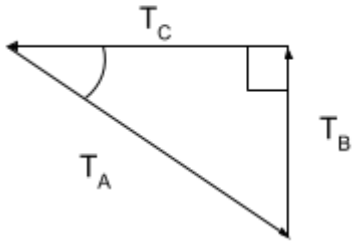
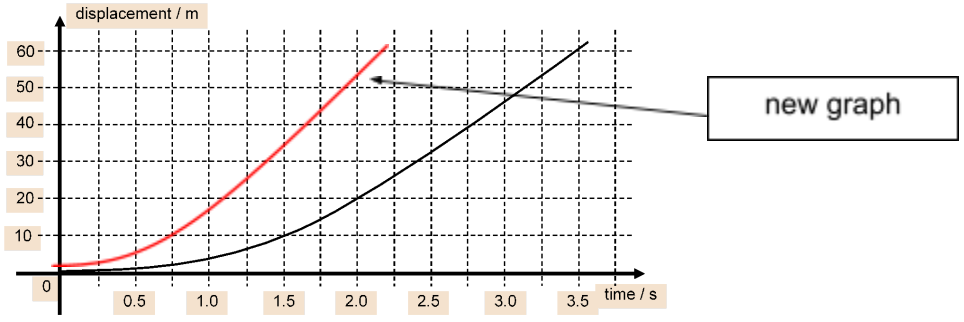
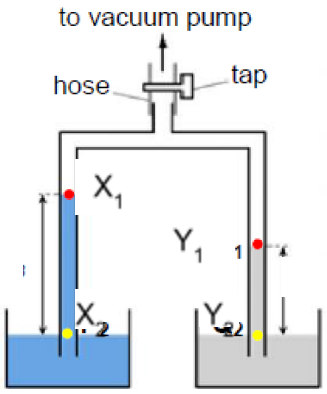
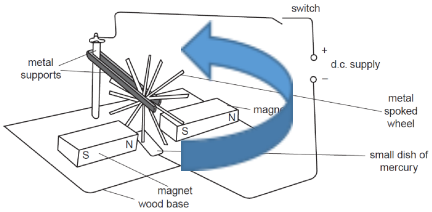
DUNMAN SECONDARY SCHOOL
SECONDARY 4 EXPRESS PHYSICS 6091
PRELIMINARY EXAMINATION 2021
SUGGESTED MARKSCHEME

PAPER 2 – SECTION A

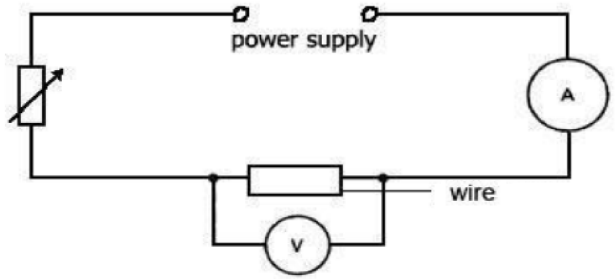
1(a)	The difference between a scalar quantity and a vector quantity is that a scalar quantity has only magnitude whereas a vector quantity has both magnitude and direction.	B1
1(b)	The vector quantity is displacement / velocity / acceleration / moment.	B1
1(c)	 T_A: Tension in string A T_B: Tension in string B T_C: Tension in string C 30° T_B = 400 sin 30° = 200 N (note: to determine based on diagram and can accept maths calculation) T_C = 400 cos 30° = 346 N (note: to determine based on diagram and can accept maths calculation)	B1 B1 B1 B1
2(a)	The gradient of the graph increases which indicates that the velocity is increasing.	B1
2(b)	Terminal velocity = (60 – 20) / (3.5 – 2.0) = 27 m/s (2sf)	M1 A1
2(c)	As it falls from rest, weight acts downwards, thus resultant force is acting downwards. As speed increases, air resistance also increases Resultant force acting downwards decreases to zero	 B1 B1
2(d)		A1
3(a)(i)	F_{net} = ma 4.0 - 0.80 = 2.0 a a = 1.6 m/s^2 1.6 = $\frac{v-u}{\Delta t}$	 M1

