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Suggested Answers to 2015 O level Science Physics 5076/5077 Paper 2

1) (i)
Air is a poor conductor of heat. By trapping pockets of air in between the plastic strips of the winter coats, heat loss from the human body to the surrounding via conduction is minimised. Furthermore, the plastic strip itself is also a thermal insulator, which reduces heat loss through conduction.

(ii)
Heat energy produced by the human body is trapped within the coat and thus cold air from the surrounding does not come into contact with the warm air inside the coat. Thus a convection current cannot form and heat loss through convection is reduced.

(iii)
The silvered surface of the plastic strip is a good reflector/ bad absorber/ poor emitter of thermal radiation and so heat from the human body is reflected back towards the body which reduces heat loss by radiation.

2) (i) Force by aircraft to take off

$F = ma$
$= 1.2 \times 105\ kg \times 3$
$= 360\ 000\ N$ or $360\ KN$

(ii) Speed of aircraft after 25 s

$a = (v-u)/(t)$
$3 = (v-0)/25$
$v = 75\ m/s$

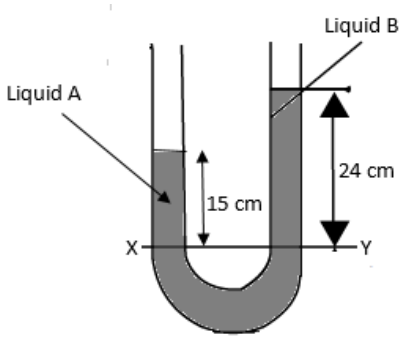
(iii) Minimum vertical force for take off

$w = mg$
$= 1.2 \times 105\ kg \times 10\ N/Kg$
$= 1.2 \times 106\ N$ or $1.2\ MN$

3) (a) (i) mobile phone => **Radio waves/microwaves**
(ii) sunbeds => **Ultraviolet radiation**
(iii) TV remote control => **Infrared radiation**
(iv) Satellite TV => **Microwaves**

(b) **Ultraviolet light** is the electromagnetic wave mentioned in (a) with the greatest frequency

4)



(ai) Vol (A) = cross-sectional area x height = 3(15) = 45 cm^3
Mass (A) = density x volume = 1.2 x 45 = 54 g

(aii) Pressure at X due to Liquid A = $\frac{F}{A} = \frac{(0.054)(10)}{3 \times 10^{-4}}$ = 1800 Pa

(b) pressure at X = pressure at Y
$(h\rho g)_B$ = 1800 N
∴ $\rho_B = \frac{1800}{(0.24)(10)}$ = 750 kg/m^3 = 0.75 g/cm^3

Teacher's Comments: Pressure in a liquid is the same at the same height of the liquid.

5) Mass of arrow = 0.18 kg

Force applied on the arrow = 125 N
Distance moved by arrow = 60 cm = 0.6 m

(a) work done on arrow = (125)(0.6) = 75 J

(b) Since efficiency of arrow = 75%, useful energy output by the arrow = 0.75(75) = 56.25J

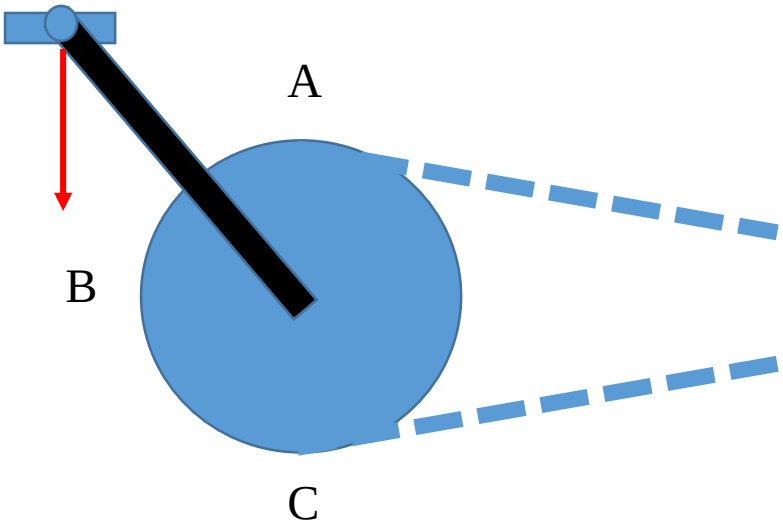
initial K.E. of arrow = 56.25 J
∴ $\frac{1}{2}mv^2 = 56.25$

