May 2022 Pp. 2A.

1a i. Air Resistance + Fluid resistance

ii. shorter braking distance + less water + air resistance

iii By Newton's 2nd law of motion, if Resistive Forces are less, Resultant force is bigger, ∴ acceleration/deceleration is less since $F = ma$ and $F$ is directly $\propto$ $a$.

bi. $F = ma$

$-2.8\times10^{6} = 2.2\times10^{8} \times a$ (negative sign since resistive force so it opposes motion)

$a = -0.013\ m/s^2$

ii. $t = 5\ min = 300\ s$

$a = -0.013\ m/s^2$

$V = 2.1\ m/s$

$u = ?$

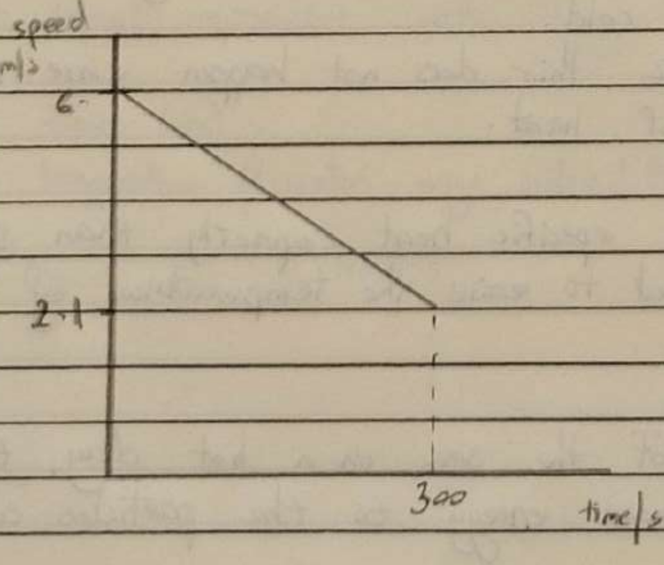
$a = \frac{v-u}{t}$

$-0.013 = \frac{2.1 - u}{300}$

$(0.013 \times 300) = 2.1 - u$

$u = 2.1 + 3.9 = 6\ m/s$

iii.




iv) finding the area under the graph.

c i. Efficiency is the ratio of the energy output compared to the energy input. in a system

ii. heat + sound energy losses.

iii. Power wasted = ?
Power input = 33 M J/s
Power output =
Eff = 36%

∴ Power wasted
= Power in − Power out.

$$\frac{\text{Power out}}{\text{Power in}} \times 100 = \text{Eff.}$$

$$\frac{P.O.}{33} = 36/100$$

$$P.O = 36/100 \times 33 = 11.88 \text{ MJ/s}$$

∴ Power wasted :
= 33 − 11.88 = 21.12 M J/s.

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2 ai metal spoon is a good conductor of heat, ∴ when touched heat flows along the free electrons from our body to the spoon, making us feel cold.
In the case of plastic, this does not happen since it is a bad conductor of heat.

ii. water has a greater specific heat capacity than sand. ∴ more energy is needed to raise the temperature of 1kg of water by 1°C.

iii. When one gets out of the sea, on a hot day, the heat from the air gives more energy to the particles and thus makes water evaporate, leaving the skin with less energy, ∴ we feel cold.

iv. silver is a good reflector of heat, so when heat from the body tries to escape to the surroundings, a silver sheet reflects the heat back. ∴ preventing the body from loosing too much heat. Black on the other hand is a good absorber.

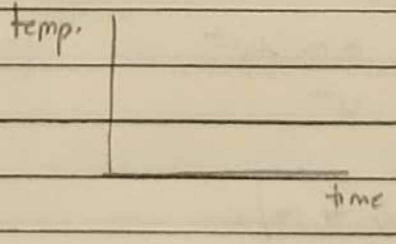
v. This is called the greenhouse effect. The short wavelength radiation from the sun enters the glass container, heating the inside. When it then tries to get out of the container, it would not have enough energy to escape, thus it remains trapped inside the container, raising the inside temperature.
∴ Temp. inside > temp. outside.

bi. thermometer, electronic timer

ii. - cover jerry can with lagging material A.
- fill it with the hot water to the top.
- start electronic timer and read initial temp. with thermometer
- every 2mins take a new reading of temperature and note in a table. Do this for say 15mins.
- repeat experiment with lagging material B.

iii. time (mins)
temperature of water using material B (°C)

iv. A.



3a i. $m_s = 0.23 kg$ mom. $= mv = 13 \times 0.23 = 2.99 kg\ m/s$.
$v_s = 13 m/s$

ii. By Newton's 3rd law of motion, for every action there is an equal + opposite reaction.
Also, this is an example of an explosion and momentum is conserved. Momentum before $= 0$. ∴ momentum after is also equal to 0. ∴ momentum of snowball = - momentum of Karen. ∴ Karen moves in the opposite direction.

iii. Since the pads are compressible, they will lengthen the time of collision, ∴ the force on the knees is smaller since $F \propto \frac{1}{t}$ for the same change in momentum.

iv. since the ball comes to rest, momentum becomes 0.

v. the energy of the moving snowball will be transferred into heat and sound energy, leaving the snowball with 0 energy.

b i. PE at A, KE at B.

ii. $PE_{lost} = KE_{gained}$

$mgh = \frac{1}{2} mv^2$

$m \times 10 \times 1.0125 = \frac{1}{2} \times m \times v^2$

$\frac{2 \times 10 \times 1.0125 \times m}{m} = v^2$

$v = \sqrt{20.25} = 4.5 m/s$.

