2018 Secondary 4 Prelim Exam Physics 6091 Suggested Solutions

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
С	С	С	D	D	D	D	С	В	Α
Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
D	В	Α	D	D	В	В	В	Α	В
Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
Α	В	С	Α	С	С	В	D	С	В
Q31	C32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40
С	В	D	D	Α	D	С	A	Α	Α

Paper 2

Paper 1

Section A

1	(a)	Speed increases at a constant rate of 2.0 m/s ² .	
		For every 1s, the speed increases constantly by 2.0 m/s.	
	(b)	Car A – Straight line starting from 0 with a gradient of 2.0 (+value)	
		Car B – Horizontal line at 2.0 m/s (-value)	
	(c)(i)	$d = 0.5(t)(2.0t) = t^2$	
	(c)(ii)	$t^2 + 2t = 1000$	
		t = 30.6 s = 31 s (ecf)	
2	(a)	5.0 N acting on ball C and 5.0 N acting on ball A in the opposite direction.	
	(b)	• 0.66 N ± 0.06 N.	
		Correct arrow direction	
		Correct diagram	
	(C)	Fr = ma	
		0.50N = (0.10 kg)(a)	
		$a = 5.0 \text{ m/s}^2$	
	(d)	As the resultant force is not too large and due to inertia, ball A continue	
		to move in the general forward direction.	
3	(a)(i)	$M = W \times d$	
		= 10 N x 1.0 m = 10 Nm	
	(a)(ii)	Taking moment about P,	
		CW moment = ACW moment	
		10 N x 1.0 m + 15 N x 2.5 m = Q x 1.8 m + 5 N x 0.5 m	
		Q = 25 N	

 As air is pumped in, the number of air particles per unit volume in the balloon increases 	
 As air is pumped in, the number of air particles per unit volume in the balloon increases 	
 Frequency of collision (between air particles and the wall of the balloon) will increase (the force of each collision remains constant as temp, hence speed is constant) As the pressure inside the balloon is greater than the pressure outside, there is a net outward force (which cause the balloon to expand.) 	
5 (a) John's <i>loss</i> in GPE is equal to gain in KE and work done against friction	_
(b) GPE = mgh = $(70kg)(10 N/kg)(5.0m) = 3500 J$	+ +
(c) work done against = net loss in Energy = loss in GPE – gain in KE = $3500 \text{ J} - \frac{1}{2}(70 \text{ kg})[(8.0 \text{ m/s})^2 - (2.0 \text{ m/s})^2]$ = 1400 J	
 (d) Since there is less water, the frictional force is larger, resulting in a larger work done against friction. (Hence there is lesser gain in KE and hence the velocity will be lower than 8.0 m/s.) 	
6 (a) $Q = mc\Delta\theta = (100g)[2.4 J/(gK)](50°C - 17°C)$ = 7900 J	
(b) $Q_{freeze} = mI_f = (0.100 kg)(4.2 \times 10^5 J/kg) = 42000 J$ time = 100 s / 7900 J x 42000 J = 530 s t = 630 s (ecf)	
(c) In real life the difference between the temperature of the glycerol and ice (its surrounding) is getting smaller, hence the rate of heat transfer will decrease with time.	
7 (a) The angle of incidence of ray 2 at S is 0°	+
(b) $\sin c = 1/n = 1/1.47$ $c=42.8^{\circ}$	
(c) Ray 1: The angle of incidence of ray 1 in the Pyrex glass < critical angle of Pyrex Ray 3: It is travelling from an optically less dense to an optically denser medium	•
8 (a) i. Loudness decreases as amplitude of sound decreases with time.	

		ii. pitch remains constant as frequency of sound remains constant as				
	(b)					
	(a)					
		\leftrightarrow				
0	(2)	As the dust particle comes into contact with the rods, electrons from the				
9	(a)	rods are transferred to the dust particles				
	(b)(i)	As the metal plates are positively charged, the dust particles are				
	(~)(.)	attracted to it as unlike charges attract.				
	(b)(ii)					
		negatively				
		charged dust				
		particle				
		<u>↓</u> /				
		charged				
		metal				
		plate				
10	(a)(i)	• As the current enters the solenoid, the solenoid becomes an				
		electromagnet.				
		• The bolt, which is made of magnetic material iron, becomes an				
		Induced magnet.				
	(2)/;;)	IT IS ATTRACTED TO THE SOLENOID. To push the iron holt back to its original position (the striker plate) when				
	(a)(II)	the switch is open				
	(a) (iii)	The magnetic force generated by the solenoid is weaker and				
	(, (,	its magnitude is less than the tension of the spring.				

