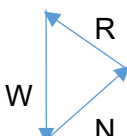
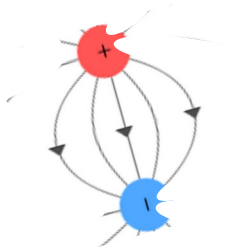
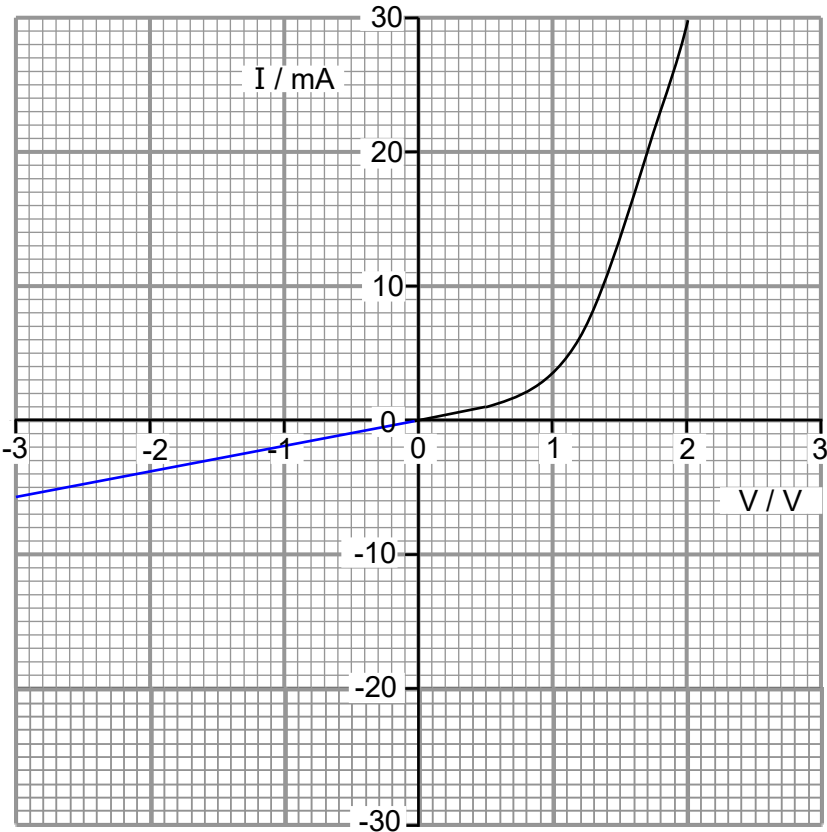


