St. Margaret's Secondary School

Preliminary Examinations 2010

PHYSICS 5058/01 & 02

Secondary 4 Express

Paper 1

1	D	11	A	21	B	31	C
2	C	12	C	22	A	32	A
3	C	13	A	23	D	33	A
4	B	14	C	24	B	34	D
5	B	15	B	25	C	35	B
6	C	16	D	26	A	36	D
7	D	17	D	27	D	37	C
8	B	18	C	28	A	38	A
9	C	19	C	29	A	39	C
10	B	20	C	30	D	40	D

Paper 2

$$s = \frac{1}{2}(u + v)t$$

1 (a) $0.40 = \frac{1}{2}(0 + 80.0)t$ [1]

$t = 0.010\text{ s}$ [1]

$$v = u + at$$

(b) $80.0 = 0 + a(0.010)$ [1]

$a = 8000\text{ m/s}^2$ [1]

(c)

2 marks for correct shape graph with clearly labelled values
1 mark for correct labelling of graph (leaves bow & hits target)
1 mark for correct calculation of distance travelled by arrow during flight
(0.40 m for acc portion; 15.6 m for the 80 m/s portion)

2 (a) Upward forces at A and B. [1]

(b) W = mg = 10.8 x 10 = 108 N [1]

(c) $\perp$ distance of W from B = (70.0 cos 45°) - 12.0
= 37.5 cm [1]

Taking moments about the B,

$$CM = ACM$$
$$F_A \times 60.0 = 108 \times 37.5 \quad [1]$$
$$F_A = 67.5\,N \quad [1]$$

F_B = 108 – 67.5 = 40.5 N [1]

3 (a) P = (120 x 1000 x 10) [1] = 1200000 Pa [1]

(b) Pressure increases with depth [1] so a thicker base is needed to withstand the greater force per unit area at the base. [1]

(c) (i) loss in GPE = gain in KE
mgh = ½ mv^2
10×100 = ½ $\times v^2$ [1]
v = 44.7 m/s [1]

(ii) Power generated $= 3600 \times 10 \times 100 \times 60\%$ [1]
$= 3600000 \times 60\%$
$= 2160000$ W [1]

4 (a) The dust are kept in suspension as they are continuously hit by the air molecules/particles [1] which are at constant random motion and moving at high speeds. [1]

(b) (i) As the gas is heated, the gas molecules gain K.E/speed up and hit the piston with a greater force and more often [1], hence pushing the piston outwards.

(ii) As the piston moves outwards the volume of the gas increases and the rate of collision decreases, hence pressure decreases. [1] The piston stops moving when the pressure inside equals the pressure outside. [1]

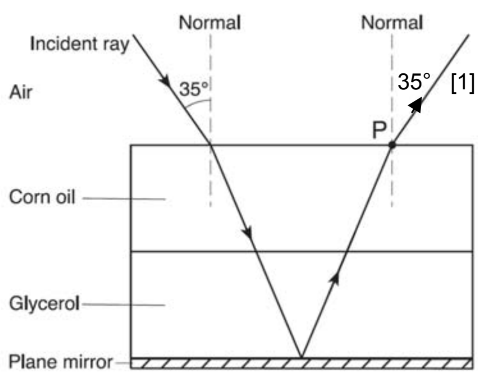
$$n = \frac{\sin i}{\sin r}$$

5 (a) $1.47 = \frac{\sin 35}{\sin r}$ [1]

$r = 23°$ [1]

(b) Both have the same refractive indices [1] therefore the speed of light does not change when it reaches the interface and no bending will be observed.[1]

(c)



(d) No. [1]
The incident ray from air can only enter the corn oil at max. 90 °, this will give a refracted angle = critical angle of corn oil. [1] But for total internal reflection to occur, the incident angle at P needs to be greater than the critical angle of corn oil. [1]

6 (a) positive charges on the inside and negative charges on the outside of the can. (equal number must be drawn.) [1]

(b) The can will be positively charged. [1] The excess electrons will move from the can to the earth. [1]

(c) No. [1] As metal rod and the hand are conductors of electricity, the electrons will flow from the rod to the hand and to earth and the rod will be neutral. [1]

7 (a)

$$\frac{1}{R_{//}} = \frac{1}{20} + \frac{1}{5}$$

$$= \frac{5}{20}$$

$$R_{//} = 4\ \Omega \quad [1]$$

$R_T = 2 + 4 = 6\ \Omega$ [1]

