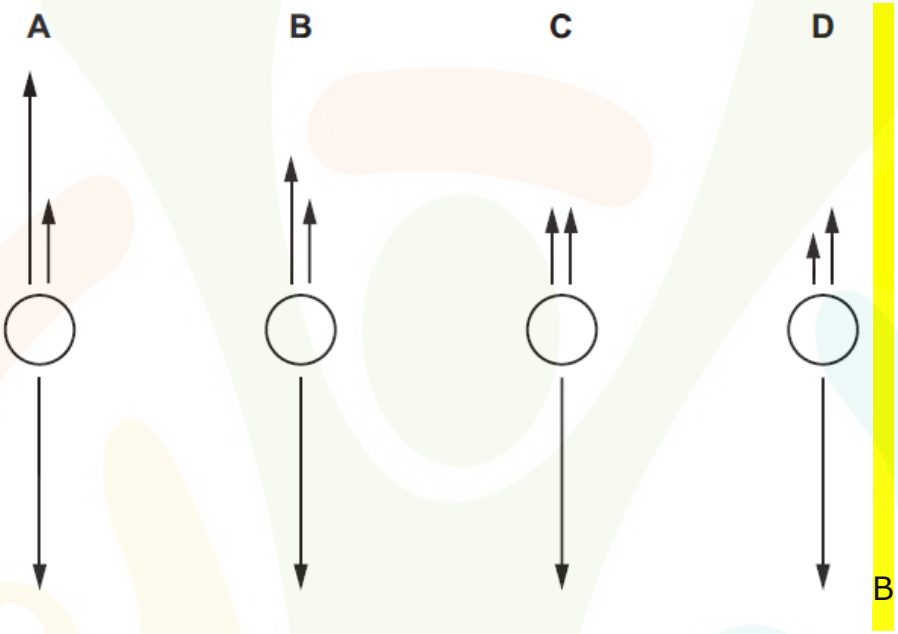
Grades 11 and 12

1. A spherical object falls through water at constant speed. Three forces act on the object. Which diagram, showing these three forces to scale, is correct?



2. A force acting on a moving ball causes its motion to change. This force stays constant. What makes the force produce a greater change in the motion of the ball?

A decreasing the total mass of the ball

B increasing the temperature of the ball

C using a ball with a hollow centre but the same mass

D using a different material for the ball so that it has a lower density but the same mass

3. Diffraction is a term used to describe one aspect of wave behaviour. What does diffraction make possible?

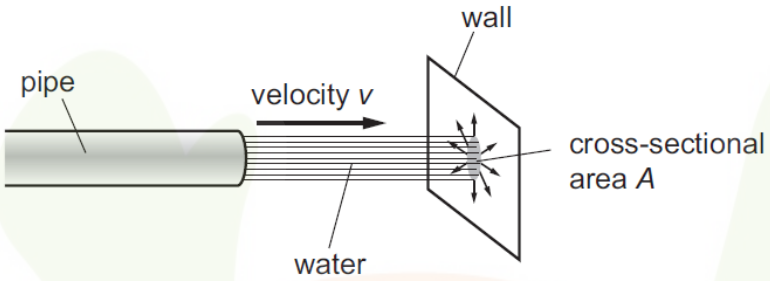
A the ability to hear around corners

B the ability to hear high frequency and low frequency sound waves

C the ability to hear loud and quiet sounds

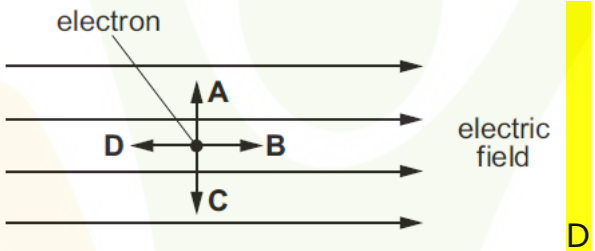
D the ability to hear sound through a brick wall

4. Water flows out of a pipe and hits a wall. When the jet of water hits the wall, it has horizontal velocity v and cross-sectional area A. The density of the water is ρ. The water does not rebound from the wall. What is the force exerted on the wall by the water?



A. $\rho \cdot v/A$ B. $\rho \cdot v^2/A$ C. $\rho \cdot A \cdot v$ D. $\rho \cdot A \cdot v^2$

5. The diagram shows an electron in a uniform electric field. In which direction will the field accelerate the electron?



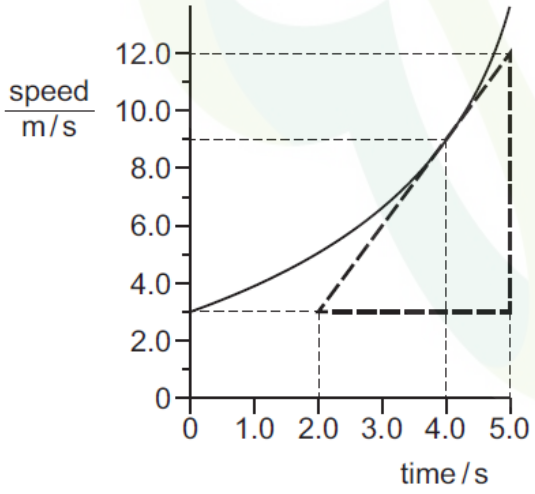
D

6. One property Q of a material is used to describe the behaviour of sound waves in the material. Q is defined as the pressure P of the sound wave divided by the speed v of the wave and the surface area A of the material through which the wave travels: What are the SI base units of Q?

