Brainiacs Physics Olympiad Preliminary Round Sample Exam Paper 2

Category II – grades 9 and 10

EASY

Q1.

The three balls shown are dropped from a bench. Which balls have the same acceleration?

A. aluminium and lead only
B. aluminium and wood only
C. lead and wood only
D. aluminium, lead and wood

Q2.

A man climbs a ladder. Which two quantities can be used to calculate the useful power of the man?

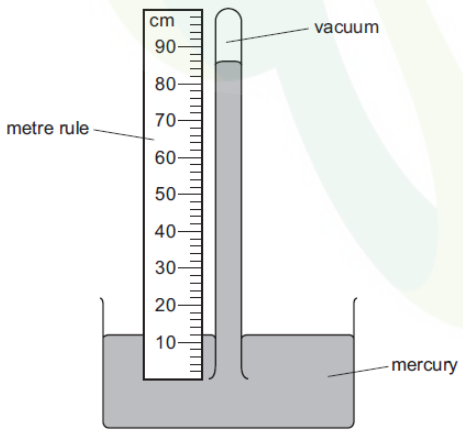
A. the weight of the man and the time taken only
B. the weight of the man and the vertical distance moved only
C. the work done by the man and the time taken only
D. the work done by the man and the vertical distance moved only

Q3.

Which unit is equivalent to a volt (V)?

A. A /Ω B. J/C C. J/s D. W/C

Q4. The diagram shows a simple mercury barometer. Which length is used to find the value of atmospheric pressure?



A. 12 cm B. 74 cm C. 86 cm D. 100 cm

Q5.

What is the purpose of a relay?

A. to change a large voltage into a small voltage
B. to change a small voltage into a large voltage
C. to use a large current to switch on a small current
D. to use a small current to switch on a large current

NORMAL

Q6.

A metal has a specific heat capacity of 360 J/(kg ^{o}C). An object made of this metal has a mass of 2.0 kg. What is the thermal capacity (heat capacity) of the object?

A. 180 J/^{o}C B. 180 J/kg C. 720 J/^{o}C D. 720 J/kg

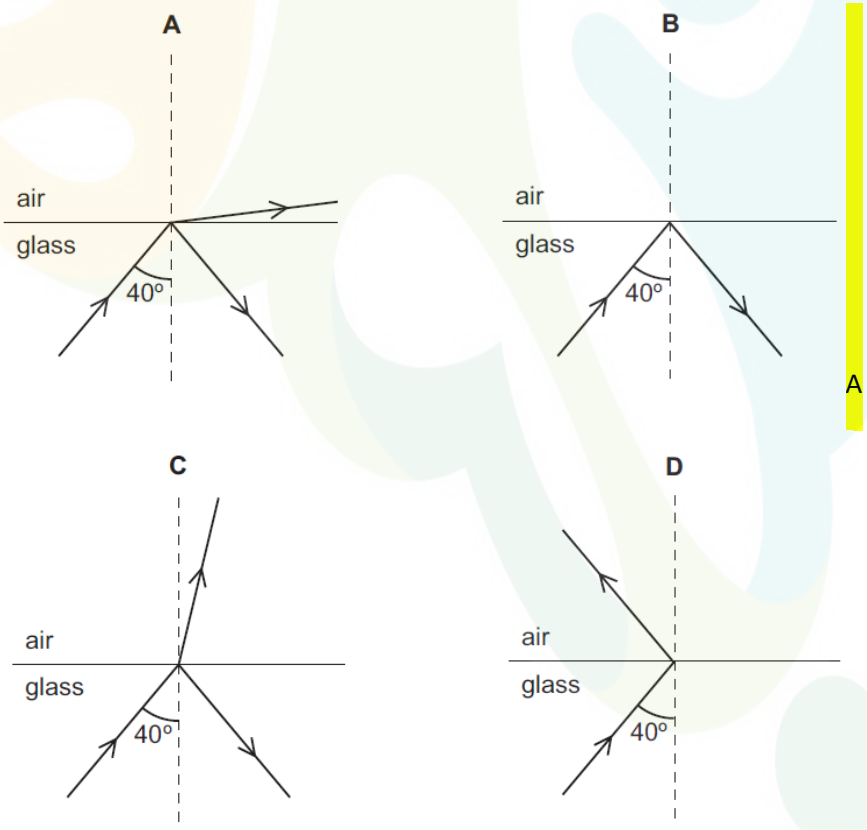
Q7.

Light has a speed of 1.24×10^{8} m/s in diamond. What is the refractive index of diamond?

A 0.41 B 1.54 C 2.42 D 3.72

Q8.

A ray of light passes from glass into air at an angle of incidence of 40^{o}. The glass has a critical angle of 42^{o}. Which diagram shows what happens to the ray?



