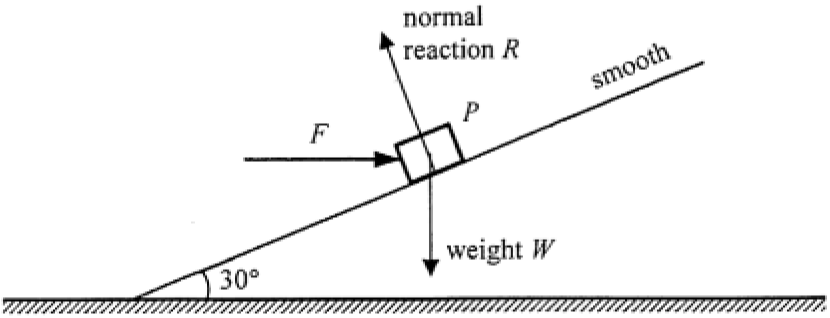
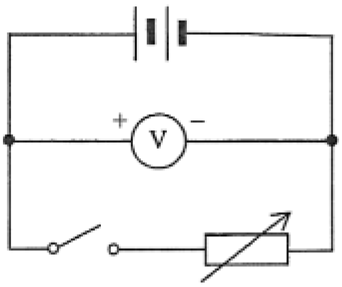
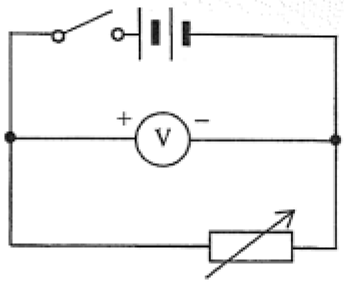
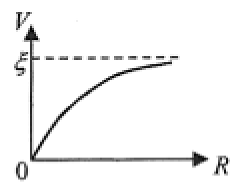
2024 DSE Physics Sample Paper 1B (Marking Scheme)

1.	(a) $Pt = ml$		
	$l = \dfrac{150 \times (5\times60)}{0.016}$	1M	
	$= 2812500 \text{ J kg}^{-1} \approx 2810 \text{ kJ kg}^{-1}$	1A	
		2	
	(b) $C\,(100-22) = m_w c_w\,(22-20)$		
	$C = \dfrac{0.100 \times 4200(22-20)}{(100-22)}$	1M	
	$= 10.76923 \text{ J °C}^{-1} \approx 10.8 \text{ J °C}^{-1}$	1A	
		2	
2.	(a) (i) 	1A 1A	Forces R(or N) and W(or Mg) correctly indicated and labell
		2	
	(ii) $R\cos 30° = W = Mg$ and $R\sin 30° = F$	1M	$M = 10$ kg; $Mg = 98.1$ N
	$F = Mg \times \tan 30° = 56.63806 \text{ N} \approx 56.6 \text{ N}$	1A	For $g = 10 \text{ m s}^{-2}$, $57.735027 \text{ N} \approx 57.7 \text{ N}$
	$N = R = \dfrac{Mg}{\cos 30°} = 113.27612 \text{ N} \approx 113 \text{ N}$	1A	$115.470054 \text{ N} \approx 115 \text{ N}$
	Or $R = W\cos 30° + F\sin 30°$ and $W\sin 30° = F\cos 30°$	1M	
		3	
	(b) (i) $g\sin\theta = 9.81 \sin 30° = 4.905 \text{ m s}^{-2} \approx 4.91 \text{ m s}^{-2}$	1A	5 m s^{-2} for $g = 10 \text{ m s}^{-2}$
		1	
	(ii) Decrease	1A	

