Miscellaneous questions

1. A ball is launched into the air with a velocity of 12.5 ms^{-1}.

i) Calculate the time it takes to reach its highest point.

ii) Calculate the maximum height the ball rises to.

iii) Calculate the times (two answers) when the displacement of the ball is 1.0 m.

2. A photon has a wavelength of 425 nm. Calculate the energy it delivers to a surface it is incident on.

3. A 0.5 m^2 surface is irradiated with red light of wavelength 620 nm. If the irradiance of the light at the surface is 2.0 Wm^{-2}, then calculate the number of photons that strike the surface each second.

4. A 60 kg chap on 5 kg sledge a is pulled by a force of 65 N. If the acceleration of the sledge is 0.2 ms^{-2}, calculate the frictional force on the sledge.

5. A lift is rising with an acceleration of 0.5 ms^{-2}. If a 60 kg man is standing on scales, calculate the reading on the scales.

6. A lift is rising with an acceleration of 0.5 ms^{-2}. If a 100 g apple is hanging on a Newton balance, calculate the reading on the balance.

7. A 60.0 g tennis ball travelling at 30 ms^{-1} receives an impulse of -2.8 Ns from a racquet. Calculate the momentum of the ball the instant it leaves the racquet.

8. A boat travels 2.0 km on a bearing of 090 then travels 2.0 km on a bearing of 320. Find its resultant displacement vector.

9. The work done on an electron in a uniform and parallel electric field is 32 x 10^{-19} J. Calculate the force the electric field exerted on the electron moved 1.0 cm as the work was done.

10. White light is projected towards a screen through a diffraction grating. Describe what is seen on the screen.

11. A glass block has a refractive index of 1.43. Calculate its critical angle.

12. A ball is launched with a velocity of 30 ms^{-1} ; 30^0 (to horizontal). Calculate its horizontal component of velocity.

13. A proton and an alpha particle are injected into a magnetic field. How could you tell which was which?

14. A shell is launched horizontally from a cliff of height, 100 m at a speed of 75 ms^{-1}.

i) Calculate the time it takes the shell to hit the ground if friction is ignored.

ii) Calculate how far from the cliff will the shell land.

iii) Calculate the vertical velocity of the shell as it lands.

iv) Calculate the velocity of the shell as it lands.

15. At what point does a stationary observer hear the pitch of a police car siren change?

16. The work done on an alpha particle as it traverses a uniform and parallel electric field is 3.2×10^{-16} J. If the negatively charged plate is at a potential of -1000 V, then calculate the potential of the positively charged plate.

17. If the ground state of Hydrogen is -13.6 eV and the first excited state is -3.40 eV, then calculate the energy of the photon emitted when electrons fall from the excited state to the ground state.

18. Calculate the effective power developed in a 1000 Ω resistor when supplied with a mains voltage of peak 320V.

19. An ac signal forces an electron beam in an oscilloscope to follow a wave shape. If there are three boxes between two crests and the time base is set at 2 ms/cm then calculate the frequency of the signal.

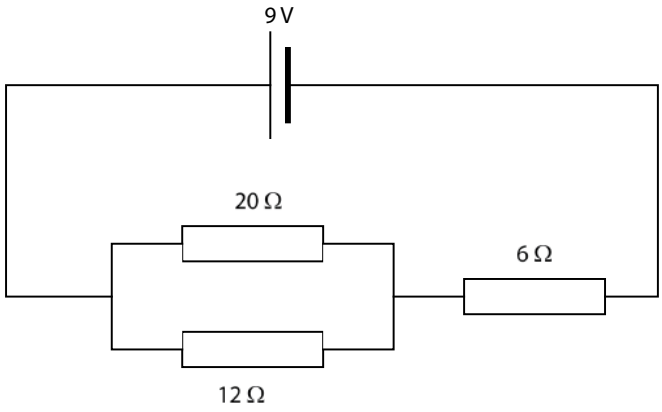
20. A bulb designed to operate at 2.0 V blows when it is connected to an ac voltage of 2.0 V_{rms}. Suggest a reason why

21. A 6 Ω and a 12 Ω resistor in series are connected to dc voltage of 2.0 V, calculate the power developed in the circuit.

