Brainiacs Physics Olympiad Preliminary Round Sample Exam Paper 2

Category III – grades 11 and 12

EASY

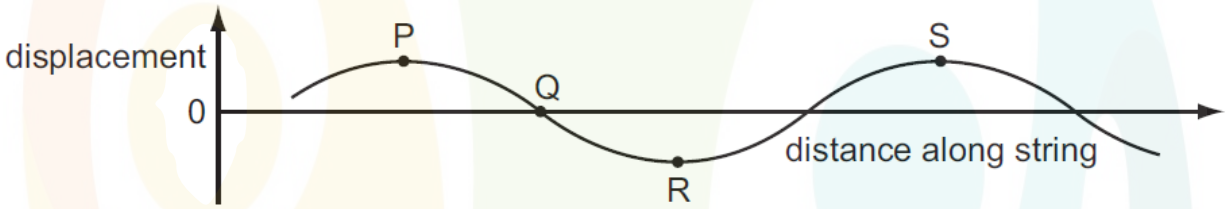
Q1.

Which term represents a physical quantity?

A. metre
B. percentage uncertainty
C. quark flavour
D. spring constant

Q2.

The graph shows the shape at a particular instant of part of a transverse wave travelling along a string.
Which statement about the motion of points in the string is correct?



A. The speed at point P is a maximum.
B. The displacement at point Q is always zero.
C. The energy at point R is entirely kinetic.
D. The acceleration at point S is a maximum.

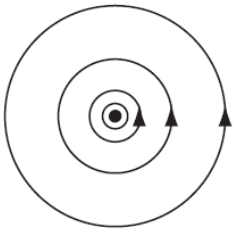
Q3.

What is the ultimate tensile stress of a material?
A. the stress at which the material becomes ductile
B. the stress at which the material breaks
C. the stress at which the material deforms plastically
D. the stress at which the material reaches its elastic limit

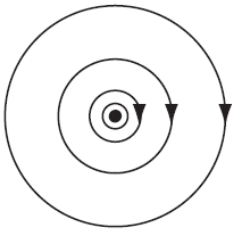
Q4.

Which diagram represents the electric field of a negative point charge, shown by • ?

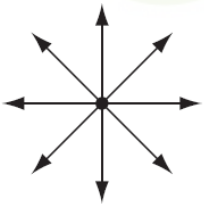
A



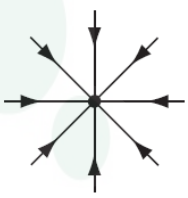
B



C



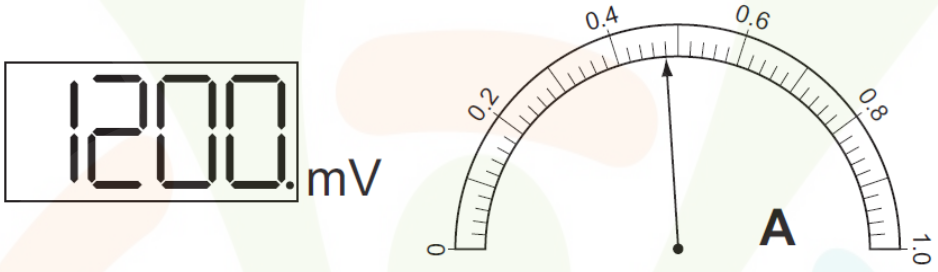
D



D

Q5.

The resistance of an electrical component is measured. The following meter readings are obtained. What is the resistance?



A. 2.5 Ω B. 2.7 Ω C. 2500 Ω D. 2700 Ω

NORMAL

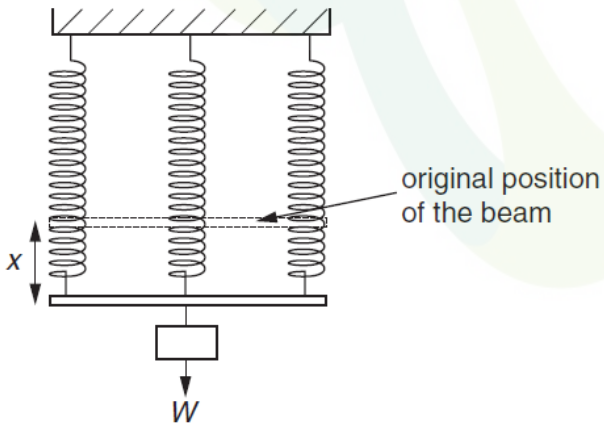
Q6.