3.	(a) $\frac{1}{2}mv^2 = mgh$		
	$= (50)(9.81)(1.5)$	1M	
	$= 735.75 \text{ J} \approx 736 \text{ J}$	1A	For $g = 10 \text{ m s}^{-2}$, K.E. = 750 J
		2	
	(b) (i) Kinetic energy and potential energy (of the athlete) change to elastic potential energy (of the trampoline).	2A	
		2	
	(ii) $\bar{F}d = mgh + mgd$ [Or $\bar{F}d = \frac{1}{2}mv^2 + mgd$]	1M	
	$\bar{F} = \frac{50(9.81)(1.5+0.40)}{0.40}$		
	$= 1839.375 + 490.5$		
	$= 2329.875 \text{ N} \approx 2330 \text{ N}$	1A	For $g = 10 \text{ m s}^{-2}$, $\bar{F} = 2375 \text{ N}$
	Or		
	$\bar{F} = \frac{1}{0.40}[735.75 + (50)(9.81)(0.40)]$	1M	
	$\approx 2330 \text{ N}$	1A	
		2	
4.	(a) Sound waves having the same frequency / wavelength and a constant phase difference (or always in phase / in opposite phase) are coherent.	1A	
		1	
	(b) (i) When the sound waves from A and B meet at various positions along OY, interference occurs.		
	At positions where the two waves are in phase, constructive interference occurs and gives maximum (loudness).	1A	
	At positions where the two waves are in opposite phase, destructive interference occurs and gives minimum (loudness).	1A	
		2	
	(ii) Any ONE: • due to background noise • due to reflection of unwanted sound from the wall, floor etc. • the intensity of sound waves from A and B reaching P are NOT equal as $AP < BP$ therefore cancellation is incomplete.	1A	
		1	
	(c) Path difference at Q $3\lambda/2 = 2.58 - 2.17$ $= 0.41 \text{ m}$	1M	
	$\therefore \lambda = 0.27333333 \text{ m} \approx 0.273 \text{ m}$ $v = f\lambda$ $= (1200)(0.273)$ $= 328 \text{ m s}^{-1}$	1A	Accept 327.6 m s^{-1} to 328 m s^{-1}
		2	

		Marks	Remarks
5.	(a) (i) Angle of incidence at A, $i_A = 90° - 30° = 60°$	1A	
		1	
	(ii) $n_g \sin c = n_c \sin 90°$	1M	
	$\Rightarrow \dfrac{n_g}{n_c} = \dfrac{1}{\sin c} \geq \dfrac{1}{\sin 60^\circ} = 1.1547005 \approx 1.15$	1A	
		2	
	(iii) Total internal reflection.	1A	
	For light rays from O with $\theta > 30°$, they will fail to undergo total internal reflection.	1A	
		2	
6.	(a) With superconductor / extremely low or nearly zero resistance,	1A	
	a much larger current flows in the coils producing a stronger magnetic field (with less heat loss due to the current flow).	1A	
		2	
	(b) P and Q : N (north pole)	1A	
	Repulsive force between like poles	1A	
		2	
	(c) (i) As the train is not in contact with the rail, there is no friction / interaction between the train and the rail, thus smoother due to less vibration.	1A	
7.	(a) 	1A 1A	Correct circuit with correct symbol Correct polarity Alternative circuit 
	Close the switch and record corresponding V and R readings	1A	
	Adjust the resistance R to lower/other value(s) and repeat the experiment	1A	
	Precaution: - First set the variable resistor to its maximum / a large value - Open the switch after each measurement - Any reasonable answer } Any **ONE**	1A	
		5	
	(b) Terminal voltage V delivered increases with increasing (loading) resistance R (or graphical representation)	1A	Accept: 
	$V = \xi \dfrac{R}{R+r}$ <u>OR</u> $V = \xi - \dfrac{\xi}{R+r} r$	1A	
		2	

8.	(a)	(i)	By Lenz's law, an e.m.f. would be induced such that it opposes the change, i.e. decrease of magnetic flux (into the paper) by driving an induced current (clockwise) in the coil / circuit (complete).	1A 1A		
					2	
		(ii)	$N\Delta\Phi = NBA$ $= (20)(0.3)(0.005)$ $= 0.03$ Wb	1A		
			$\xi = \frac{N\Delta\Phi}{\Delta t} = \frac{0.03}{0.5}$	1M		
			$= 0.06$ V (or 60 mV)	1A		
					3	
9.	(a)	(i)	β decay / beta decay OR ${}^{40}_{19}\text{K} \rightarrow {}^{40}_{20}\text{Ca} + {}^{0}_{-1}\beta$	1A		
					1	
		(ii)	Justified: the penetrating power of β radiation enables it to penetrate the body's organ / skin Or Not justified: the activity is low and is comparable to background radiation / β radiation is largely shielded by the human body	1A		
					1	
	(b)	(i)	$\frac{0.45 \times 0.012\%}{40.0} = 1.35 \times 10^{-6}$ (mole)	1A		
					1	
		(ii)	$k = \frac{\ln 2}{1.25 \times 10^9\ (3.16 \times 10^7)} = 1.754803 \times 10^{-17}\ (\text{s}^{-1})$	1M/1A		i.e. 5.545177×10^{-10} (year^{-1})
			Activity $= kN$ $= 1.754803 \times 10^{-17} \times (1.35 \times 10^{-6} \times 6.02 \times 10^{23})$ $= 14.261284$ (Bq) ≈ 14.3 (Bq)	1A		Accept 14.2 to 14.3 (Bq)
					2	