22. A 6 Ω and a 12 Ω resistor in parallel are connected to dc voltage of 2.0 V, calculate the power developed in the circuit.

23. A 6 Ω and a 12 Ω resistor in parallel are connected to dc voltage of 18.0 V, calculate the current in the 12 Ω resistor.

24. The circuit below shows two parallel resistors with one other resistor in series.

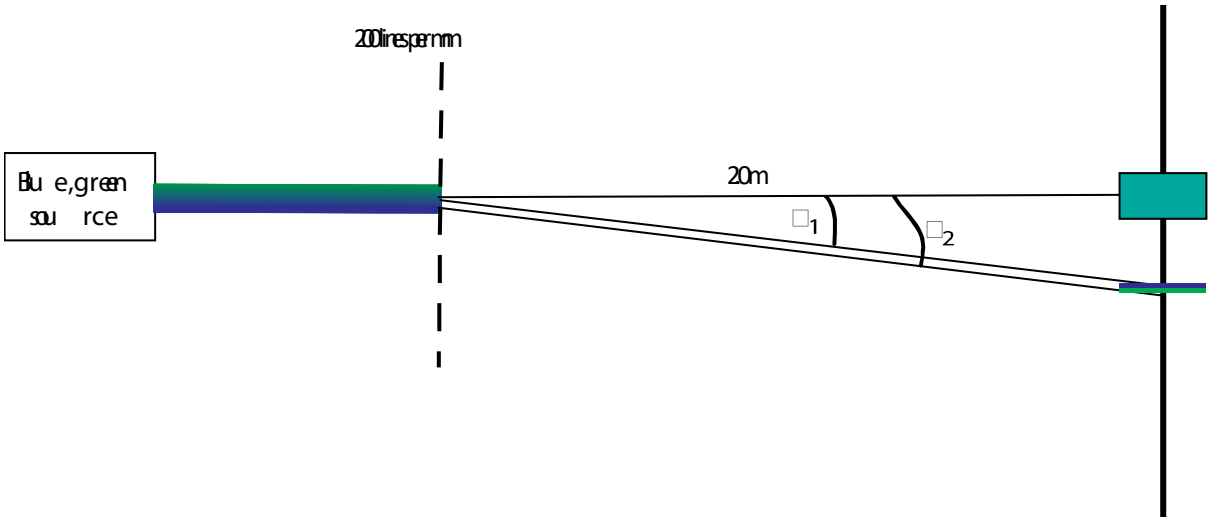


i) Calculate the current in the 20 Ω resistor.

ii) Calculate the power developed by the circuit.

25. The momentum of a rock of mass 5 kg is 30 kg ms^{-1}, calculate its kinetic energy.

26. The blue and green light in the diagram below have wavelengths 430 and 510 nm respectively.

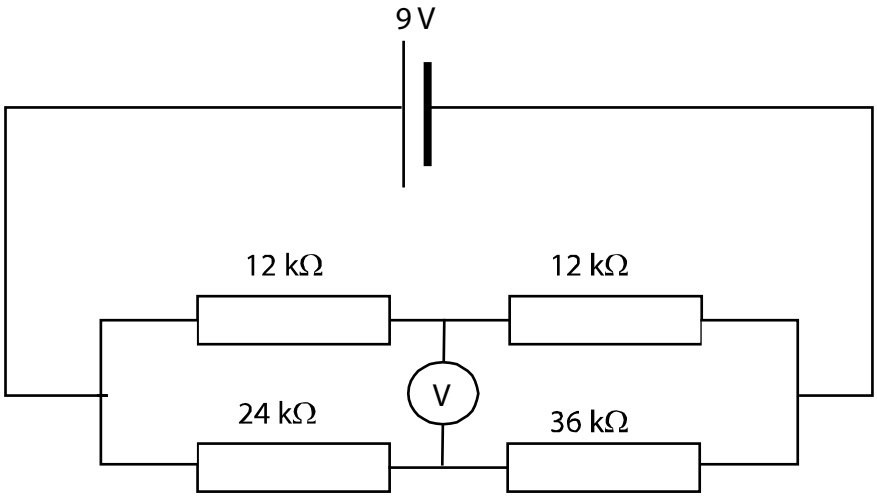


Calculate the difference between $\theta 1$ and $\theta 2$.