(OR)

$PE = mgh = m \times 10 \times 1.0125$

$PE = 10.125m J$

$KE = \frac{1}{2} mv^2$

$10.125m = \frac{1}{2} mv^2$

$\frac{10.125 \times 2 \times m}{m} = v^2$

$v = \sqrt{20.25} = 4.5 m/s$

iii. mom. = mv.  mom = 0.225 kg m/s

$m = ?$

$V_B = 4.5$ m/s.

$0.225 = 4.5 \times m$

$\frac{0.225}{4.5} = m$

$m = 0.05$ kg.

iv. $v_x = 4.5$ m/s (→)

$m_x = 0.05$ kg.

$mom_{x8} = 0.225$ kg m/s. } bef. vel after = 1.8 m/s (←)

$V_y = -2.8$ m/s (←)

$m_y = ?$ } bef. vel after = 1.4 (→)

momentum bef = momentum after

$mom_x + mom_B = mom_x + mom_B$

$0.225 + (mv)_B = (0.05 \times -1.8) + (m \times 2.8)$.

$0.225 - 2.8m = -0.09 + 1.4m$.

$0.225 + 0.09 = 1.4m + 2.8m$.

$0.315 = 4.2m$.

$\frac{0.315}{4.2} = m$

$m = 0.075$ kg.

4ai. electrons leave the cloth and enter the polythene strip

ii. electrons from the peespex rod leave, and enter the cloth

iii. no electrons should flow to the thread, otherwise charge would ~~not~~ be earthed from plastic strip.

iv. an electric conductor has free electrons which allow electron to flow, whereas an electric insulator does not allow electricity to flow since they do not have free electrons b i. current is the rate of flow of electrons.

ii. when S is open, total R. is :

$\frac{1}{R_T} = \frac{1}{30} + \frac{1}{24} = \frac{3}{40}$

$R_T = 40/3 = 13.3\ \Omega$

$\therefore V = IR =$ .

$12 = I \times 13.3$

$I = 12/13.3 = 0.9A$.

(OR)

I across 30Ω

I across 24Ω

$V = 12V$ (parallel)

$V = IR$

$\frac{12}{30} = I$

$I = 0.4A$

$V = IR$

$12 = I \times 24$

$\frac{12}{24} = I = 0.5A$

$\therefore I_t = 0.4 + 0.5 = 0.9A$.

iii. $P = IV$

$P_{10} = 1.2 \times 12$

$P_{10} = 14.4\ W$

$P_{10} = ?$

$I_{10} =$ (need to find) →

$R = 10\Omega$.

$V = IR$

$12 = I \times 10$

$I = 12/10$

$I = 1.2A$

iv. $\frac{1}{R_T} = \frac{1}{10} + \frac{1}{24} + \frac{1}{30} = \frac{7}{40}$

$R_T = 40/7 = 5.71\ \Omega$

v. $P = IV$

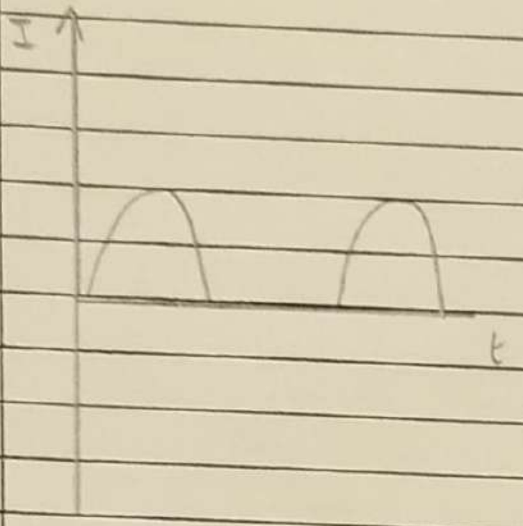
$P = 2.1 \times 12 = 25.2W$.

$I_t = \frac{V_t}{R_t} = \frac{12}{5.71}$

$I_t = 2.1A$

$E = Pt = 25.2 \times 3600 = 90720\ J$

c.i. semi-conductor diode

ii. 


5.a When a.c. supply is connected, the coil becomes an electromagnet and a magnet field grows and collapses around it. Everytime, cutting the magnetic field lines by the car's coil. This induces a current in the car's coil.

b. - since the two coils are not linked with each other by a soft magnetic material
- other magnetic materials around the coils which might interfere with the magnetic fields

c. - increasing the no. of turns around the coils
- using a more powerful ac. supply. or introducing an iron core in each coil

d. at vertical alignment, max. current is induced.
at horizontal alignment no current is induced
and at any other alignment less current is induced

e. magnetic fields are still present in water, so induction can still occur.

F $\frac{N_p}{N_s} = \frac{V_p}{V_s}$

$\frac{N_p}{200} = \frac{240}{12}$

$N_p = \frac{240 \times 200}{12} = 4000$ turns.

g. Since the car was moved back + forth for multiple of times, there was continuous cutting of magnetic flux, ∴ a continuous induced current.

h. the magnetic field lines were cut at a faster rate, ∴ greater induced current, ∴ brighter light.

i. Faraday's law which states that the emf induced in a conductor is directly ∝ to the rate at which the magnetic field lines are cut by the conductor.

j. When the direction of the force is changed, the direction of the induced current also changes, hence opposite deflection on galvn.