A ball of mass 2 kg travelling at 8 m s^{-1} strikes a ball of mass 4 kg travelling at 2 m s^{-1}. Both balls are moving along the same straight line as shown. After collision, both balls move at the same velocity *v*. What is the magnitude of the velocity *v*?

A. 4 m s^{-1} B. 5 m s^{-1} C. 6 m s^{-1} D. 8 m s^{-1}

Q7.

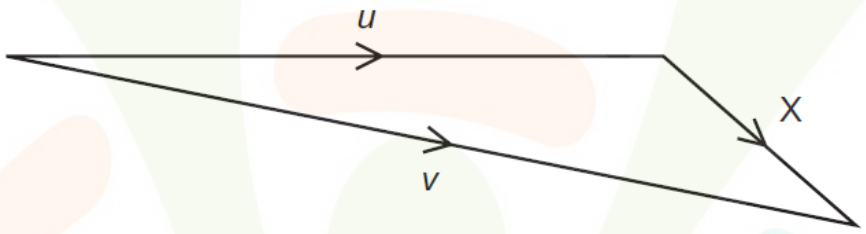
A beam, the weight of which may be neglected, is supported by three identical springs. When a weight *W* is hung from the middle of the beam, the extension of each spring is *x*. The middle spring and the weight are removed. What is the extension when a weight of 2*W* is hung from the middle of the beam?



A. 3x/2 B. 4x/2 C. 2*x* D. 3*x*

Q8.

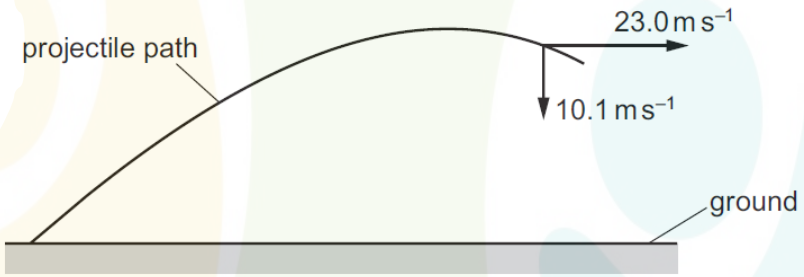
An object has an initial velocity u. It is subjected to a constant force F for t seconds, causing a constant acceleration a. The force is not in the same direction as the initial velocity. A vector diagram is drawn to find the final velocity v. What is the length of side X of the vector diagram?



A. F B. F·t C. a·t D. u + a·t

Q9.

A projectile is thrown at an angle to the ground. At a certain time, the projectile has a horizontal velocity of 23.0 m s^{-1} and a vertical velocity of –10.0 m s^{-1}. What is the speed of the projectile at this time?



A. 12.9 m s^{-1} B. 20.7 m s^{-1} C. 25.1 m s^{-1} D. 33.1 m s^{-1}

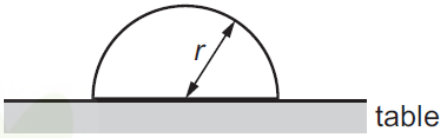
Q10.

A cylindrical block of wood has cross-sectional area A and weight W. It is totally immersed in water with its axis vertical. The block experiences pressures p_t and p_b at its top and bottom surfaces respectively. Which expression is equal to the upthrust on the block?

A. $(p_b - p_t)A + W$
B. $(p_b - p_t)$
C. $(p_b - p_t)A$
D. $(p_b - p_t)A - W$

Q11.

An object shaped as a hemisphere rests with its flat surface on a table. The object has radius *r* and density ρ. The volume of a sphere is $\frac{4\pi r^3}{3}$.



Which average pressure does the object exert on the table?

A. $\frac{\rho r^2}{3}$ B. $\frac{\rho r^2 g}{3}$ C. $\frac{2\rho r}{3}$ D. $\frac{2\rho r g}{3}$

Q12.

The diagram shows a second harmonic standing wave on a string fixed at both ends.

What is the phase difference, in rad, between the particle at X and the particle at Y?

A. 0
B. π/4
C. π/2
D. 3 π/4

Q13.

A simple pendulum oscillates with frequency f. The length of the pendulum is halved. What is the new frequency of the pendulum?

