SOLUTIONS

1. a) 8600 – 8200 = 400.0N (4 s.f) towards the elephant
   b) If it weighs 21000N, it must have a mass of 21000/9.8 = 2143kg
   a = F / m = 400 / 2143 = 0.1867 ms^{-2} (4 s.f.) towards the elephant

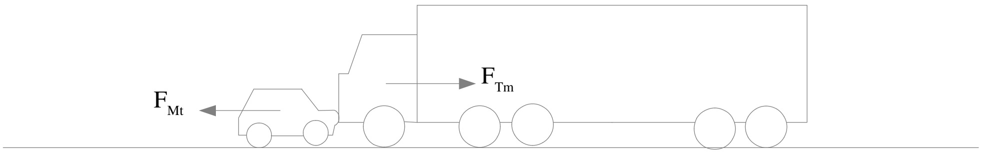
2. a) No, it's the same. The force needed to stop depends on inertia (mass) which is same for both.
   b) Friction is a force always acting in the opposite direction to motion – when friction is around it's easier to stop the object because the friction is already applying some of the necessary force.

3. Mass describes the inertia in an object, and is the same everywhere. Weight is the force of gravity and is different if you're on a different planet.

4. Friction cancels weight (zero net force, no acceleration) so friction is 60×9.8 = 590N (2 s.f.)

5. A row boat accelerates by pushes the water back with the oars. The water, according to Newton's third law, applies an equal and opposite force on the oars, pushing them (and therefore the boat) forwards. A motor boat either uses a propellor or a jet to push the water back but the principle is still the same as for oars.

6. a)

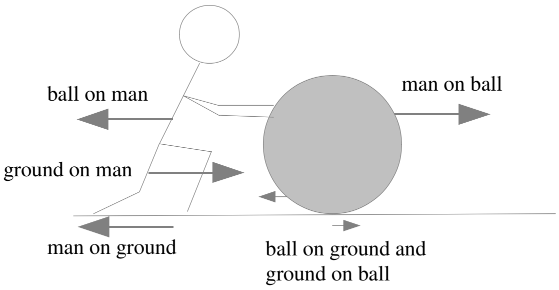


   b) Truck pushes mini (F_{Mt}), mini pushes truck (F_{Tm})

   c) Neither, they feel the same

   d) The mini (it has less mass)

7.



The net force on the man is (by ground) → and ← (by ball) so the net force on the man is zero; he does not accelerate.
The net force on the ball is ← (by ground) and → (by man) so the net force is →; the ball accelerates to the right.

8.
   a) Electric fields are regions in which charged particles experience a force. The direction of field lines represents the direction of force and the line density represents the force strength.
   b) When two objects are rubbed together, electrons may jump, leaving one object negatively charged (extra electrons) and one positively charged (less electrons).
   c) They don't exist. The electrons in the conductor rearrange such that there isn't any.
   d) The charges tend to gather at sharp points meaning the electric field there is strong.
   e) $F = kq_1q_2/r^2$ (force is proportional to charges and inversely proportional to distance squared)
   f) Proportional: if you increase one, the other will increase. Inversely proportional: increase one and the other will decrease.
   g) An uncharged object brought near a charged object may polarise, which means its negative and positive charges seperate and form dipoles, so that one end is relatively negative and the other end is relatively positive.

9.

a) $F = kq_1q_2/r^2 = 9.00 \times 10^9 \times 0.011 \times 0.030 / (0.14)^2 = 1.5 \times 10^8$ N (2 s.f.) *attraction*

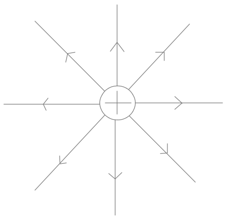
b) $E_{+ve} = kq/r^2 = 9.00 \times 10^9 \times 0.011 / (0.07)^2 = 2.0 \times 10^{10}$ NC^{-1} *towards -ve*

$E_{-ve} = kq/r^2 = 9.00 \times 10^9 \times 0.030 / (0.07)^2 = 5.5 \times 10^{10}$ NC^{-1} *towards -ve*

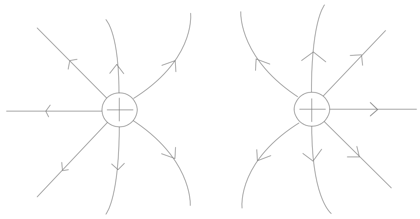
Since they are in same direction, they add: $E_T = 7.5 \times 10^{10}$ NC^{-1} (2 s.f.) *towards -ve*

10.