10	(b) (i)	 Current in CD produces a magnetic field, interacts with the magnetic field of the permanent magnet. Combined magnetic field at the bottom of CD is stronger than at the top of CD. This produces a resultant upward force on CD 	
	(b)(ii)	Between 0 and t ₁ : Direction of F is upward. Hence positive value. Between t ₁ and t ₂ : Direction of F is downward. Hence negative value	
		Magnitude of F is constant, because current in CD and external magnetic field strength are constant.	
	(b)(iii)	As the coil CDEF spins, it cuts the magnetic field lines. There is a rate of change of magnetic field lines linking the coil. By Faraday's law, an induced emf in CDEF. By Lenz's law, the direction of the induced emf in the coil will produce a	
		magnetic field to oppose the magnetic field linkage created by the rotating coil with the external magnetic field.	

Section B

11	(a)(i)	the cross sectional area of the wire is inversely proportional to its potential difference.	
	(a)(ii)	As the cross sectional area of the wire is doubled when wire K and wire L is used, the p.d is halved.	
	(a)(iii)	V = 0.11/2 = 0.055 A	
		Or V = 0.028 x 2 = 0.056 A	
		Or AV = constant = 0017	
		V = 0.053 A	
	(a)(iv)	Can choose any of the wires	
		R = V/I	
		= 0.85 /2.0 = 0.425 Ω	
		$R = \rho L/A$	
		$p = 0.423 \times (0.002 \times 10^{\circ})/0.030 = 1.7 \times 10^{\circ} 2211$	
	(a)(v)	Rheostat is needed to change the effective resistance in the circuit so that current can be kept constant.	
	(b)(i)	$V_{XY} = 0.50 V$	
		Emt = 0.50 + 1.00 = 1.50 V	
		Alternatively,	

		I = 1.00/0.200 = 5.00 A V= RxI = 5.00 x 0.300 Ω = 1.50 V
		(allow ecf from (i))
	(b)(ii)	Total effective resistance across XY decreases.
		Hence, by potential divider principle, more of the e.m.f. will go towards YZ.
		Or
		Total effective resistance of whole circuit decrease, hence current flowing through YZ is higher.
	(b)(iii)	Voltmeter has a very high resistance/infinite resistance.
12	(a)	Direction is from D to A.
	(b)	 The induced current in the coil produces a magnetic field that interacts with the external magnetic field, producing an unbalanced resultant magnetic field that give rise to an induced force By Lenz's law, the direction of the force will oppose the motion that is producing it.
	(c)	emf 0 $1/4$ $1/2$ $3/4$ $1/2$
	(d)(i)	Np/Ns = Vp/Vs 1/5 = 6V/Vs Vs=30 V Voltage across one bulb = 15 V
	(d)(ii)	A direct supply current produces a steady magnetic field hence there will be no change in magnetic flux/field lines linking the secondary coil and no e.m.f and current is induced

	(d)(iii)	This is to ensure that the current is kept low so that it reduces the
		power loss due to heating in the cables. (P loss = $I^2 R$)
13E	(a)(i)	The earth wire is not connect. If there is leakage of current, the current will not be earth. When the user touches the kettle, he will experience electric shock.
	(a)(ii)	P = VI (100W) = (240V)(I) I = 0.42 A or 0.417 A fuse = 1 A
	(a)(iii)	 The red wire is the live wire which has to be connected to the fuse. When there is excessive current, it will melt the fuse thus disconnect the kettle from the high electrical potential.
	(b)	$P = V^{2}/R$ $100 W = (240V)^{2}/R$ $R = 576 \Omega$ $V = IR$ $110 V = I(576 \Omega)$ $I = 0.191 A$
	(c)(i)	 Electical fire may occur. Thinner wire has higher resistance, as air conditioner unit draws high current too, it will results in a lot of heat produced causing electrical fire to occur.
	(c)(ii)	Resistance per unit metre = $0.050 \Omega / (2.0)^2$ = 0.013Ω
13 O	(a)	$\lambda = 60 \text{ cm} / 3 = 20 \text{ cm}$
	(b)	3T = 30 s T = 10 s f = 1/T = 1/10s = 0.1 Hz.
	(c)(i)	There is a change in speed
	(c)(ii)	Perpendicular to the wave direction and continue from the incident wavefront. Scale: 0.80 cm representing 20 cm

(c)(iii)	$\lambda = 7.5 \pm 0.75$ cm (remember to multiply the scale)	
	$\lambda/2 = 3.75 = 3.8$ cm	
(d)(i)	Both have particles vibrating about a fixed point perpendicular to the direction of wave propagation.	
(d)(ii)	Continue to move in a straight line.	
	Not charged so no induced force	
(d)(iii)	Does not req a medium/ can be refracted or reflected/	
	speed in vacuum = 3.0 x 10 ₈ m/s	