Brainiacs Physics Olympiad Preliminary Round Sample Exam Paper 3

Category III – grades 11 and 12

EASY

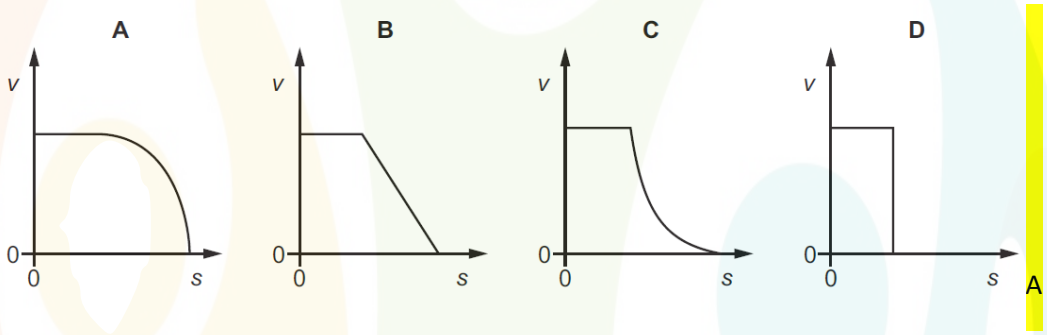
Q1.

What is an equivalent unit to 1 volt?

A. 1 J/A B. 1 J/C C. 1 W/C D. 1 W/s

Q2.

A car is travelling at constant velocity. Its brakes are then applied, causing uniform deceleration. Which graph shows the variation with distance s of the velocity v of the car?



A

Q3.

With which types of wave can the Doppler shift be observed?

A. all types of wave
B. light and sound waves only
C. sound waves and water waves only
D. sound waves only

Q4.

What is a correct statement of Ohm's law?

A. The potential difference across a component equals the current providing the resistance and other physical conditions stay constant.

B. The potential difference across a component equals the current multiplied by the resistance.

C. The potential difference across a component is proportional to its resistance.

D. The potential difference across a component is proportional to the current in it providing physical conditions stay constant.

Q5.

What is a conclusion from the alpha-particle scattering experiment?

A. Protons and electrons have equal but opposite charges.

B. Protons have a much larger mass than electrons.

C. The nucleus contains most of the mass of the atom.

D. The nucleus of an atom contains protons and neutrons.

NORMAL

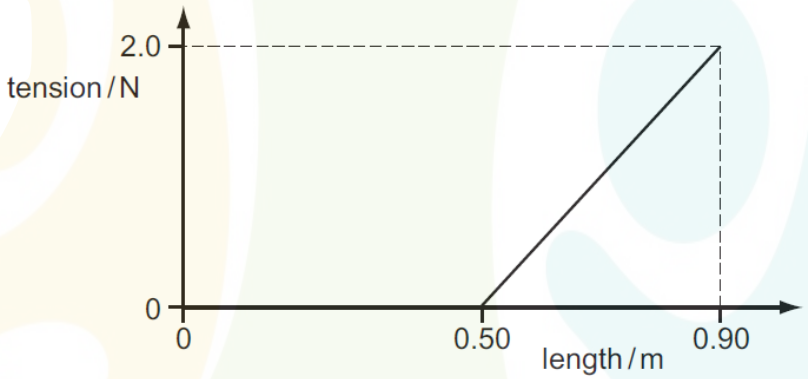
Q6.

In an experiment, a radio-controlled car takes 2.50 ± 0.05 s to travel 40.0 ± 0.1 m. What is the car's average speed and the uncertainty in this value?

A. 16 ± 1 m s^{-1}
B. 16.0 ± 0.2 m s^{-1}
C. 16.0 ± 0.4 m s^{-1}
D. 16.00 ± 0.36 m s^{-1}

Q7.

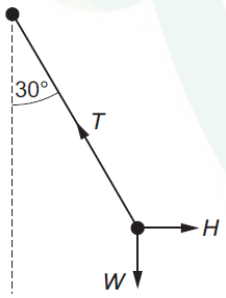
A spring of unextended length 0.50 m is stretched by a force of 2.0 N to a new length of 0.90 m. The variation of its length with tension is as shown. How much strain energy is stored in the spring?



A 0.40 J B 0.80 J C 0.90 J D 1.8 J

Q8.