	$= \frac{v - 0}{5.0}$ v = 8.0 m/s	 A1
3(a)(i)	Since $F_{net} = 0$ when F balances the frictional force of 0.8 N, Based on Newton's Second Law, the acceleration becomes zero. Based on Newton's First Law, the box continues to move at a constant speed (of 8.0 m/s) in the same direction.	B1 B1
3(b)	Since F is the action force exerted by the boy on the box, the other force, F1, which is equal to F in magnitude, but acting in the opposite direction of F is the reaction force by the box acting on the boy. F1 is part of the action-reaction pair with F by Newton's Third Law.	B1 B1
4(a)(i)	kinetic energy at B = gravitational potential energy at A = mgh = 50 x 10 x (350 / 100) = 1750 J = 1800 J (2sf)	 M1 A1
4(a)(ii)	(½) mv^2 = 1750 OR 1800 v = 8.37 m/s = 8.4 m/s (2sf) OR v = 8.49 = 8.5 m/s (2sf)	M1 A1
4(b)(i)	energy lost due to friction = 50 x 10 x [(350 – 300) / 100] = 250 J	M1 A1
4(b)(ii)	work done against friction is 250 J force x distance = 250 J force = 250 / 15 = 16.7 N = 17 N (2sf) [Note: it is ok for this answer not to have unit N and allow ECF from 4(b)(i)]]	 A1
5(a)	Energy must be provided by external source to weaken the intermolecular force of attraction OR for the liquid molecules to gain internal potential energy in the liquid in order for it to become gas.	B1
5(b)	Total energy lost = energy lost by water during cooling + latent energy lost during freezing $= mc\Delta\theta + mL_f$ = 500(4.2)(30 – 0) + 500(330) = 228 000 J = 230 000J (2sf)	 M1 M1 A1
5(c)	The heated water near the heater at the bottom of the tank expands and rises due to decreased density. The cooler water from the top sinks as it has a higher density. This sets up a convection current until all water in the tank is heated.	B1 B1

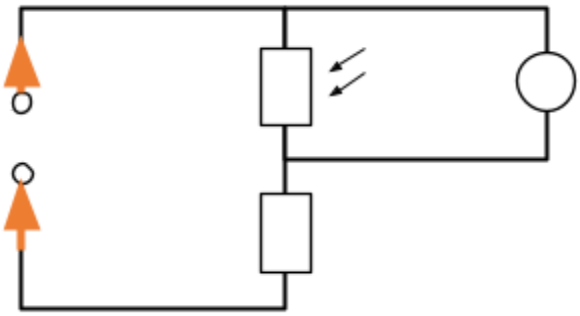
6(a)	 X_1 and Y_1 or X_2 and Y_2	B1
6(b)	$P_A = P_B$ $1.20 \times \rho_A \times g = 0.76 \times 13\,600 \times g$ $\rho_A = 8613 = 8600$ kg/m^3 (2sf)	M1 A1
6(c)	When the tap is opened, the **liquid levels in both tubes will drop** and **achieve the same height as the liquids in the containers**.	B1 B1
7(a)	Electrons are transferred from the pipe to the fuel during the rubbing action.	B1
7(b)	Spark might jump from the charged plane and ignite the fuel causing explosion.	B1 B1
7(c)	Metal is an electrical conductor (or has low resistance) which will allow electrons to flow through it from the aeroplane to the ground. OR aeroplane to be earthed.	B1 B1
8(a)	When the switch is closed, current will flow through the coil and the iron core becomes an electromagnet. The electromagnet will induce magnetism in the iron bolt. Hence, the electromagnet attracts the iron bolt, causing it to move to the left, allowing the door to be opened.	B1 B1
8(b)	Increase the current / increase the number of turns on the coil / move the iron core closer to the iron bolt. [Any 2] The changes increase the strength of the electromagnet / Magnetic field is stronger closer the electromagnet (if change given is to move iron core closer to the iron bolt).	B1 B1
8(c)	Steel is a permanent magnet, hence there might be an issue for the steel bolt to close efficiently. As the steel bolt will remain attracted to the iron core when the switch is opened.	B2
9(a)	When the switch is closed, current will be able to flow through the metal spoked wheel and set up a magnetic field around it. This magnetic field will interact with the magnetic field of the magnet. This will interaction will produce a force that enables the wheel to turn.	B1 B1
9(b)		B1
9(c)	The force exerted on each spoke will cause the wheel to move a certain distance. Having a minimum of 8 spokes will allow the next spoke to maintain a close circuit.	B1

	OR to allow momentum for the wheel to rotate continuously.	