A. 2f

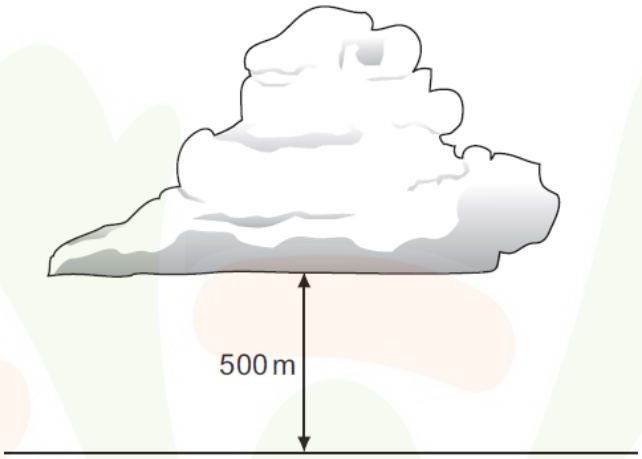
B. $\sqrt{2}$f

C. f/$\sqrt{2}$

D. f/2

Q14.

The diagram shows a thundercloud whose base is 500 m above the ground. The potential difference between the base of the cloud and the ground is 200 MV. A raindrop with a charge of 4.0 x 10^{-12} C is in the region between the cloud and the ground. What is the electrical force on the raindrop?



A. 1.6 x 10^{-6} N B. 8.0 x 10^{-4} N C. 1.6 x 10^{-3} N D. 0.40 N

Q15.

A top quark has a charge of $+\frac{2}{3}e$ where *e* is the elementary charge. What is the charge of an anti top quark?

A. $-\frac{2}{3}e$ B. $-\frac{1}{3}e$ C. $+\frac{1}{3}e$ D. $+\frac{2}{3}e$

DIFFICULT

Q16.

A spring has an unstretched length of 4.50 cm. The spring is fixed at one end and a force of 35.0 N is applied to the other end so that the spring extends. The spring obeys Hooke's law and has a spring constant of 420 N m^{-1}. What is the strain of the extended spring?

A. 0.019 B. 0.083 C. 1.85 D. 2.67

Q17.

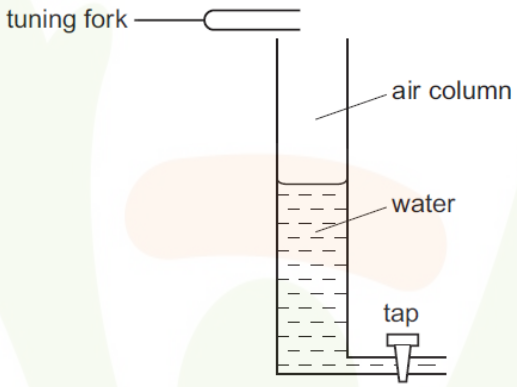
A balloon of volume V contains 10mg of an ideal gas at a pressure P. An additional mass of the gas is added without changing the temperature of the balloon. This change causes the volume to increase to 2V and the pressure to increase to 3P.
What is the mass of gas added to the balloon?

A. 5 mg B. 15 mg C. 50 mg D. 600 mg

Q18.

The diagram shows an experiment to produce a stationary wave in an air column. A tuning fork, placed above the column, vibrates and produces a sound wave. The length of the air column can be varied by altering the volume of the water in the tube. The tube is filled and then water is allowed to run out of it.

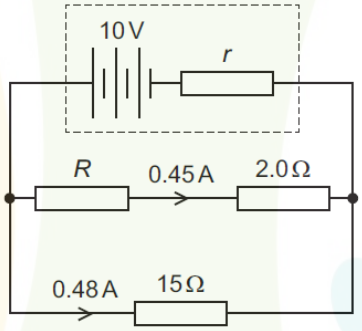
The first two stationary waves occur when the air column lengths are 0.14 m and 0.42 m. What is the wavelength of the sound wave?



A. 0.14 m B. 0.28 m C. 0.42 m D. 0.56 m

Q19.

What are the values of *r* and *R* in the circuit below?



	r/Ω	R/Ω
A	3.0	14
B	3.0	20
C	5.8	14
D	5.8	20

A

Q20.

The lines of a diffraction grating have a spacing of 1.6×10^{-6} m. A beam of light is incident normally on the grating. The first order maximum makes an angle of 20^{o} with the undeviated beam. What is the wavelength of the incident light?

A. 210 nm B. 270 nm C. 420 nm D. 550 nm