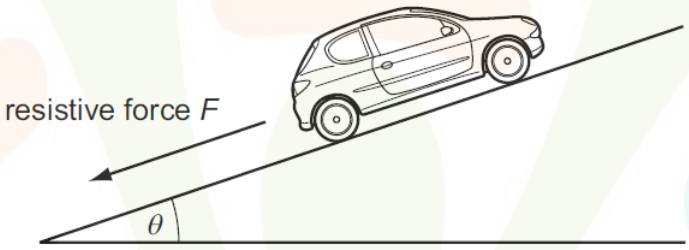
A pendulum bob is held stationary by a horizontal force H. The three forces acting on the bob are shown in the diagram. The tension in the string of the pendulum is T. The weight of the pendulum bob is W. The string is held at an angle of 30° to the vertical. Which statement is correct?



A. H = T cos 30
B. T = H sin 30
C. W = T sin 30
D. W = T cos 30

Q9.

A car of mass m travels at constant speed up a slope at an angle θ to the horizontal, as shown in the diagram. Air resistance and friction provide a resistive force F. What force is needed to propel the car at this constant speed?



A. mg cos θ
B. mg sin θ
C. mg cos θ + F
D. mg sin θ + F

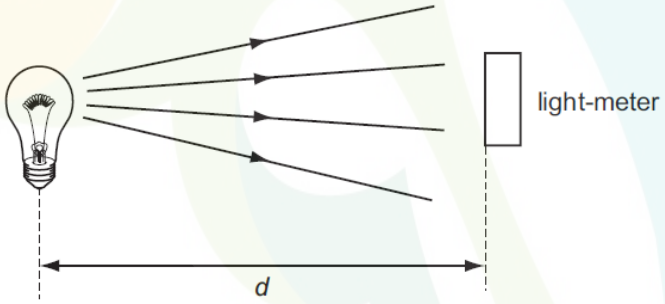
Q10.

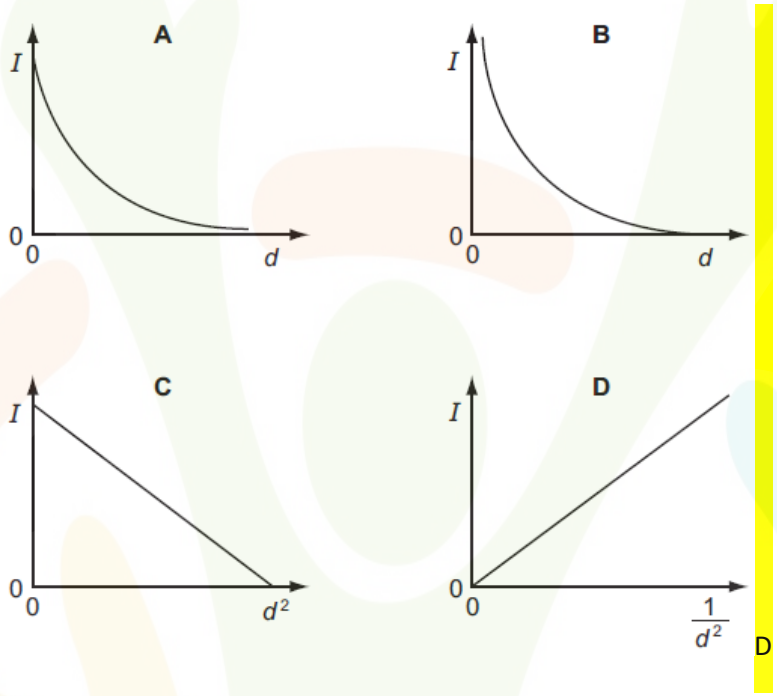
The pump of a water pumping system uses 2.0 kW of electrical power when raising water. The pumping system lifts 16 kg of water per second through a vertical height of 7.0 m. What is the efficiency of the pumping system?

A. 1.8% B. 5.6% C. 22% D. 55%

Q11.

A light-meter measures the intensity *I* of the light falling on it. Theory suggests that *I* varies inversely as the square of the distance *d*. Which graph of the results supports this theory?