A

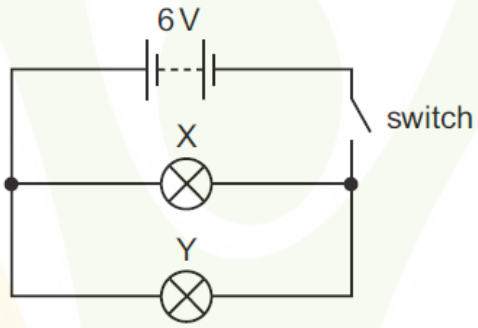
Q9.

Visible light, X-rays and microwaves are all components of the electromagnetic spectrum. Which statement about the waves is correct in a vacuum?

A. Microwaves travel faster than visible light and have a shorter wavelength.
B. Microwaves travel at the same speed as visible light and have a shorter wavelength.
C. X-rays travel faster than visible light and have a shorter wavelength.
D. X-rays travel at the same speed as visible light and have a shorter wavelength.

Q10.

In the circuit below, X and Y are identical 6 V lamps. What happens when the switch is closed?



A. X lights more brightly than Y.
B. Y lights more brightly than X.
C. X and Y light with equal brightness.
D. Neither X nor Y light.

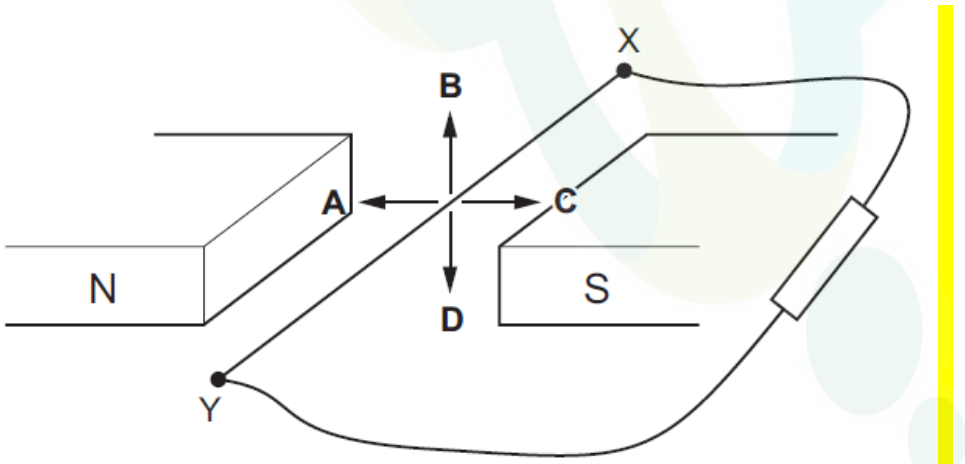
Q11.

A torch has a simple circuit with a 3.0 V battery and a lamp. There is a 20 mA current in the lamp. How much energy is transferred to the lamp in 5.0 minutes?

A. 0.30 J B. 18 J C. 60 J D. 0.30 kJ

Q12.

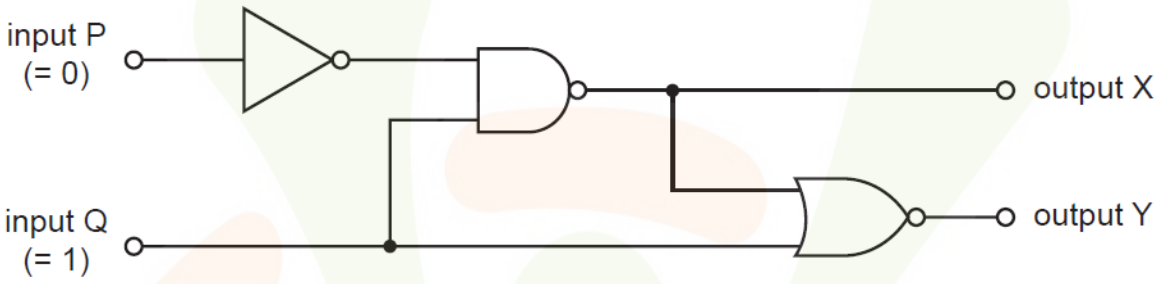
The diagram shows a copper wire XY connected to a resistor. The wire is moved in the magnetic field between the poles of a magnet. There is an induced current in the wire from X to Y. In which labelled direction is the wire moving?



B

Q13.

The diagram shows a combination of logic gates. Input P is at a logic state 0 (low) and input Q is at a logic state 1 (high). What are the logic states at output X and at output Y?



	output X	output Y
A	0	0
B	0	1
C	1	0
D	1	1

A

Q14.

The current in a lamp connected on its own to the mains supply is 0.60 A. A table decoration has three of these lamps connected in parallel. Which rating of fuse is suitable to protect this circuit?