27. If you heat up a semiconductor you create two mechanisms for conduction. Why?

28. What is meant by coherent waves?

29. Look at the Wheatstone bridge below.



i) Calculate the potential difference displayed on the voltmeter.

ii) What change would we need to make so the potential difference reads zero?

iii) What name to we give to a bridge that reads zero volts when the voltmeter is connected as above?

30. A ball is thrown into the air with a velocity of 20 ms^{-1}. It arrives back to the thrower's hand a short time later. (note: the graphs can be drawn in any order but present them in the order asked)

i) Draw a fully labelled displacement time graph for the ball.

ii) Directly below this graph, using the same time scale, draw a fully labelled velocity-time graph.

iii) Directly below this graph, using the same time scale, draw a fully labelled acceleration-time graph.

31. A photon of ultraviolet light of wavelength 200 nm is incident on a metal plate. If the emitted electrons have zero kinetic energy…

i) Calculate the threshold frequency of the metal

ii) Calculate the work function of the metal.

32. If light with a frequency less than the threshold frequency for a metal is incident on that metal then no electrons will be emitted irrespective of how bright the light is. Explain why.

33. The speed of light drops from 3.0×10^{8} ms^{-1} to 2.5×10^{8} ms^{-1} as it enters a material. Calculate the refractive index of the material.

Answers

1 i) 1.3 ms^{-1} ii) 8.0 m, iii) 0.08 s and 2.47 s

2. 4.7×10^{-19} J

3. 3.1×10^{18} photons/second

4. 52 N

5. 528 N

6. 1.03 N

7. -1.8 $kgms^{-1}$

8. Approximately 1 km 022^{0}

9. 32×10^{-17} N.

10. Spectrums on either side of a central white maximum. Blue is in the inside of each spectrum. Red is on outside.

11. 44.4^{0}

12. 25.6 ms^{-1}

13. The proton will travel in a path with greater curvature.

14. i) 4.5 s ii) 337.5 m iii) -44.1 ms^{-1} iv) 87 ms-1 ; 59.5^0 to the vertical.

15. At the instant the car passes him.

16. 1000 V

17. 1.6×10^{-18} J

18. 51.2 W

19. 166.7 Hz

20. The peak voltage of the signal is 2.8 V

21. 0.22 W

22. 1 W

23 1.5 A

24 i) 0.25 A

ii) 6 W

25. 45 J

26. 0.9^0

27. You move electrons to conduction band where they can conduct and create holes on valence band that aids conduction in that region.

28. Waves with a constant phase difference.

29. i) 0.9 or -0.9 V, depending on voltmeter orientation.

ii) Change the 36 k resistor to 24 k for example. There are other changes that could be made.

iii) Balanced

30. i) This should be a camel shaped hump always above the t-axis with a maximum displacement of 2.04 m and total time of 4.1 s.

ii) This should be a downwards diagonal line of gradient -9.8 ms^{-2}. The line should start at 20 ms^{-1} and end at -20 ms^{-1} and it should cut the axis at 2.04 s and end at 4.08 s.

iii) A horizontal line at -9.8 ms^{-2}.

31. i) 1.5×10^{15} Hz. ii) 9.9×10^{-19} J.

32. The energy is delivered by photons and absorbed by surface electrons in single (Lumps or bundles) packets. Unless the energy (per packet) absorbed by an electron is sufficient to leave the metal it will not leave because it can only absorb one packet at a time.

33. 1.2