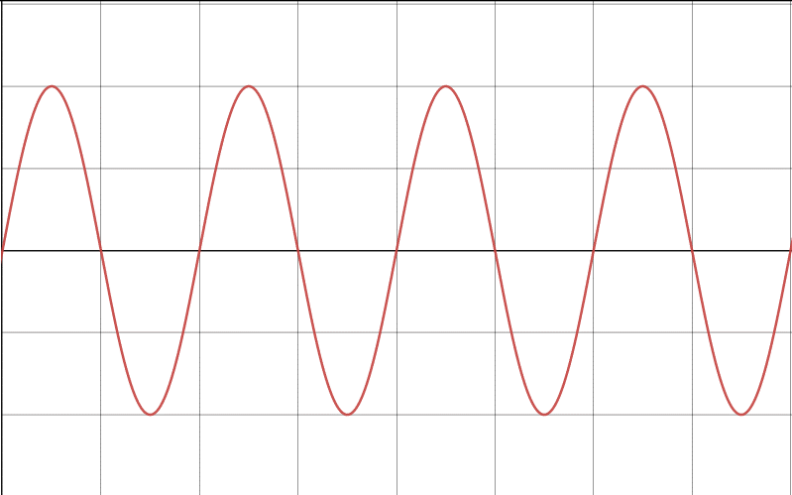
Section A

Qn	Answer	Marks
1a	force of <u>sled and boy</u> on slope that is <u>equal in magnitude to N</u> (and opposite in direction).	B1
1b	As velocity increases, the <u>resistive force increases</u> . His <u>resultant force will decrease</u> since the forward force is a constant. Therefore, his <u>acceleration will decrease</u> .	B1 B1
1c	<u>Lie down</u> on the sled to make himself more streamlined. <u>Bend lower</u> to reduce his surface area exposed to air resistance. Accept: Go up higher the slope / increase weight / push harder to give an initial acceleration	Any 1 B1
1d	- correct diagram - arrows showing correct direction of force  $R = 350 \text{ N}$ (345 – 355 N)	C1 C1 A1
2a	<u>Pressure on the floor in Fig. 2.1 is smaller than in Fig. 2.2</u> because in Fig. 2.1, the boy is sitting on four legs of the chair compared to two in Fig. 2.2. For the <u>same force</u> , a <u>larger contact area will produce smaller pressure</u> , since $p = F/A$. Reject: surface area / area	B1 B1
2b	The <u>line of action of the combined weight</u> acting at the CG is <u>lying outside the base</u> of the chair (on the right side of the pivot). This causes an <u>clockwise moment</u> since there is a <u>perpendicular distance between the line of action of the combined weight and the pivot</u> , causing instability.	B1 B1
2c	$p = 0.05 \times 13\,600 \times 10 + 100\,000$ $= 107\,000 \text{ Pa}$ (or 110 000 (2sf))	B1 for hpg A1
3a	Ball loses gravitational potential energy as it falls and gains kinetic energy. On impact with the floor, some kinetic energy is converted to thermal and sound energy to the surroundings.	B1 B1
3bi	$GPE = 1.5 \times 10 \times (2.2 - 0.4)$ $= 27 \text{ J}$	B1 for height A1
3bii	power = $27 / 0.6$ $= 45 \text{ W}$	A1

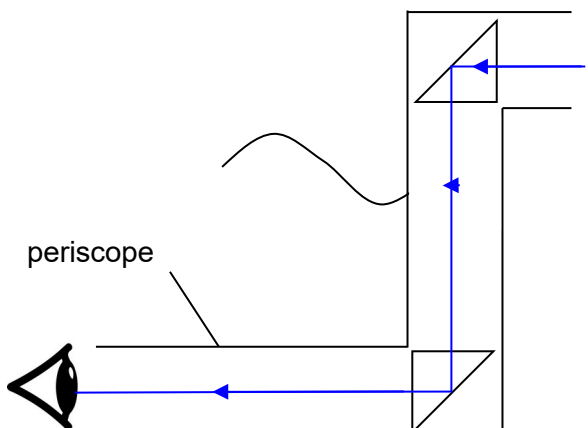
Qn	Answer	Marks
3c	Since $mgh = \frac{1}{2}mv^2$, the relationship between height and time is not linear. Or Since there is no air resistance, the acceleration is constant. Therefore, the velocity increases with time.	A1
4a	- The gas molecules are in <u>continuous</u>, <u>random motion</u>, <u>colliding</u> with the inner surface of the balloon. - An average <u>force is exerted</u> by the molecules on the inner surface of the balloon during the collisions. The <u>force per unit area</u> gives rise to the pressure exerted by the molecules on the inner surface of the balloon.	B1 B1
4b	- There are less air molecules in the chamber. There will be <u>less bombardments</u> / <u>collisions of the air molecules</u> on the outer surface of the balloon. External pressure decreases. - Pressure inside balloon is higher than pressure outside.	B1 B1
5(a)	visible light / ultra-violet / X-rays / gamma rays	B1
(b)	- scanning of luggages at airports OR - scanning of the human body (for broken bones or tooth decay) OR - checking for tiny flaws in heavy metal equipment or aircraft OR - radiation therapy to kill cancer cells - destruction or mutation of living tissues and cells	Any 1 B1
(c)	Time taken for pulse to be emitted and return = $0.05 - 0.02$ ms = 0.03 ms $v = \frac{2d}{t}$ $1500 = \frac{2d}{0.03/1000}$ $d = 0.0225 \text{ m}$	C1 C1 A1
6(a)	 - curved field lines drawn symmetrical - correct arrow direction	M1 M1