A. 0.2 A B. 0.6 A C. 1.0 A D. 5.0 A

Q15.

Uranium-235 can undergo nuclear fission in many ways. Which equation correctly shows a possible fission reaction for uranium-235?

A ${}^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3{}^{1}_{0}n$

B ${}^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{91}_{38}Sr + {}^{144}_{54}Xe + 2{}^{1}_{0}n$

C ${}^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{95}_{37}Rb + {}^{136}_{55}Cs + 3{}^{1}_{0}n$

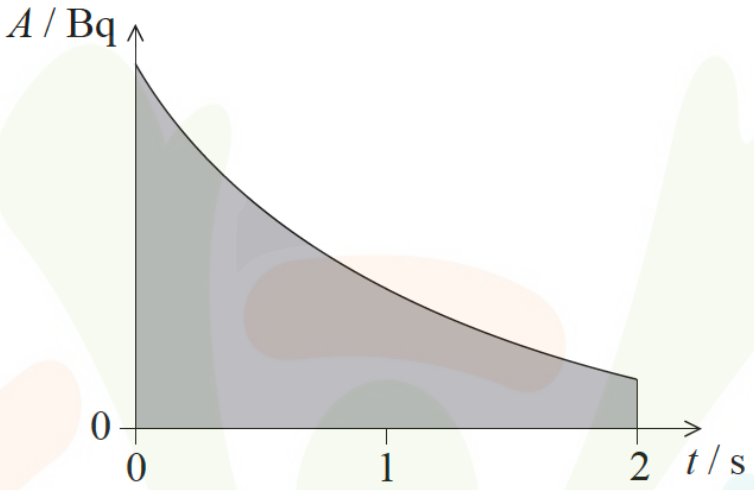
D ${}^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{87}_{35}Br + {}^{146}_{57}La + 4{}^{1}_{0}n$

A

DIFFICULT

Q16.

The graph shows the variation with time *t* of the activity *A* of a radioactive sample. The energy released in each decay is *E*. The shaded area is equal to *S*.



What does the quantity $S \times E$ represent?

A. Average energy produced in 2 s.
B. Average power produced in 2 s.
C. Total energy produced in 2 s.
D. Maximum power produced in 2 s.

Q17.

In order that a train can stop safely, it will always pass a signal showing a yellow light before it reaches a signal showing a red light. Drivers apply the brake at the yellow light and this results in a uniform deceleration to stop exactly at the red light. The distance between the red and yellow lights is x. What must be the minimum distance between the lights if the train speed is increased by 25%, without changing the deceleration of the trains?

A. 1.20x

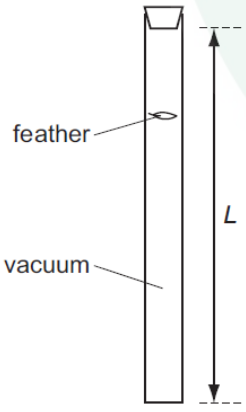
B. 1.25x

C. 1.44x

D. 1.56x

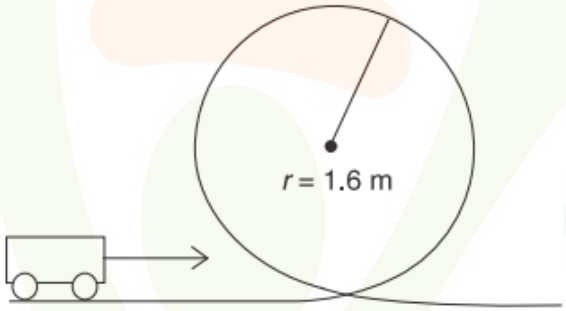
Q18.

The diagram shows a laboratory experiment in which a feather falls from rest in a long evacuated vertical tube of length L. The feather takes time T to fall from the top to the bottom of the tube. How far will the feather have fallen from the top of the tube in time 0.50 T?



A. 0.13 L B. 0.25 L C. 0.38 L D. 0.50 L

Q19. A cart with a mass of m needs to complete a loop-the-loop of radius r, as shown above. What is the approximate minimum velocity required to achieve this goal?



A $\sqrt{gr}$
B $\sqrt{5gr}$
C $2\sqrt{gr}$
D $\sqrt{2gr}$

Q20. A child drinks a liquid of density ρ through a vertical straw. Atmospheric pressure is p_o, and the child is capable of lowering the pressure at the top of the straw by 10%. The acceleration due to gravity is g. What is the maximum length of the straw that would enable the child to drink the liquid?

A $\frac{p_0}{10\rho g}$ **B** $\frac{9p_0}{10\rho g}$ **C** $\frac{p_0}{\rho g}$ **D** $\frac{10p_0}{\rho g}$ A