∴ speed at which arrow leaves bow, v = $\sqrt{\frac{2(56.25)}{m}} = \sqrt{\frac{2(56.25)}{0.18}}$ = 25 m/s

(c) By the Principle of Conservation of Energy,
Loss in K.E. = Gain in G.P.E

$\frac{1}{2}mv^2 = mgh$
56.25 = mgh
∴ maximum height gained by the arrow, h = $\frac{56.25}{mg} = \frac{56.25}{(0.18)(10)}$ = 31.25 m

6)

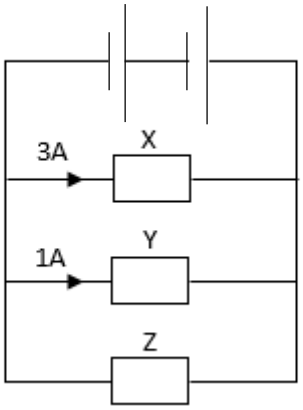


When the pedal is at A, no moment is produced as there is zero perpendicular distance between the pivot and the pedal at A.

When the pedal is at B, there is maximum moment produced as there is maximum perpendicular distance between the pivot and the pedal at B.

Thus an increasing moment is required to move the pedal from A to B and likewise a decreasing moment is required to move the pedal from B to C.

7)



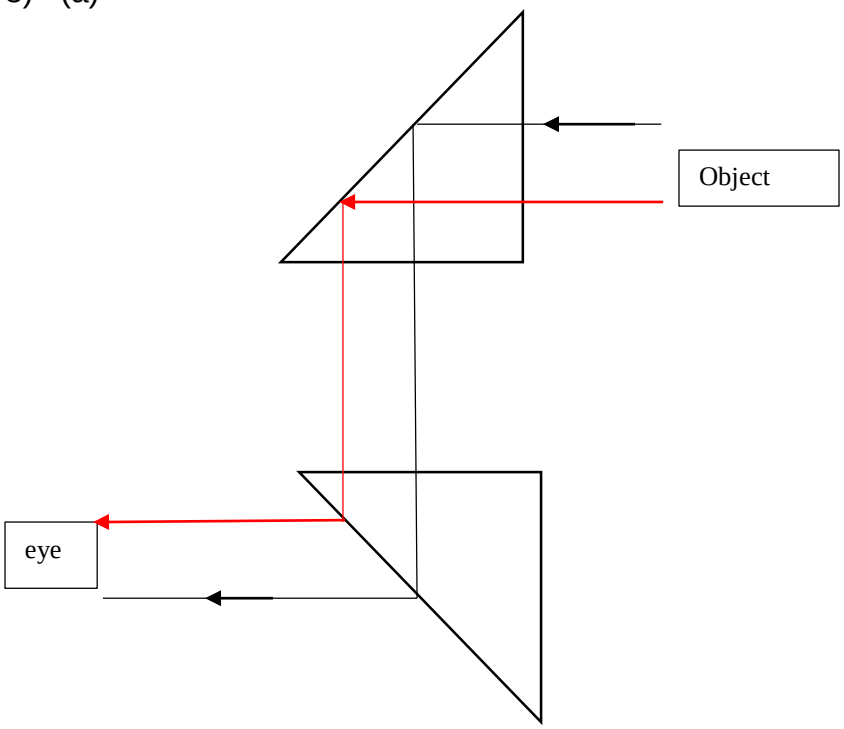
(a) total effective resistance of circuit = 0.75 Ω
emf of cell = 6 V
∴ total current of circuit = $\frac{V}{R} = \frac{6}{0.75}$ = 8 A

(b) Current through resistor Z = 8 – 3 – 1 = 4 A

(c) Resistance of Z = $\frac{V}{I} = \frac{6}{4}$ = 1.5 Ω

(d) Power of Z, P = IV = (4)(6) = 24 W
∴ energy dissipated by Z in 15 mins = Pt = (24)(15 x 60) = 21.6 kJ

8) (a)