Qn	Answer	Marks
(b) (i)	negative sphere repels electrons and positive sphere attracts electrons to move from bottom layer of sand to top layer	B1
(b) (ii)	negatively charged sand grains and positively charged sticky paper on the side nearer to the sand grains / positively charged sphere cause electrostatic forces of attraction	B1
(c)	$V = \frac{W}{Q}$ $5000 = \frac{2.0}{Q}$ $Q = 0.00040 \text{ C (or } 0.000400 \text{ C)}$	C1 A1
7(a) (i)	graph is a curve / the values of I are not directly proportional to V	B1
(ii)	decreases	B1
(iii)	 straight line extended from line between 0 and 0.5 V to a maximum of (-3,-5)	M1

Qn	Answer	Marks
(b)	From graph when $I = 20 \text{ mA}$, $V = 1.7 \text{ V}$ $R = \frac{V}{I}$ $= \frac{1.7}{20/1000}$ $R = 85 \Omega$	C1 A1
(c)	- brightness decreases (to zero when slider is at A) - resistance of AJ decreases causing <u>p.d. across AJ</u> to decrease <u>p.d. across LED</u> decreases	B1 B1
8ai		B1
8aii	Period, $T = 4 \times 2$ $= 8 \text{ ms}$ $= 8 \times 10^{-3} \text{ s}$ Frequency $= 1 / T$ $= 1 / (8 \times 10^{-3})$ $= 125 \text{ Hz}$	C1 A1

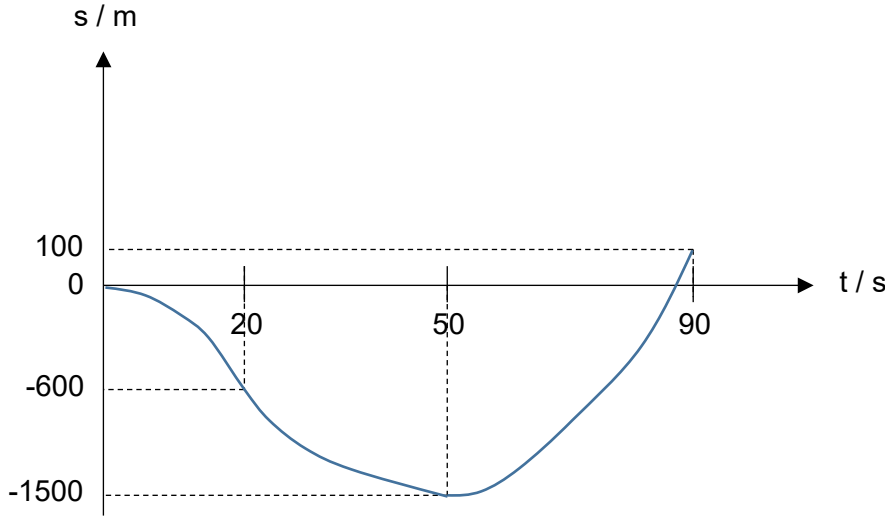
8aiii	 Amplitude doubled Frequency doubled	B1 B1
8bi	$V_P I_P = V_S I_S$ $100 \times 0.4 = 200 \times I_S$ $I_S = 40 / 200$ $= 0.20 \text{ A}$	C1 A1
8bii	- The changing magnetic flux generated by the primary coil is unable to <u>link</u> to the secondary coil (the further away from the primary coil, the weaker the magnetic field) to induce a significant current. Or - Magnetic field lines are unable to reach and <u>cut</u> the secondary coil	B1

Section B

Qn	Answer	Marks
9	ratio of speed of light in vacuum to speed of light in the medium	B1
(a)(i)		
(ii)	borosilicate glass	B1
(iii)	Angle of incidence at CD = $90^\circ - 50^\circ$ = 40° $n = \frac{\sin r}{\sin i}$ $1.52 = \frac{\sin r}{\sin 40^\circ}$ $r = 77.7^\circ$	C1 A1
(b)	$n = \frac{1}{\sin c}$ $= \frac{1}{\sin 31.3^\circ}$ $= 1.92$ Flint glass	C1 A1
(c) (i)	 periscope • light rays drawn vertical and horizontal, 90° to each other • correct arrow direction	B1 B1
(ii)	• <u>angle of incidence</u> in glass of 45° is <u>greater</u> than <u>critical angle</u> of 31.3° • light ray travelling from <u>optically denser</u> glass to <u>optically less dense</u> air	B1 B1