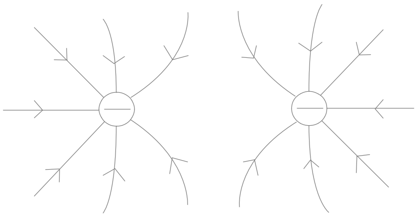
a)



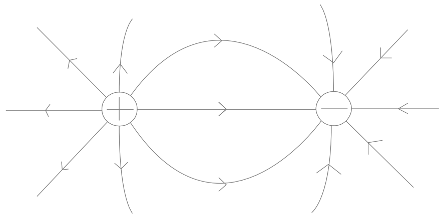
b)



c)



d)



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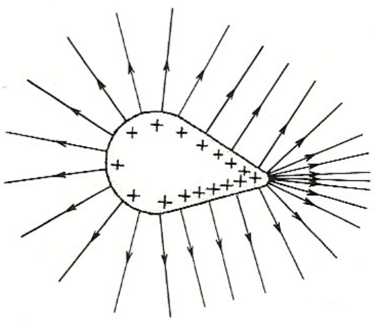

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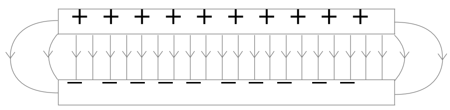
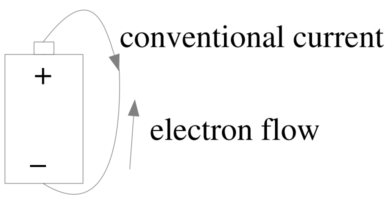


11.



12. a) Direction of force a North pole placed there would feel

b) The strength of the field (or force)

13. a) $R_T = R_1 + R_2 + R_3 = 1.0 + 2.0 + 3.0 = 6.0\Omega$ (2 s.f.)

b) $R_T = 1/ (1/R_1 + 1/R_2) = 1/ (1/1\times10^3 + 1/2\times10^3) = 700\Omega$ (1 s.f.)

c) $R_T = 1/ (1/R_1 + 1/R_2) + R_3 = 1/(1/2 + 1/2) + 1 = 2\Omega$ (1 s.f.)

14. a) $V = IR$ (or $I = V/R$ or $R = V/I$)

b) $R = V/I = 5/1 = 5\Omega$ (1 s.f.)

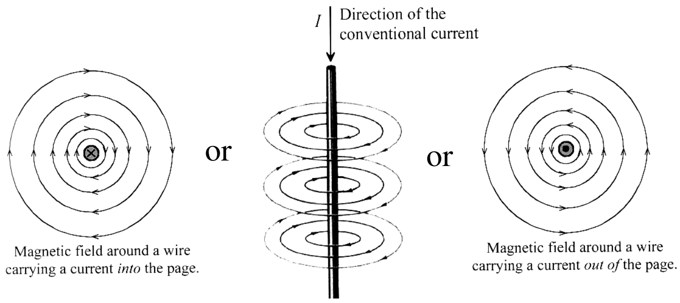
c) $V = IR = 3\times1 = 3V$ (1 s.f.)

d) $R_T = 1/ (1/R_1 + 1/R_2) + R_3 = 1/(1/2.1 + 1/1.5) + 0.61 = 1.5\Omega$ (2 s.f.)

$V = IR = 1.1\times1.5 = 1.6V$ (2 s.f.)

