Wallace Hall Academy
Physics Department

Advanced Higher Physics

Quanta

Solutions

TUTORIAL 1.0

Quantum Theory

Numerical answers

1. $\pm 1.1 \times 10^{-23}$ kg m s^{-1}

2. $\pm 5.65 \times 10^{-9}$ m

3. $\pm 5.3 \times 10^{-26}$ J

4. $\pm 1.4 \times 10^{-26}$ kg m s^{-1}

5. (a) 1.8×10^{-10} m
   (b) 6.1×10^{-14} m
   (c) 2.0×10^{-38} m

6. The electron has the larger de Broglie wavelength by 1800 times.

7. (a) 4.7×10^{-13} m
   (b) 1.4×10^{-21} kg m s^{-1}

8. (a) 8.4×10^{6} m s^{-1}
   (b) 8.7×10^{-11} m
   (c) Particle behaviour

9. 2.5×10^{-11} m (2.46×10^{-11} m)

10. 940 V

11. 2.4×10^{-11} m (24 pm)

12. (a) (i) 1.06×10^{-34} kg m^2 s^{-1} (1.056×10^{-34} kg m^2 s^{-1})
    (ii) 3.2×10^{-34} kg m^2 s^{-1}
    (b) Show $2\pi r = n\lambda$
    (c) (i) 6.6×10^{-10} m
    (ii) 1.3×10^{-9} m

TUTORIAL 2.0

Particles from space

Numerical answers

1. 5.0×10^{-13} N

2. 3.8×10^{-15} N

3. A neutron has zero charge: $q = 0$

4. (a) 6.1×10^{-16} N out from page
   (b) Zero force, as velocity is parallel to magnetic field.

5. 4.5×10^{6} m s^{-1}

6. 1.6×10^{-19} C

7. 9.1 T

8. (a) 2.1×10^{-13} N
   (b) This force is a central force at right angles to the direction of motion.
   (c) 2.9×10^{-4} m

9. 0.54 m

10. (a) 45 mm
    (b) 2.9×10^{-16} N

11. (a) 2.6×10^{7} m s^{-1}
    (b) 1.1×10^{-7} s
    (c) 2.2×10^{-12} J

12. 1.9×10^{6} m s^{-1}

13. 0.61 T

14. 9.56×10^{7} C kg^{-1}; proton, q/m for proton = 9.56×10^{7} C kg^{-1}

15. (a) $v \cos\theta$
    (b) $v \sin\theta$
    (c) $v \cos\theta$ stays unchanged ,as it is parallel to the magnetic field

16. (a) 2.3×10^{6} m s^{-1}
    (b) 6.4×10^{6} m s^{-1}
    (c) 2.36×10^{-13} N
    (d) 1.6×10^{-4} m
    (e) 1.6×10^{-10} s
    (f) 3.7×10^{-4} m

17. (a) 4.4×10^{5} m s^{-1}
    (b) 3.7×10^{5} m s^{-1}
    (c) 2.8×10^{-14} N
    (d) 8.2×10^{-3} m
    (e) 1.4×10^{-7} s
    (f) 6.2×10^{-2} m

18. (a) 1.2×10^{-4} m
    (b) 5.4×10^{-4} m