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Qn	Answer	Marks
10a	Fuse – a thin wire that melts when excess current flows through it and breaks the circuit. It is connected to the live wire. Circuit breaker – consists of an <u>electromagnet</u> that breaks the circuit when excessive current flows through it. Earth wire – low potential wire connected to the metal body of an appliance that allows excess current to flow when the appliance becomes live.	Any 1 (can also be switch, double insulation, three pin plug)
10bi	$600/230 + 50 \cdot 3/230 + 1200 \cdot 2/230 + 20 \cdot 15/230$ $= 15 \text{ A}$	M1 for any 2 correct sets of calculation A1
10bii	The <u>range of operating currents</u> for the appliances is <u>too wide</u> . For appliances that draw less current such as the standing fan or refrigerator, it can be dangerous if an electrical fault occurs and the appliance overheats before the fuse can melt.	M1 M1
10ci	AB ↑ CD ↓	A1 Force must be drawn on coil
10cii	Fleming's left-hand rule	A1
10ciii	When <u>AB rotates clockwise past its vertical position</u> due to inertia, the <u>split ring commutator will switch contacts</u> with the carbon brush <u>nearer to the south pole</u> of the magnet. The <u>current will now flow from A to B</u> and the <u>force acting on AB will be downwards</u>, causing AB to continue rotating clockwise.	A1 A1

Qn	Answer	Marks
11Ea	Rate of change of displacement	B1
11Eb	- From $t = 0$ s to $t = 20$ s, car is moving with a <u>constant acceleration in the negative direction</u> of 3 m s^{-2} / velocity increases at a constant rate in the negative direction. - From $t = 20$ s to $t = 50$ s, it is moving with a <u>constant deceleration in the negative direction</u> of 2 m s^{-2} / constant negative acceleration in the negative direction / velocity decreases at a constant rate in the negative direction. - From $t = 50$ s to $t = 90$ s, it is moving in the <u>opposite / positive direction</u> with <u>constant acceleration</u> of 2 m s^{-2} / velocity increases at a constant rate in the opposite / positive direction.	B1 B1 B1
11Ec	acceleration of car, $a = (v - u) / t$ $= [0 - (-60)] / (50 - 20)$ $= 60 / 30$ $= 2 \text{ m/s}^2$ deceleration = -2 m/s^2	C1 A1
11Ed	<u>Area</u> under the velocity-time graph	B1
11Ee	 Award 1 mark each for correct shape of graph for the 3 time intervals, no need labelling - From $t = 0$ s to $t = 20$ s, displacement = $\frac{1}{2} \times 20 \times 60$ = 600 m (negative direction) - From $t = 20$ s to $t = 50$ s, displacement = $\frac{1}{2} \times 30 \times 60$ = 900 m (negative direction)	A1 A1

	From $t = 50 \text{ s}$ to $t = 90 \text{ s}$, displacement = $\frac{1}{2} \times 40 \times 80$ = 1600 m (positive direction)	A1
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[illegible]

Subtract from the total score if incorrect [up to 2 marks]:

- ⌚ s.f. [up to 1 mark]
- ⌚ units [up to 1 mark]

4E Pure Physics GE2 P1 (6091) 2022

1	2	3	4	5	6	7	8	9	10
B	A	B	C	A	A	C	B	C	C
11	12	13	14	15	16	17	18	19	20
D	A	D	C	C	C	B	B	D	B

S4E Phy 6091 P2 GE2 2022
ANSWER SCHEME

21	22	23	24	25	26	27	28	29	30
B	D	D	D	A	B	C	D	A	B
31	32	33	34	35	36	37	38	39	40
C	C	D	A	A	B	B	C	B	C