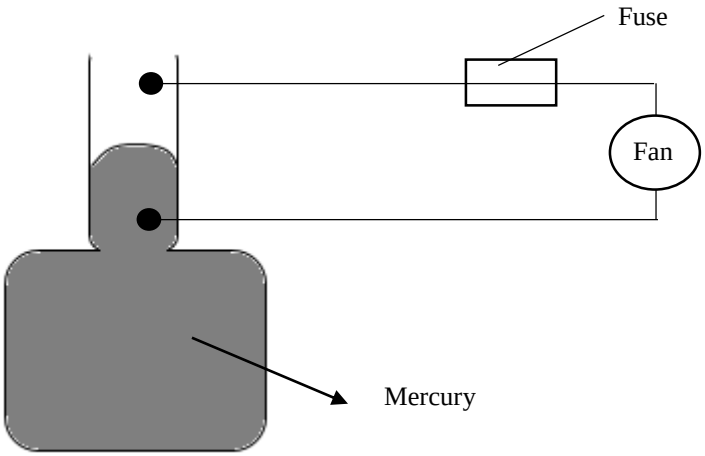


(b) virtual, inverted, same size as object

(c) Angle of incidence is any value greater than 42°. This is because, when the angle of incidence equals critical angle, refraction angle is 90°. Therefore for any angle greater than 42°, total internal reflection occurs.

9) When the negatively charged rod is brought close to the top of the metal rod, with the metal foil attached at the bottom, the electrons from the top of the metal rod are pushed towards the metal foil at the bottom. Since like charges repel, an accumulation of negative charges causes the metal foil to deflect.

10)



(a) An increase in room temperature causes the mercury to expand and thus its volume increases.

(b) When the temperature of the room falls, the mercury contracts and its volume decreases. As the mercury thread falls below the point where it is connected to the circuit, the contact between the mercury and the circuit is broken, hence resulting in an open circuit. Thus the fan will stop.

Teacher's Comments: The mercury thread acts like an automatic switch.

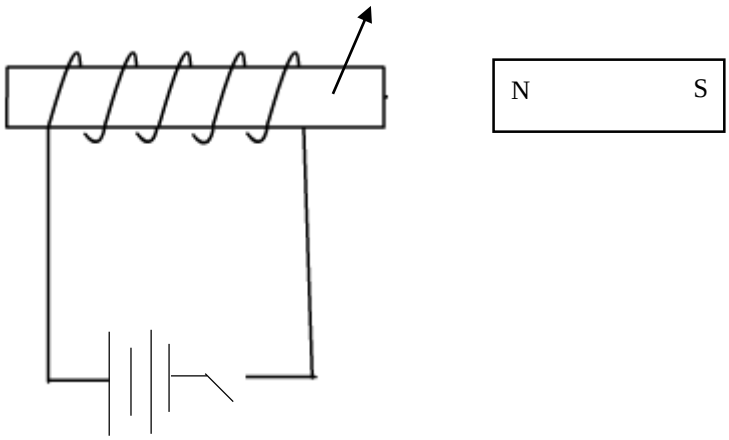
(c) P = IV

∴ I required by the fan = $\frac{P}{V} = \frac{450}{230}$ = 1.956 A

A suitable fuse rating would be 3 A.

Teacher's Comments: 2A is not used as 1.96A is approximately 2A, hence 3A is chosen.

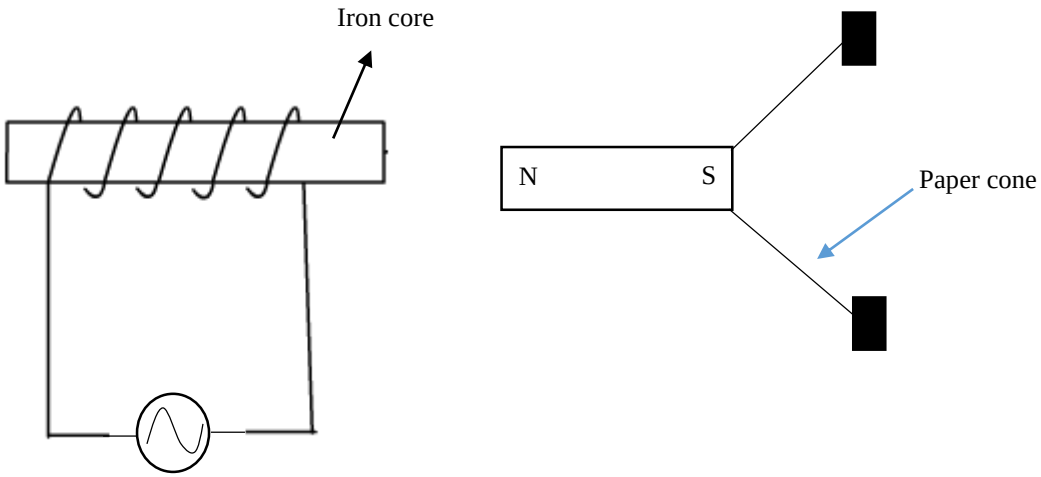
11)



(a)(i) The iron core gets magnetised. By using right hand grip rule, North pole is produced on the left side of the iron core and South pole is produced on the right side of the iron core. Hence, the magnet is attracted to the iron core since unlike poles attract.