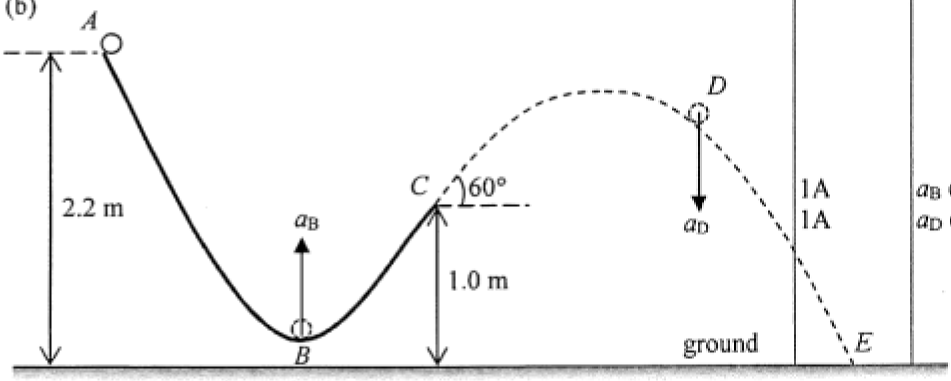
10.	(a) (i) (I) $pV = nRT$ $(1.0 \times 10^5)(6.0 \times 10^{-4}) = n(8.31)(300)$ $n = 0.0240674$ number of molecules $N = nN_A$ $= (0.0240674)(6.02 \times 10^{23})$ $= 1.448857 \times 10^{22} \approx 1.45 \times 10^{22}$	1M 1A
	(II) average kinetic energy of gas molecules $E_K = \frac{3}{2}\left(\frac{R}{N_A}\right)T$ $= \frac{3}{2}\left(\frac{8.31}{6.02 \times 10^{23}}\right)(300)$ $= 6.211794 \times 10^{-21}\text{ J} \approx 6.21 \times 10^{-21}\text{ J}$	1M 1A 4
	(ii) (I) N and E_K remain unchanged.	1A+1A 2
	(II) $E_K = \frac{1}{2}mc_{\text{r.m.s.}}^2$ $\frac{1}{2}m(600)^2 = \frac{1}{2}(\frac{1}{5}m)c_{\text{r.m.s.}}^2$ $\Rightarrow c_{\text{r.m.s.}} = \sqrt{5} \times 600$ $= 1341.6408\text{ m s}^{-1} \approx 1340\text{ m s}^{-1}$	1M 1A 2

11.

(a) $v_B > v_C > v_D > v_A$ — 1A

[1]

(b)



1A — a_B correctly marked

1A — a_D correctly marked

[2]

(c) (i) Gravitational potential energy is changed to kinetic energy from A to B, and — 1A

some kinetic energy is changed back to gravitational potential energy from B to C. — 1A

[2]

(ii) $\frac{1}{2}mv^2 = mgh$

$v^2 = 2(9.81)(2.2 - 1.0)$ — 1M

$v = 4.852216 \text{ m s}^{-1} \approx 4.85 \text{ m s}^{-1}$ — 1A

For $g = 10 \text{ m s}^{-2}$, $v = 4.89898 \text{ m s}^{-1} \approx 4.90 \text{ m s}^{-1}$
Accept 4.85 m s^{-1} to 4.90 m s^{-1}

[2]

(iii) Horizontal speed (at C) $= 4.85 \times \cos 60°$ — 1M
$= 2.426108 \text{ m s}^{-1} \approx 2.43 \text{ m s}^{-1}$

For $g = 10 \text{ m s}^{-2}$, horizontal speed $= 2.44949 \text{ m s}^{-1} \approx 2.45 \text{ m s}^{-1}$

Distance $= 2.43 \times t = 2.55 \text{ m}$ — 1M
$t = 1.051066 \text{ s} \approx 1.05 \text{ s}$ — 1A

Accept 1.04 s to 1.10 s

Or
Vertical speed (at C) $= 4.85 \times \sin 60°$ — 1M
$= 4.202142 \text{ m s}^{-1} \approx 4.20 \text{ m s}^{-1}$