$$Q = \frac{P}{vA}$$

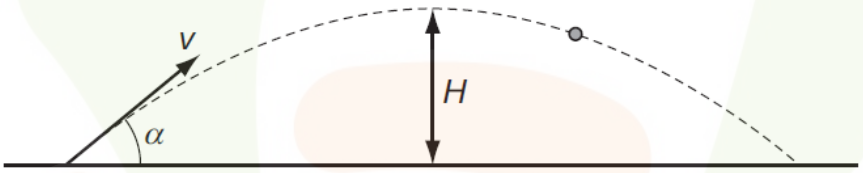
A kg m^2 s^{-3} B kg m^{-3} s^{-1} C kg m^{-4} s^{-1} D kg m^{-2} s^{-2}

7. The curved line on the graph shows the motion of a car. What is the acceleration of the car at the time of 4.0 s?



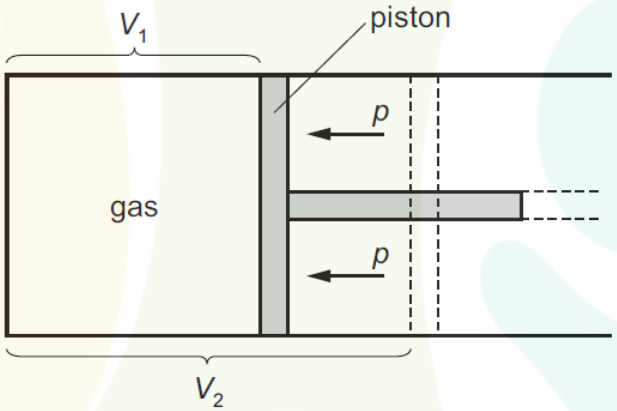
A 0.33 m/s^2 B 0.44 m/s^2 C 2.3 m/s^2 D 3.0 m/s^2

8. A cannon fires a cannonball with an initial speed v at an angle α to the horizontal. Which equation is correct for the maximum height H reached?



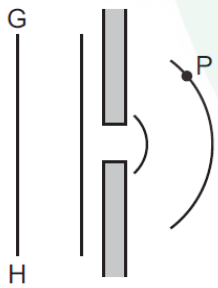
A $\frac{v\sin\alpha}{2g}$ B $\frac{g\sin\alpha}{2v}$ C $\frac{(v\sin\alpha)^2}{2g}$ D $\frac{g^2\sin\alpha}{2v}$

9. A gas is enclosed inside a cylinder which is fitted with a frictionless piston. Initially, the gas has a volume V_1 and is in equilibrium with the external pressure p. The gas is then heated slowly so that it expands at constant pressure, pushing the piston back until the volume of the gas has increased to V_2. How much work is done by the gas during this expansion?



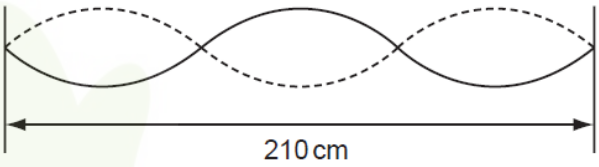
A. $p(V_2 - V_1)$ B. $p(V_2 - V_1)/2$ C. $p(V_2 + V_1)$ D. $p(V_2 + V_1)/2$

10. A monochromatic plane wave of speed c and wavelength λ is diffracted at a small aperture. The diagram illustrates successive wavefronts. After what time will some portion of the wavefront GH reach point P?



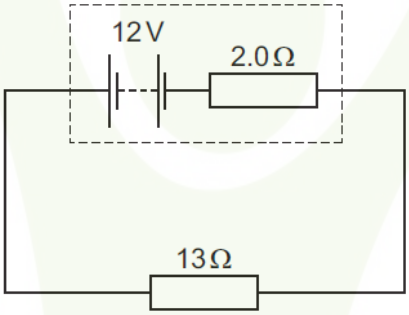
A 3λ/2c B 2λ/c C 3λ/c D 4λ/c

11. A stationary wave of frequency 80.0 Hz is set up on a stretched string of length 210 cm. What is the speed of the waves that produce this stationary wave?



A 56.0 m s^{-1} B 112 m s^{-1} C 5600 m s^{-1} D 11 200 m s^{-1}

12. A power supply of electromotive force (e.m.f.) 12 V and internal resistance 2.0 Ω is connected in series with a 13 Ω resistor. What is the power dissipated in the 13 Ω resistor?



A 8.3 W B 9.6 W C 10 W D 11 W

13. Polarisation is a phenomenon associated with a certain type of wave. Which condition must be fulfilled if a wave is to be polarised?

