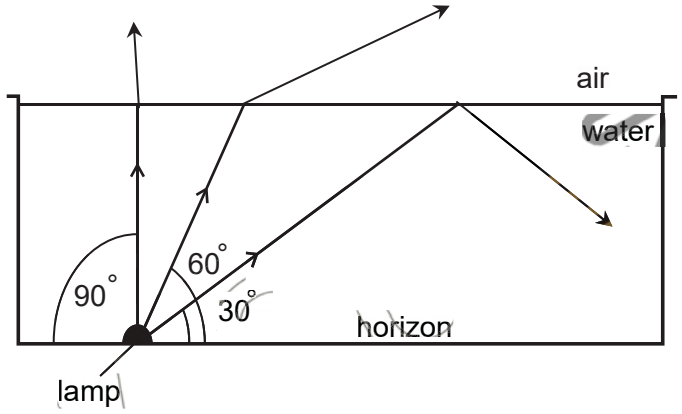
2019 PRELIMINARY EXAMINATION
PHYSICS 6091

PAPER 1

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

PAPER 2

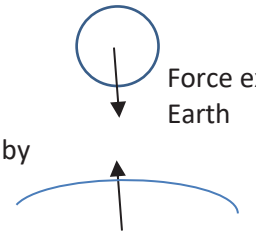
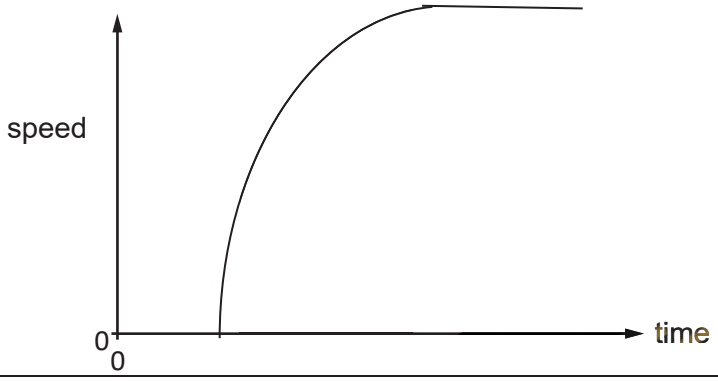
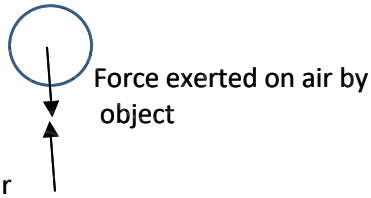
Qn	Suggested solution	Mark	Remark
1(a)(i)	Acceleration = (5.6 – 2.2)/1.35 – 0.20 = 2.3 ms^{-2}	[2]	Evidence (two coordinates and tangent shown on graph
(ii)	Total distance = area under v-t graph ≅6.0 m	[2]	Calculation showing how area is derived
(b)(i)	▪ Air resistance increases with increasing speed as GPE is converted to KE.From F_{net} =ma, the net force acting on the ball decreases and it will undergo deceleration [1] ▪ The wall's resistance is constant. From $F_{resistance}$ = ma, the deceleration is a constant. [1]	[2]	
	Total	6	
2(a)	Weight = (1.3– 0.38)x10 Nkg^{-1} = 9.2 N	[1]	No marks for no working/wrong unit
	Line sloping from 13.0 N to 3.8 N Line parallel from t-axis from 4.0 s *Time taken for the fuel to blast off = 0.92 kg/0.23 kgs^{-1} = 4.0 s *working optional	[1] [1]	
(c)(i)	0.5 s	[1]	
(ii)	Resultant force acting at 2.5 s = 16.7 – 7.3* N [1] = 9.4 N [1]	[1] [1]	*value as per graph drawn
	Total	6	
3(a)(i)	Pressure exerted on the floor in Fig. 3.2 is greater than that in Fig. 3.1. Weight of the boy and chair, W_r is distributed over two legs compared to over four legs plus the shoes, so from P =W/A, the smaller area of contact in Fig.3.2 will result in a larger pressure.	[2]	

