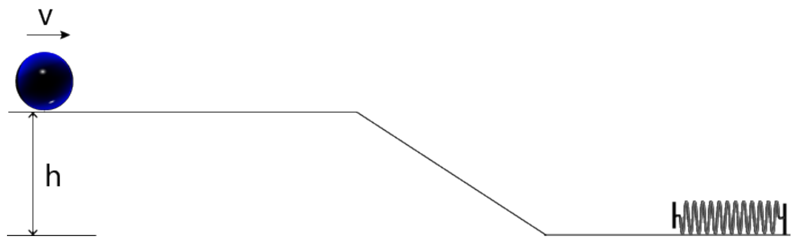
Block A has a mass of 15 kg and is on a frictionless table. Block B has a mass of 5 kg. Calculate the tension in the string joining the blocks.

4. A 0.1 kg ball attached to a string of negligible mass is rotated horizontally in a circle with a radius of 0.5 m. The ball revolves 10 times in 5 seconds.

   (a) Calculate the centripetal force on the ball.

   (b) Calculate the force of tension in the string.

5. A ball rolls down a ramp and compresses a spring as shown.

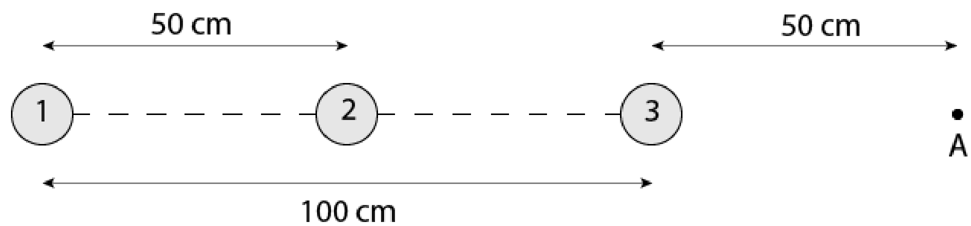


The ball has an initial velocity of 10 m/s and the height, h, is 0.5 m.

(a) Calculate the velocity of the ball at the bottom of the ramp (before it reaches the spring).

(b) The ball continues along the flat surface and compresses the spring ($k = 200$ N/m) 20 cm from its equilibrium position. Calculate the mass of the ball.

6. Three charges are placed in a line.

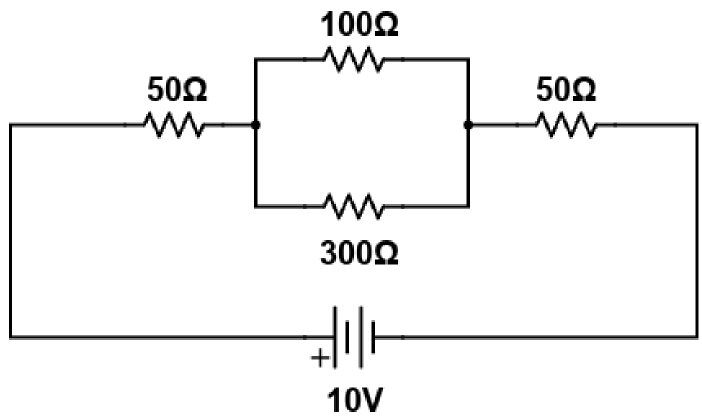


$q_1 = 10.0$ nC
$q_2 = -5.0$ nC
$q_3 = 5.0$ nC

(a) Calculate the net electrostatic force on charge q_3.

(b) Calculate the net electric potential at point A.

7. Consider the following circuit.

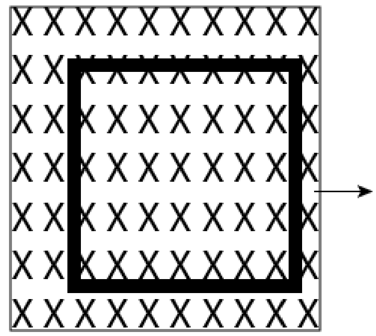


(a) Calculate the equivalent resistance of the circuit.

(b) Calculate the voltage drop across the 100 Ω resistor.

(c) Calculate the current flowing through the 100 Ω resistor.

8. A square coil of 100 loops is positioned perpendicular to a magnetic field of 0.5 T going into the page. The length of one side of the coil is 10 cm.



The loop is quickly and uniformly pulled from the field (moving perpendicular to the magnetic field) to a region where the magnetic field drops abruptly to zero. It takes 1.0 s for the whole coil to reach the field-free region. Calculate the induced EMF.

9. 10 MW of power must be transmitted from a substation to a subdivision 10 km away.

   (a) Explain why the power company will transmit the power at a high voltage.

   (b) The power is transmitted at a voltage of 33 kV. The total resistance of the power lines is 0.12Ω. Calculate the power loss.