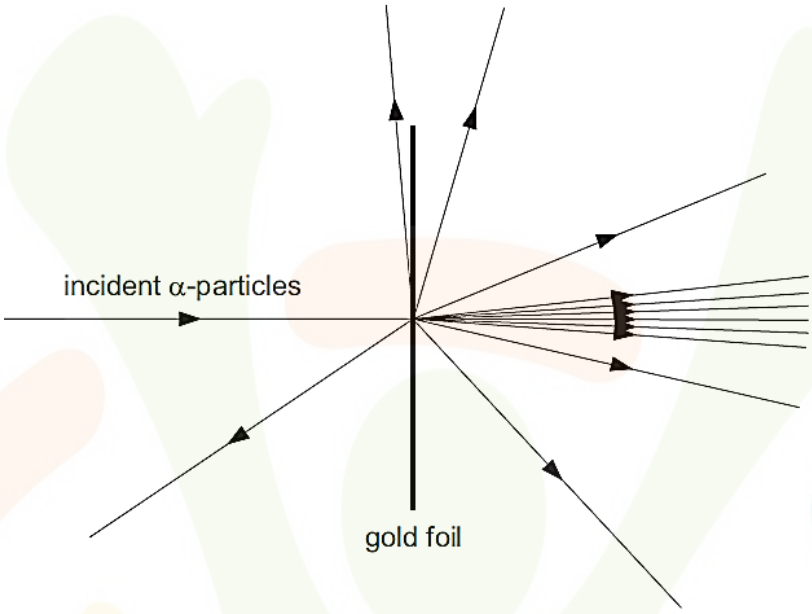
A It must be a light wave.

B It must be a longitudinal wave.

C It must be a radio wave.

D It must be a transverse wave.

14. A thin gold foil is bombarded with α-particles as shown. The results of this experiment provide information about the



A binding energy of a gold nucleus.

B energy levels of electrons in gold atoms.

C size of a gold nucleus.

D structure of a gold nucleus.

15. Two metals, A and B, have work functions of 4 eV and 10 eV, respectively. Which metal has the higher threshold wavelength for the photoelectric effect?

A) Metal A
B) Metal B
C) Both have the same threshold wavelength
D) Neither

16. An experiment is done to measure the resistance of a wire. The current in the wire is 1.0 ± 0.2 A and the potential difference across the wire is 8.0 ± 0.4 V. What is the resistance of the wire and its uncertainty?

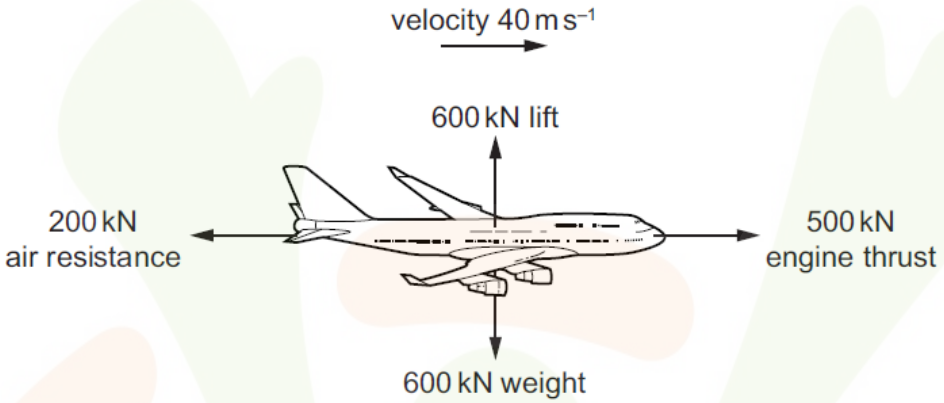
A (8.0 ± 0.2) Ω

B (8.0 ± 0.6) Ω

C (8 ± 1) Ω

D (8 ± 2) Ω

17. The force diagram shows an aircraft accelerating. At the instant shown, the velocity of the aircraft is 40 m s^{-1}. At which rate is its kinetic energy increasing?



A 2.4 MW B 8.0 MW C 12 MW D 20 MW

18. A car of mass 1400 kg is travelling on a straight, horizontal road at a constant speed of 25 m s^{-1}. The output power from the car's engine is 30 kW. The car then travels up a slope at 2° to the horizontal, maintaining the same constant speed. What is the output power of the car's engine when travelling up the slope?

A 12 kW B 31 kW C 42 kW D 65 kW

19. Light of wavelength 600 nm is incident on a pair of slits. Fringes with a spacing of 4.0 mm are formed on a screen. What will be the fringe spacing when the wavelength of the light is changed to 400 nm and the separation of the slits is doubled?

A 1.3 mm

B 3.0 mm

C 5.3 mm

D 12 mm

20. A distant star is receding from the Earth with a speed of 1.40×10^{7} m s^{-1}. It emits light of frequency 4.57×10^{14} Hz. The speed of light is 3.00×10^{8} m s^{-1}. The Doppler effect formula can be used with light waves. What will be the frequency of this light when detected on Earth?

A 2.04×10^{13} Hz

B 4.37×10^{14} Hz

C 4.57×10^{14} Hz

D 4.79×10^{14} Hz