(a)(ii)	The line of action of the combined weight of the student and the chair is in line with the pivot [1]in Fig. 3.2. If he tilted further backwards, the line of action of this combined weight is not in line with the pivot [1] and this creates a resultant anticlockwise moment about the two hind legs[1].	**[3]**	Unstable equilibrium not accepted unless accompanied by explanation
(b)(i)	Anticlockwise moment of plank = 230 N x 1.3 m = 299 Nm = 300 Nm (2s.f.) [1]	**[1]**	
3(c)	The painter's weight created a net clockwise moment about the right hand support / the clockwise moment > 299 Nm	**[1]**	
	Total	**7**	
4(a)	It is the incident angle in the optically less dense medium which resulted in a refracted angle of 90° in the optically less dense medium	**[2]**	
(b)		**[2]**	Three rays correctly drawn [2] Two rays correctly drawn [1]
(c)	$n_{water} = 1/ \sin c_{water}$ $= 1/ \sin 49^o$ $= 1.33$	**[2]**	
(b)	▪ Within the circular patch – the light is incident at the surface at an angle of incidence $\delta 49^o$ and emerge out of the water [1]. ▪ Beyond the circular patch, the light is incident on at the water surface at an angle of incidence > 49°, resulting in total internal reflection. Light does not emerge out [1]. The edge of the circular patch thus represents the boundary between total internal reflection and no total internal reflection.	**[2]**	
	Total	**7**	
5(a)	Gas A	**[1]**	
(b)	$P_B + (0.08)(13600)(10) = 120000$ [1] PB = 1.09×10^5 Pa or 1.1×10^5 Pa. [1]	**[2]**	
(c)	H_1 will drop and H_2 will rise [1] resulting in a bigger difference between the two levels . Black surfaces are good absorbers of radiation/thermal energy. Gas A receives the thermal energy, resulting in a pressure build-up [1]. This increase in pressure pushes the level of mercury down in the left arm and up in the right arm, thus increasing the height difference between the two levels. [1]	**[3]**	

	Total	**6**	
6(a)	Even heating throughout / Take less time / speed up heating / even temperature[1] Heating the water from below creates a convection current due to the displacement of cooler denser water at the top by warmer but less dense water below[1] This continuous movement of water will ensure that thermal energy is evenly spread throughout and time taken for heating the water is less.	**[2]**	
(b)(i)	Molecules vibrate vigorously on receiving thermal energy. The increase in the amplitude of molecular vibration increases the spacing between the molecules[1]. Layers of liquid molecules are moving faster and move further apart[1]. Both factors produce an increase in the volume of water. Thus water expands.	**[2]**	
(ii)	Level X drops and then rises [1] Copper expand faster than water. The increase in volume of copper will lower the water level first. After the copper ceases expanding, the continual expansion of water will raise its level.	**[2]**	
	Total	**6**	
7(a)	▪ When a high current passes through, the iron core is magnetized because a magnetic field is set up in the coil [1] ▪ The magnetized core then attracts the iron lever, rotating it about the pivot and lifting it up [1] ▪ This causes the springy metal to be released as it is pulled by the spring and this causes the contacts to be opened. ▪ The spring also pulls the springy metal towards the reset button thereby pushing it outwards[1]	**[4]**	
(b)	The workings will not be affected as the core is still magnetized and attraction still take place.	**[1]**	
	Total	**5**	
8(a)	P = 1.8 x 1.2 = 2.16 W	**[1]**	
(b)	E = Pt = 3 x 16 x 60 x 60 = 172800J	**[2]**	
(c)	▪ The a.c. flowing in the coil in the charging unit produces a changing magnetic field in coil Y, which is concentrated by the soft-iron bar [1]. ▪ When the brush unit is placed on the charging unit, the changing magnetic flux linking coil Y and X produces the induced e.m.f. [1] ▪ The induced a.c. current in coil X will charge the cell connected to it	**[3]**	
(d)	Because both the brush and charging unit are completely covered by plastic, the casing will not be 'live' even if there is a fault and	**[1]**	