Paper 2 – SECTION B

10(a)(i)	High current caused overheating of the wire ($P = I^2 R$ heating) and wire A melted. [Note: do not accept voltmeter range is from 0 to 3.50 V and hence could not measure more than 3.50 V. Under working conditions, the voltmeter used would be able to.]	B1
10(a)(ii)	The p.d. increases proportionally / uniformly / constantly / linearly as current increases.	B1
10(a)(iii)	R = V/I = 0.20 / 1.60 = 0.125 = 0.13 Ω (2sf)	 A1
10(a)(iv)	Workable circuit to vary current and get p.d. (e.g. use of rheostat or potentiometer or variable power supply) Correctly drawn circuit symbols and connections with ruler Able to measure accurately current (ammeter) in wire and p.d. (voltmeter) across wire  	B1 B1 B1
10(a)(v)	Approximately 2.40 A (same current for series connection). Sum of p.d. in both wires in series is about 2.00 V (wire A) + 0.50 V (wire B) = 2.50 V (dry cell).	B1 B1
10(b)(i)	Strong wind causes cooling, reducing resistance and hence, by V = IR, reduces the p.d. OR Conduction of heat away from wire by the wind also leads to lower temperature	B1
10(b)(ii)	Fig 10.3 is now able to measure p.d. of currents previously not measurable in Fig. 10.2 OR Fig. 10.3 shows smaller increase in p.d. as current is increased than Fig. 10.2	B1

11(a)	The earth wire will connect the metal casing to the ground/earth. When live wire touches the metal casing it will trigger a high current flowing to the ground/earth. This high current will cause the fuse to melt or blow, and this will disconnect the high voltage to the computer. This prevents the user from electric shock. (Note: do not accept answer if the students explain how the earth wire and fuse work independently.)	B1 B1 B1
11(b)	A thinner wire will heat up faster due to higher resistance. This might cause the wire to melt and cause fire from occurring.	B1 B1
11(c)(i)	$N_S / N_P = V_S / V_P$ N_S = (15.0 / 240) x 3600 = 225 turns	M1 A1
11(c)(ii)	For 100% ideal transformer (zero loss), $I_P \times V_P = I_S \times V_S$ I_P = (1.2 x 15.0) / 240 = 0.075 A (2sf)	M1 A1
11(c)(iii)	Increase the magnetic field strength by concentrating magnetic field lines inside it OR Ensures good magnetic flux linkage between primary and secondary coil	B1
12E (a)	Air is optically less dense than water. Hence, speed of light increases as it gets from water to air, causing the light to bend away from the normal	B1 B1
12E (b)(i)	Angle of incidence is 0^o OR incident ray lies along the normal. OR The ray hits the surface perpendicularly.	B1
12E (b)(ii)	n = 1 / sin c c = $\sin^{-1}$ (1 / 1.56) = 39.9 ^{o}	A1
12E (b)(iii)	Total internal reflection will occur. It is because the ray is travelling from an optically denser medium to a less dense medium and the angle of incidence is greater than critical angle.	B1 B1
12E (b)(iv)	n = c / v v = c / n = 3.0 × 10^8 / 1.56 v = 1.92 x 10^8 m / s = 1.9 x 10^8 m / s (2sf)	M1 A1
12E (b)(v)	v = f x wavelength wavelength = v / f = 3.0 x 10^8 / 6.5 x 10^{14}	M1

	= 4.62 x 10^{-7} m = 4.6 x 10^{-7} m (2sf)	A1
12O (a)	Rate of flow of electric charge.	B1
12O (b)	 15 V LDR 50 Ω V + -	B1
12O (c)(i)	I = V / R = 15 / (800 + 50) = 0.0176 A = 0.018 A (2sf)	M1 A1
12O (c)(ii)	V = IR = 800 x 0.0176 OR = 800 x 0.018 = 14.1 V = 14 V (2sf) = 14.4 V = 14 V (2sf)	M1 A1
12O (d)	Voltmeter reading will slowly increase. When light intensity decreases, resistance of LDR will increase and hence the voltage will increase.	B1 B1
12O (e)	Voltmeter reading will decrease. With the light intensity remaining constant, resistance of the circuit will increase with the 100 Ω fixed resistor. Hence, current in the circuit will decrease. This will cause the voltage across the LDR to decrease.	B1 B1