Oxford Resources for IB

Physics – 2023 Edition

Answers

Theme D – Field

D.1 – Gravitational fields

Practice questions – Page 480

1 **a.** 6.9×10^{-9} N

b. 0.66 m

2 **a.** 1.6×10^{14} kg

b. 6.8×10^{-9} m s^{-2}

Practice questions – Page 481

3 0.997

4 32 km

5 B

Practice questions – Page 485

6 D

7 2.0 days

8 3.5×10^{11} m

Practice questions – Page 487

9 **a.** 6.4×10^{23} kg

b. 2.3×10^{7} m

10 7.08×10^{3} s (approximately 2 hours)

Practice questions – Page 493

11 **a.** 1.2×10^{9} J

b. 0.58 m s^{-2}

12 **a.** 3.0×10^{7} J

b. around 5500 to 6000 km

Practice questions – Page 452

13 **a.** $\sqrt{1.5} \simeq 1.22$

b. $-\frac{1}{3}E$

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14 **a.** 4.2×10^{10} J

b. 5.8×10^{7} J

15 **a.** 8 m s^{-1}

b. 8×10^{16} kg

Practice questions – Page 501

16 4.2×10^{4} m s^{-1}

17 **a.** 2.1×10^{10} J

b. 1.1×10^{4} m s^{-1}

c. 1.9×10^{10} J

D.2 – Electric and magnetic fields

Practice questions – Page 510

1 **a.** 15 nC

b. **i.** 0.20 mN

ii. 0.39 mN

2 **a.** 3.0 N

b. 78 mm

Practice questions – Page 512

3 **a.** 1.0×10^{21} N C^{-1}

b. 160 N

4 -3.3×10^{-9} C

5 1.5 m

Practice questions – Page 514

6 **a.** 1.6×10^{7} N C^{-1}, to the left

b. 81 mN, to the right

7 A

8 D

Practice questions – Page 519

9 **a.** 67 kV m^{-1}

b. −60 nC

10 **a.** 80 kV m^{-1}

b. 1.6 kV

Practice questions – Page 525

11 2.0×10^{5} V m^{-1}, vertically downwards

12 **a.** 6*e*

b. 8 electrons

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Practice questions – Page 532

13 **a.** −2.9 V

b. **i.** $+3.7 \times 10^{-9}$ J

ii. -2.6×10^{-9} J

c. **i.** $+7.5 \times 10^{-9}$ J

ii. -5.2×10^{-9} J. Negative work indicates that the potential energy of the system decreases.

14 **a.** -4.9×10^{-4} J

b. $+4.9 \times 10^{-4}$ J

15 **a.** 120 V

b. 240 V m^{-1}

Practice questions – Page 539

16 **a.** C

b. D

17 A

D.3 – Motion in electromagnetic fields

Practice questions – Page 544

1 A

2 C

Practice questions – Page 549

3 **a.** 7.5×10^{-5} N m^{-1}

b. zero

4 1.8×10^{-5} N, to the left

Practice questions – Page 552

5 5.2×10^{6} m s^{-1}

6 **a.** 1.0×10^{4} m s^{-1}

b. 7.3×10^{3} m s^{-1}

Practice questions – Page 555

7 **a.** positive

b. $q = \frac{mv}{BR}$

8 B

9 **a.** 1.9 cm

b. 9.6×10^{5} m s^{-1}

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Practice questions – Page 558

10 **a.** 1.13×10^5 m s^{-1}

b. 28.3 kV m^{-1}

11 **a.** 9.05×10^4 m s^{-1}

b. 1.17×10^{-26} m s^{-1}

12 D

D.4 – Induction

Practice questions – Page 566

1 **a.** 0.10 A

b. **i.** 0.40 V

ii. 3.3 m s^{-1}

iii. 40 mW

2 0.19 V

Practice questions – Page 573

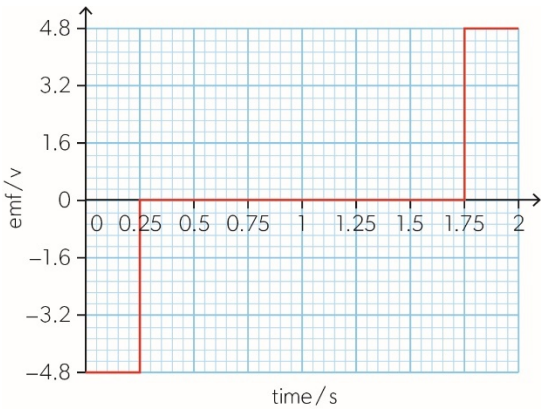
3 **a.** 1.4×10^{-3} Wb

b. 17 mV

c. 7.2 mJ

4 **a.** 0.75 T

b.