(a)(ii) When the batteries are reversed, the current flow in the circuit will also be reversed. By using right hand grip rule, the right side becomes North pole and the left side of the iron core becomes South pole. Hence the magnet and the iron core will repel each other since like poles repel.

(b)(i)



When the battery is replaced with an a.c. source, the polarity of the coil will keep reversing repeatedly. This will cause the bar magnet to move towards and away from the iron core repeatedly as it keeps getting attracted and repelled in quick successions. This causes the paper cone to vibrate and produce longitudinal sound waves.

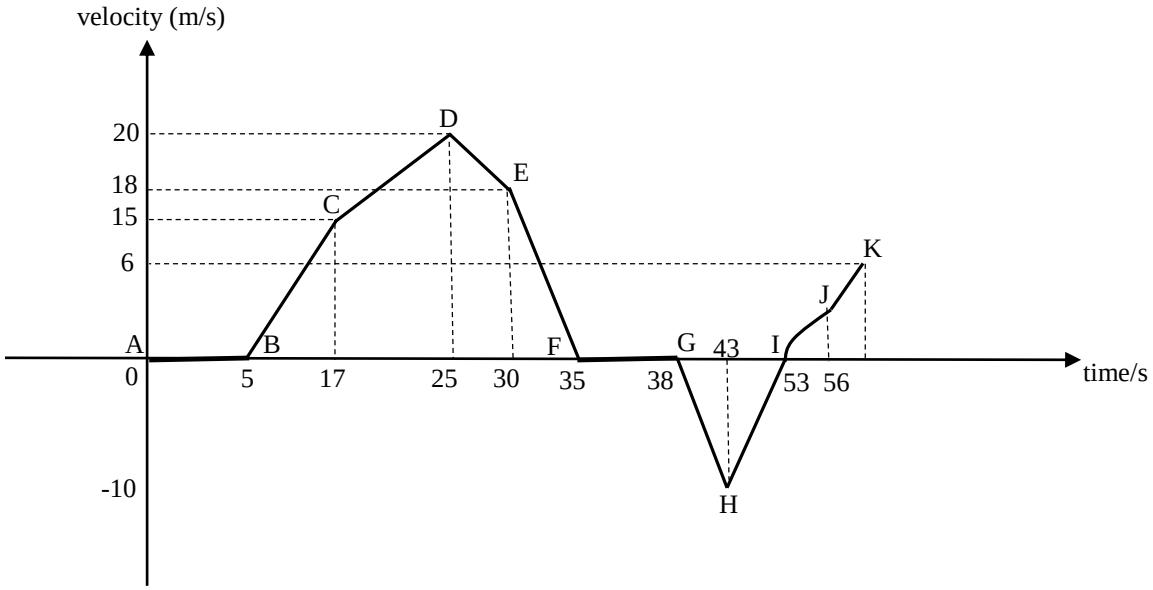
Teacher's Comments: Sound waves are generated by the vibration of air particles. The vibrating paper cone will produce sound waves as they will cause the air next to them to vibrate as well.

(b)(ii) There are 3 complete oscillations.
3 wavelengths => 7 - 1 = 6 m
1 wavelength => 6 m / 3 = 2 m
v = fλ
∴ wavelength, λ = 2 m

(b)(iii) Doubling the volume of the speakers would double the amplitude of the wave.

(c) v = fλ
∴ wavelength, $\lambda = \frac{v}{f} = \frac{330}{240} = 1.375$ m

12)



(a) A to B => Stationary
B to C => increasing speed is the greatest
C to D => increasing speed
D to E => braking
E to F => stopping

(b) From C to D, the speed increases from 15m/s to 20m/s over a period of 8 seconds. This shows that there is a rate of change of speed per unit time.

(c)

F to G	=>	stationary
G to H	=>	moves in the opposite direction with increasing speed
H to I	=>	decelerating in the same direction as from G to H
I to J	=>	moving with non-uniform acceleration
J to K	=>	constant acceleration