	hence the earth wire is not necessary and a two-pin plug will suffice.		
	Total	**7**	
9(a)	Difference is in the direction of oscillation of the particles. Longitudinal wave, the particles oscillate parallel to the direction of wave propagation Transverse wave, the particles oscillate perpendicular to the direction of wave propagation.	**[1]**	
(b)(i)	S-wave / Secondary Wave and surface waves	**[1]**	
(ii)	When the ground move up, the weight, due to its inertia, will tend to remain in its state of rest and move downwards. The spring is stretched[1] When the ground move down, the stretched spring will release its stored elastic potential energy and pull the weight up [1]	**[2]**	
(c)(i)	4×10^3 km [1 m] 1m – clear marking on the graph	**[2]**	
(ii)	Average speed = 4000 km / (7x 60)s = 9.52 kms^{-1}	**[2]**	
(iii)	Average speed = (7.8 – 3.2)x 10^3 km÷(20 mins 20 s – 10 min 40 s) = 4.6 x 10^3 ÷ 9 min 40 s = 7.93 kms^{-1}	**[2]**	
	Total	**10**	
10(a)(i)	▪ The rotation of the magnet induces each end of the ▪ soft iron to alternate in polarity at every half rotation. [1] ▪ The strength of the magnetic flux in the soft iron increases and decreases as the magnet move towards and away from the soft iron. [1] ▪ The coil experiences a constant rate of change of magnetic flux linkage with this alternating polarity and changing magnetic field strength. This induces an alternating e.m.f hence an alternating current in the coil. [1]	**[3]**	
(ii)	more turns in coil/ thicker wires/ stronger magnet/ faster rotation	**[2]**	
(b)(i)	To reduce power loss because with high voltage and low current is lowered [1] This reduces power loss through joule heating/heating effect by the current [1]	**[2]**	
(ii)	N = 25/400 = 0.0625 (1:16)	**[1]**	
(iii)	P = VI 800W = 240 x I I = 800/240 = 3.33 A	**[2]**	Calculation shown that warrant correct

	Fuse : 4 A		selection of fuse rating.
	Total	**10**	
Either 11(a)	Charging without contact between a conductor and a charged body/ separation of charges in a conductor when the conductor is placed in an electric field	**[1]**	
(b)(i)	▪ P induces positive charges on Q on the side closer to P/repels electrons on Q to the right side leaving positive charges induced on the side closer to P[1] ▪ P and Q are attracted to each other as opposite charges attract[1].	**[2]**	
(ii)	▪ P and Q will be repelled away from each other as like charges repel [1]. ▪ Both P and Q will be displaced at the same angle from the vertical and remain in that equilibrium position [1]. ▪ Both spheres have the same amount of charge and the force of repulsion are action-reaction pair forces [1]	**[3]**	
(c)(i)	EITHER Electrons from the hair are stripped off/transferred from the hair atoms and deposited on the balloon [1].The excess electrons on the balloon cause it to become negatively-charged [1] OR Friction between the hair and the balloon generates thermal energy[1]. The weakly-attracted electrons of the atoms of the hair gain this thermal energy to escape and deposited on the balloon thereby making it negatively-charged [1]	**[2]**	
(c)(ii)	EITHER The negatively-charges on the balloon and the polarized atoms on the hair. Opposite charges attracts, causing the hair to be attracted to the balloon. **OR** The negatively-charged balloon attracts the positively-charged hair / induces the positively-charge on the hair closer to the balloon. As opposite charges attract, the hair is attracted to the balloon.	**[1]**	
(iii)	Charges accumulated on the balloon will be retained on the balloon in and around the region where the balloon is being rubbed.	**[1]**	
	Total	**10**	

11OR (a)(i)	 Earth and object exerts an equal and opposite pull on earth other. The force exerted on the object is the weight. The object exerts an amount of force equal to this weight on the Earth.	**[1]** **[1]**	
(b)(i)		**[1]**	
(ii)	 At terminal velocity, object exerts a force on the body of air as it passes through it. The body of air exerts an amount of force equal in magnitude and opposite in direction to this force.	**[1]** **[1]**	
(c)(i)	It is a point on or outside a body where the whole weight of the body appears to act.	**[1]**	
(ii)	From $mgh = ½ mv^2$ $h = ½ (5.6)^2 \div 10$ $= 1.57$ m [1] Height of CG above water = 1.57 + 4.00 = 5.57 m [1]	**[2]**	
(iii)	From $v = \sqrt{(2gh)}$ $= \sqrt{(2 \times 10 \times (5.57 - 0.8)}$ [1] $= 9.8\ ms^{-1}$ [1]	**[2]**	
	Total	**10**	