Arholiadau Ysgoloriaeth Ionawr 2020

Scholarship Examinations January 2020

Amser a ganiateir : 2 awr FFISEG

Time allowed : 2 hours PHYSICS

*You may attempt any of the questions. Credit will be given for complete answers.*

[Assume *g* = 9.8 m.s-2]

1. Given the equation $V=V\_{0}e^{-\frac{t}{τ}}$ where *V0* is the initial voltage on a capacitor of capacitance *C* which is discharging through a resistor of resistance *R*, *V* is the capacitor voltage at time *t*, and ** = *RC*, find the units of the quantity **. What is the significance of the quantity ** in practice?

2. State the conditions for equilibrium for a mass acted on by forces. What is the magnitude of the friction force that would stop a 10kg mass from slipping down a slope of 30 degrees? Draw a diagram of the problem, indicating the magnitudes and directions of the forces.

3. With reference to the idea of the moment of a force, explain how you can crack a nut by squeezing it between a door and its frame at the hinge end.

4. Two cars, initially separated from each other by a distance of 400m approach each other on a collision course. One car travels at 40 m.s-1, the other at 20 m.s-1. By plotting a distance/time graph find the position at which the collision takes place. How long after the cars start does the collision happen?

5. Explain the concept of terminal velocity of a falling body. What happens if the falling body is given an initial speed that is greater than the terminal velocity?

6. Describe, at a molecular level, the main features of the force/extension graph of a rubber band.

7. Describe an experiment which demonstrates the interference of two sound waves.

8. Describe the concept of total internal reflection, and explain how the phenomenon is used in optical fibre communications. Give one advantage of optical communications systems over electrical communications systems.

9. State the meaning of each symbol in the equation *I* = *nAve* for free electrons in a conductor. Derive the equation, showing clearly the steps in your derivation.

10. What is the total resistance, as a multiple of R, of the following network of resistors?

9R

9R

9R

4R

4R

R

11. Consider the series connection of a resistor of resistance *R* and an Inductor of inductance *L*. By means of a phasor diagram, find the phase difference between the applied voltage and the voltage appearing across the inductor if *R* = 200 ohm and *L* = 200 mH and the input voltage is of frequency 400 Hz.

12. Given that the resistance of a 20cm length of Nichrome wire of diameter 0.55 mm is 0.92 ohm, find the resistivity of Nichrome.

13. Describe how neutron emission during nuclear fission can lead to a chain reaction. Explain how this can be harnessed for energy generation in a nuclear power station.

14. A 40 g mass is fired with velocity 1 m.s-1 at another, identical mass which is initially at rest. Given that the two masses travel together with velocity 0.05 m.s-1 after they collide, calculate the energy lost during the collision. To what form is that energy likely to have been converted?