(b)

$$I_1 = \frac{V_T}{R_T}$$

$$= \frac{12}{6}$$

$$= 2.0\ \text{A} \quad [1]$$

$4\ I_2 = I_3$

$I_2 + I_3 = 5\ I_2 = 2.0$ A

$I_2 = 0.4$ A [1]
$I_3 = 1.6$ A [1]

8 (a) W_2 experiences a force toward W_1.
Or
W_2 experiences a force to the left. [1]

(b) W_2 experiences a force of attraction to W_1. W_2 also experiences a force of attraction toward W_3. [1]

However the force between W_2 and W_3 is smaller as the distance between W_2 and W_3 is larger than between W_1 and W_2 and the current in W_3 is smaller. [1]

The net force on W_2 is one of attraction toward W_1 [1]

but the magnitude is reduced due to the presence of W_3, as compared to the force experienced in Fig. 8.1. [1]

9 (a)
- Since power = voltage x current, a high voltage means a small current flows in the cable, so less power lost in the cable as thermal energy.
- Alternating voltages will produce a changing magnetic field which is needed for a transformer to work.

(b) Step-down transformer. [1]

(c) (i)

$$\text{Turns ratio} = \frac{V_P}{V_S} = \frac{25\ \text{kV}}{275\ \text{kV}} = \frac{1}{11}$$

Turns ratio is 1:11 [1]

(ii)

Power output	=	power input	
$275000 \times I_S$	=	400	
I_S	=	1.45×10^{-3} A	[1]

Assumption: transformer is 100 % efficient [1]

(d) Heating effect of the coils
or
Heating effect in the soft-iron core due to eddy currents [1]

(e) Combined resistance = 2 x (5000 x 0.0012) = 12 Ω [1]

Power loss = $I^2R = 40^2 \times 12$ [1] = 19200 W [1]

10 (a) Slip rings [1] and carbon brushes [1] correctly drawn and labelled.
Current is clockwise in coil. [1]

(b) Point Z. [1]
Point X indicates the max output when the coil is at a horizontal position with maximum cutting of the magnetic field lines.
Point Y indicates no output as the coil is in a vertical position whereby there is no cutting of magnetic field lines. [1]
When the coil is inclined as shown, there will be some cutting of magnetic field lines which is responsible for an output value between the max and zero. [1]

(c) The output graph shows a continuous curve – this is due to the continuous turning of the coil. [1]
The graph has positive and negative values at alternate phase – this is due the current changing direction every half cycle as the coil rotates in the magnetic field – effect of electromagnetic induction. [1m]

(d) The peak output value is halved [1] and the period is twice. [1]

Either

11 (a) A [1], the component of weight along the slope is greatest at A and friction has no effects on the skateboarder yet. [1]

(b)
$$\begin{aligned} GPE_A &= KE_B \\ mgh &= \tfrac{1}{2} mv^2 \\ v^2 &= 2\,gh \\ &= 2 \times 10 \times 1.8 \quad [1] \\ v &= 6.0 \text{ m/s} \quad [1] \end{aligned}$$

(c) (i) Energy lost = mg (1.8 – 1.6) = 54 x 10 x 0.2 = 108 J [1]

$$\text{Frictional Force} = \frac{\text{Energy lost}}{\text{Dist.}}$$

$$= \frac{108}{8.0} \quad [1]$$

$$= 13.5 \text{ N} \quad [1]$$

(ii)
$$\begin{aligned} \text{Energy needed at D} &= GPE_A + WD_f \\ GPE_D + KE_D &= GPE_A + WD_f \\ \tfrac{1}{2} mv^2 &= GPE_A - GPE_D + WD_f \\ 0.5 \times 54 \times v^2 &= 108 + 108 \quad [2] \\ v &= 2.8 \text{ m/s} \quad [1] \end{aligned}$$

OR

11 (a) Thermal energy needed to increase the temperature of 1 kg of the substance by 1°C (1K)

(b) So that the liquid can be heated up by convection. [1]
Hot liquid will expand and become less dense, moves up. Cool liquid on top is denser, sinks, to be heated up [1]

(c) As temperature of liquid rises, more energy is lost to the surroundings. [1]
Temperature will stop rising when the rate of thermal energy absorbed by liquid equals to rate of thermal energy given out to surroundings by the hot liquid. [1]

(d) Energy received by surroundings equals to energy given out to surroundings [1]

(e) $P\,t = m\,c\,\theta$
240 (16 x 60) = (6) c (10) [1]
c = 3840 J/(kg°C) [1]

(f) In latent heat of vaporization, more energy needed to break liquid bonds and move them much further apart. [1]
Energy also needed to lift molecules into atmosphere (work done against gravity and atmospheric pressure) [1]