c. 0.32 m s^{-1}

d. **i.** anti-clockwise

ii. clockwise

e. 23 W

5 B

6 D

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Practice questions – Page 580

7 **a.** 0.90 W

b. 0.15 A

c. 0.21 A

8 **a.** 31 W

b. 18 V

9 C

End-of-theme questions – Pages 584–585

1 **a.** The velocity of the planet is constantly changing, and its acceleration is directed towards the centre of the orbit, so there must be a force directed towards the centre.

b. 8.8×10^{23} N

c. **i.** $V = -\frac{6.67\times10^{-11}\times8.0\times10^{24}}{9.1\times10^{6}} - \frac{6.67\times10^{-11}\times3.2\times10^{30}}{4.4\times10^{10}} = -4.9\times10^{9}\ \text{J kg}^{-1}$

ii. 9.9×10^{4} m s^{-1}

2 **a.** **i.** gravitational attraction of Mars

ii. the force is perpendicular to the velocity

b. **i.** The centripetal acceleration is provided by the gravitational force so

$$\frac{GM}{R^2} = \frac{v^2}{R} = \frac{(2\pi R/T)^2}{R}$$

which leads to

$$\frac{R^3}{T^2} = \frac{GM}{4\pi^2}$$

ii. 6.4×10^{23} kg

c. 7.4×10^{24} kg

3 **a.** $E = \frac{kq}{r^2} = \frac{8.99\times10^{9}\times6.0\times10^{-3}}{0.4^2} = 3.37\times10^{8}\ \text{N C}^{-1}$

b. **i.** $5.9\times10^{19}\ \text{m s}^{-2}$

ii. The electron moves away from the point charge with decreasing acceleration and increasing speed.

4 **a.** Initially, the magnetic force is directed to the left. This is perpendicular to the velocity of the proton so its direction of motion will change but not the speed. The force will remain constant in magnitude and provide the centripetal acceleration.

b. **i.** $qvB = \frac{mv^2}{R}$, hence $R = \frac{mv}{qB} = \frac{1.67\times10^{-27}\times2.0\times10^{6}}{1.6\times10^{-19}\times0.35} = 0.060$ m

ii. 1.9×10^{-7} s

c. The change in the kinetic energy is equal to the work done by the net force; in this case the force is perpendicular to the velocity so the work done is zero.

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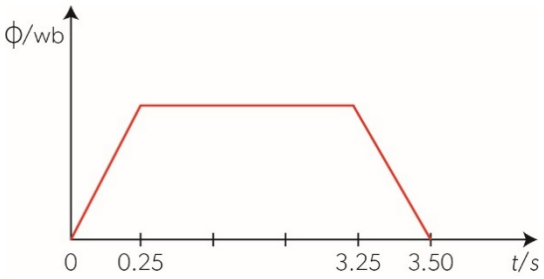
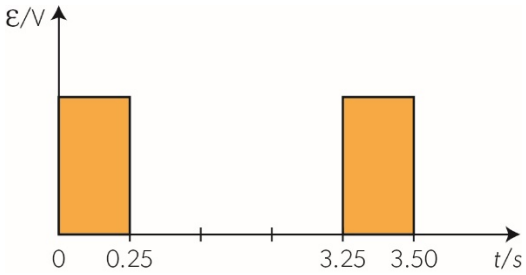
5 **a.** $v = \frac{70}{3.5} = 20 \text{ cm s}^{-1}$

b. **i.**



ii.



c. **i.** 0.80 V

ii. 1.3 N

d. **i.** $E = fvt = 1.3 \times 0.20 \times 0.50 = 0.13$ J

ii. 1.9×10^{-2} K

6 **a.** $Q = \frac{VR}{k} = \frac{3.4 \times 10^5 \times 0.48}{8.99 \times 10^9} = 18.2\,\mu\text{C}$

b. **i.** electrons leave the small sphere, making it positively charged.

ii. $q_1 = 12\,\mu\text{C}$, $q_2 = 6.0\,\mu\text{C}$

7 **a.** The magnet gets closer to the ring so the magnetic field at the position of the ring is increasing.

b. Diagram showing an arrow going anticlockwise.

c. The induced magnetic field is upwards, so the force in the magnet is repulsive.

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