D

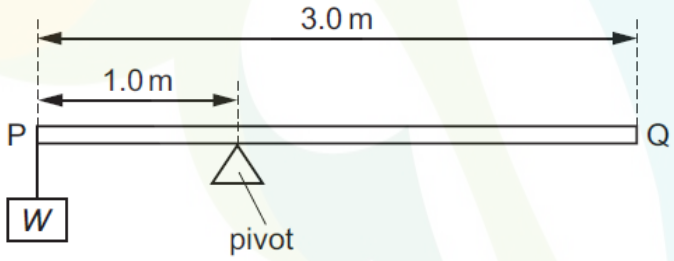
Q12.

A pipe containing air is closed at one end and open at the other. The third harmonic standing wave for this pipe has a frequency of 150 Hz. What other frequency is possible for a standing wave in this pipe?

A. 25 Hz B. 50 Hz C. 75 Hz D. 300 Hz

Q13.

The diagram shows a uniform beam PQ. The length of the beam is 3.0 m and its weight is 50 N. The beam is supported on a pivot 1.0 m from end P. A load of weight W is hung from end P and the beam is in equilibrium. What is the value of W?



A. 25 N B. 50 N C. 75 N D. 100 N

Q14.

The electric field strength between a pair of parallel plates is E. The separation of the plates is doubled and the potential difference between the plates is increased by a factor of four. What is the new electric field strength?

A. E B. 2E C. 4E D. 8E

Q15.

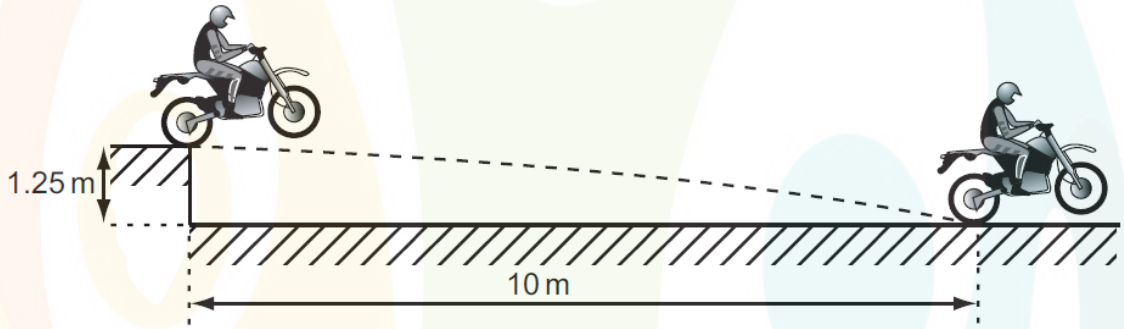
It was once thought that the mass of an atom is spread uniformly through the volume of the atom. When α-particles are directed at a piece of gold foil, the results led scientists to believe instead that nearly all the mass of the gold atom is concentrated at a point inside the atom. Which effect is possible only if nearly all the mass of the gold atom is concentrated at a point?

A. a few α-particles bounce back
B. most α-particles are only slightly deflected
C. some α-particles pass through without any deflection
D. some α-particles are absorbed

DIFFICULT

Q16.

A motorcycle stunt-rider moving horizontally takes off from a point 1.25 m above the ground, landing 10 m away as shown. What was the speed at take-off?



A. 5 m s^{-1} B. 10 m s^{-1} C. 15 m s^{-1} D. 20 m s^{-1}

Q17.

A pendulum oscillating near the surface of the Earth swings with a time period *T*. What is the time period of the same pendulum near the surface of the planet Mercury where the gravitational field strength is 0.4*g*?

A. 0.4*T* B. 0.6*T* C. 1.6*T* D. 2.5*T*

Q18.

Two containers X and Y are maintained at the same temperature. X has volume 4 m^3 and Y has volume 6 m^3. They both hold an ideal gas. The pressure in X is 100 Pa and the pressure in Y is 50 Pa. The containers are then joined by a tube of negligible volume. What is the final pressure in the containers?

A. 70 Pa B. 75 Pa C. 80 Pa D. 150 Pa

Q19.

A straight copper wire of diameter 0.42×10^{-3} m has a number density of free electrons of 8.5×10^{28} m^{-3}. In a given time interval, a charge of 0.15 C moves through the wire. What is the average displacement of the free electrons along the wire in this time interval?

A. 3.3×10^{-8} m
B. 2.0×10^{-5} m

C. 8.0×10^{-5} m
D. 2.5×10^{-4} m

Q20.

Choose the speed at which the mass of an electron is double of its rest mass.

A. c B. $\frac{\sqrt{3}}{2}$c C. c/2 D. None of these