15. a) into the page b) to the left c) to the left

16.



17.

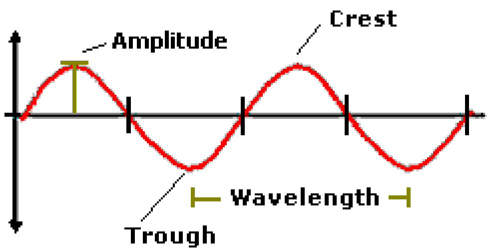
a) $B = F/(I\Delta l \sin\theta) = 0.5/(1.2\times2.0\times\sin(90°)) = 0.21$T (2 s.f.)

b) $F = BI\Delta l \sin\theta = 0.40\times6.8\times0.5\times\sin(90°) = 1.4$N (2 s.f.)

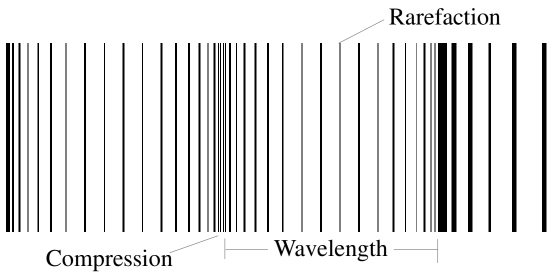
c) $\Delta l = F/(BI\sin\theta) = 50/(2.2\times1.0\times\sin(36°)) = 39$m (2 s.f.)

18.

a)



b)



19.

a) radio waves, microwaves, infrared light, green light, blue light, X-ray, gamma ray

b) gamma ray, X-ray, blue light, green light, infrared light, microwaves, radio waves

20.

a) f = 2 Hz T = 1 / f = 1 / 2 = 0.5 seconds (1 s.f.)

b) T = 2.5 seconds f = 1 / T = 1 / 2.5 = 0.40 Hz (2 s.f.)

21.

a) $\lambda = 4.30\times10^{-7}$ m $f = v / \lambda = 3.00\times10^{8} / 4.30\times10^{-7} = 6.98\times10^{14}$ Hz (3 s.f.)

b) f = 10 Hz λ = 34m v = 10×34 = 340 ms^{-1} (2 s.f.)

c) T = 10 seconds f = 1/T = 1/10 = 0.1Hz $\lambda = v / f = 340 / 0.1 = 3400$ m (2 s.f.)

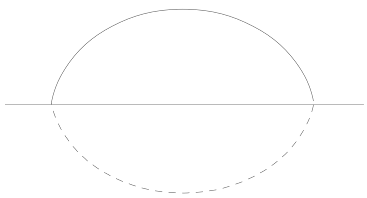
22.

a) Frequency (or wavelength)

b) Amplitude

23.

a)



b) Standing waves are caused by two waves of equal frequency and amplitude travelling in opposite directions and experiencing interference

24. Describe the behaviour of ripples produced by a bug bobbing up and own if it is

a) same frequency/wavelength in every direction

b) higher frequency in front of the bug, lower frequency behind

c) wave crests build up behind the bug forming a bow wave

25. Since the wave speed in a medium is constant the frequency of sound waves are shortened in front of the car (being produced closer together) than behind. Frequency is pitch, so you hear higher sound in front. Behind the car the waves are produced farther apart (lower frequency) so we hear low pitch. This is called the Doppler effect.

26. Diffuse reflection. This occurs when the surface is microscopically bumpy – the light bounces off in all directions and mixes so we see the colour of the object.

27.

a) $\theta' = \sin^{-1}(n\sin\theta / n') = \sin^{-1}(1.00\times\sin38° / 1.33) = 28°$ (2 s.f.)

b) $\theta = \sin^{-1}(n'\sin\theta' / n) = \sin^{-1}(1.00\times\sin45° / 1.55) = 27°$ (2 s.f.)

c) $n' = n\sin\theta / \sin\theta' = 1.00\times\sin25° / \sin15° = 1.6$ (2 s.f.)