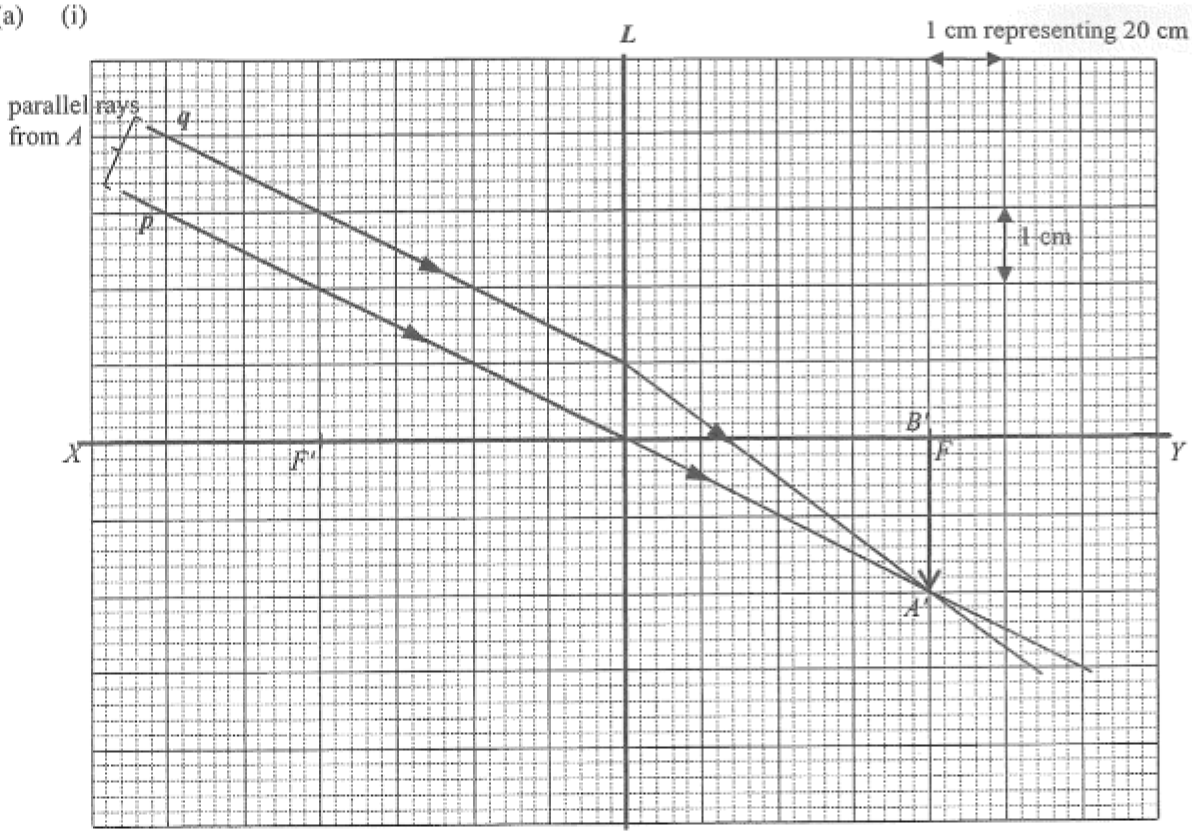
For $g = 10 \text{ m s}^{-2}$, vertical speed $\approx 4.24 \text{ m s}^{-1}$

$-1.0 = 4.20 \times t + \frac{1}{2}(-9.81)t^2$ — 1M
$t = 1.051066 \text{ s} \approx 1.05 \text{ s}$ — 1A

and $t = 1.041033 \text{ s} \approx 1.04 \text{ s}$

[3]

12. (a) (i)



refracted rays of p, q correctly drawn and	1A	
A' correctly marked.	1A	
image $A'B'$ correctly marked.	1A	
	3	
(ii) Image $A'B'$ of a distant object, say, a building is real and therefore it can be captured	1A	
by a screen (placed at the focal plane).	1A	
	2	
(b) (i) Ratio by similar triangles, $\frac{\text{height of } AB}{\text{object distance}} = \frac{\text{height of } A'B'}{\text{focal length /image distance}}$		
$= \frac{2}{4\times 20} = \frac{1}{40}$	1M	Accept height of image $A'B'$: 1.8 cm ~ 2.2 cm
$= 0.025$	1A	
	2	
(ii) $\frac{\text{height of } AB}{\text{object distance}} = \frac{1}{40} = 0.025$		
Height of $AB = 0.025 \times 200 = 5$ m	1A	
	1	