DSE Paper 1 Section A

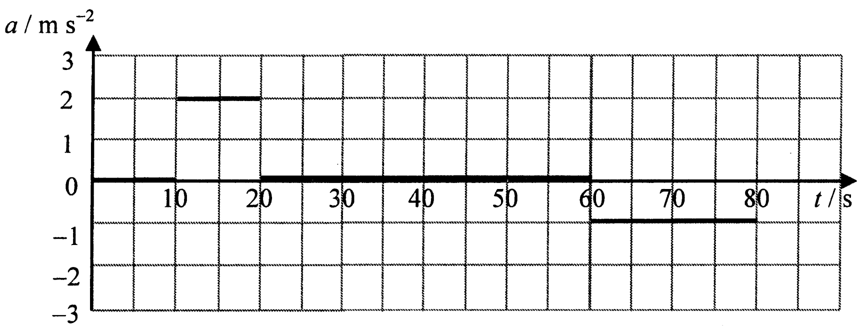
Question No.	Key	Question No.	Key
1.	D (83)	26.	A (58)
2.	A (55)	27.	D (22)
3.	C (75)	28.	D (68)
4.	A (54)	29.	B (28)
5.	B (37)	30.	B (57)
6.	D (45)	31.	D (54)
7.	C (26)	32.	A (61)
8.	C (54)	33.	C (56)
9.	B (91)		
10.	B (66)		
11.	B (29)		
12.	B (58)		
13.	B (74)		
14.	A (80)		
15.	C (78)		
16.	A (76)		
17.	B (53)		
18.	C (41)		
19.	A (76)		
20.	C (44)		
21.	D (43)		
22.	D (61)		
23.	B (53)		
24.	C (20)		
25.	D (48)		

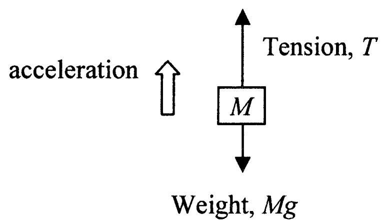
Note: Figures in brackets indicate the percentages of candidates choosing the correct answers.

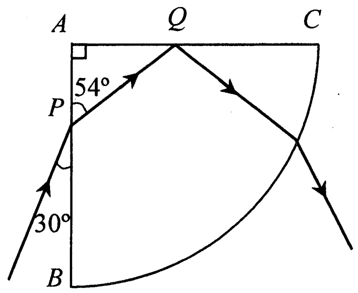
Paper 1 Section B

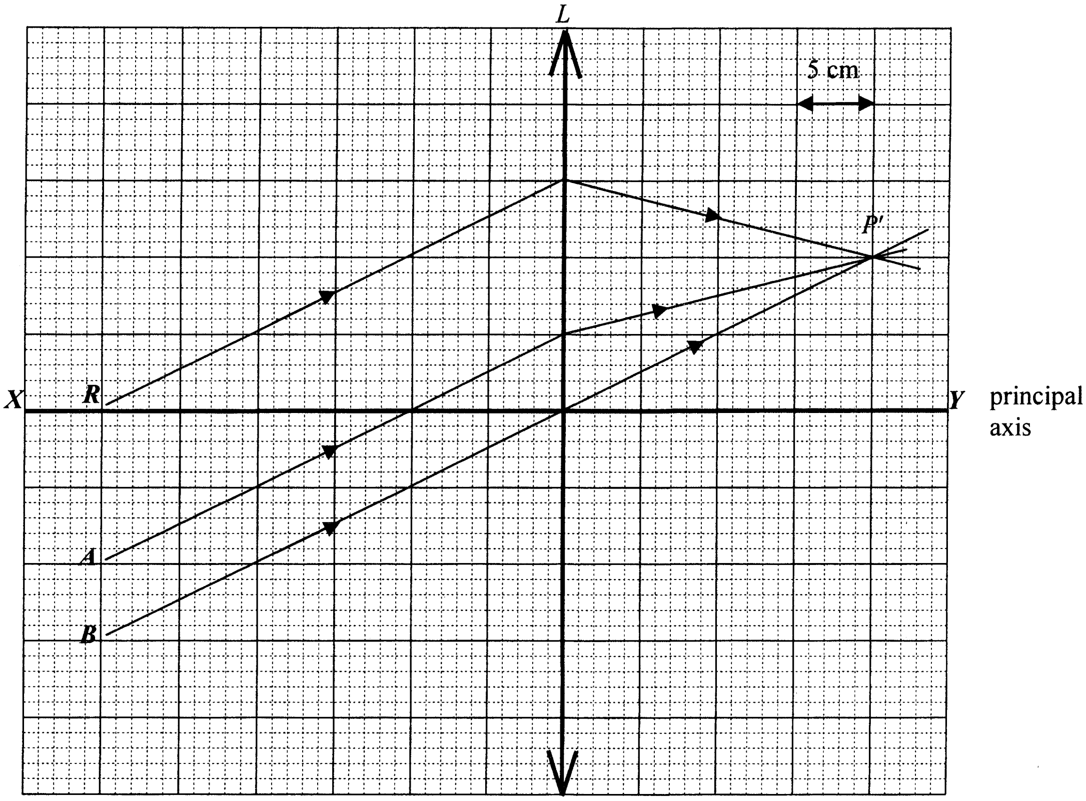
Solution	Marks	Remarks
1. (a) 5 min. (or 300 s)	1A	
	1	
(b) When the heater is switched off, its temperature is higher than the metal.	1A	
Or Heat continues to conduct to the metal until the same temperature is attained.	1A	
Or It takes time for them to attain the same temperature.	1A	
	1	
(c) (i) $mc\Delta T = IVt$	1M	
$(0.80)\, c\, (45 - 20) = (4.0)(12)(5 \times 60)$		
$c = 720\ \mathrm{J\ kg^{-1}\ {}^{\circ}C^{-1}}$	1A	
	2	
(ii) Experimental result is higher than the actual value.	1A	
Not all the energy supplied by the heater goes to the metal.	1A	
Or Some energy is absorbed by the heater itself and / or by the thermometer.	1A	
Or Heat loss to the surroundings.	1A	
	2	
(d) Glass is not a good conductor of heat.	1A	
Or Prolonged time is required for the whole glass block to attain uniform temperature.	1A	
Or No insulating material is perfect, so heat loss is appreciable.	1A	
	1	

Solution	Marks	Remarks
2. (a) (i) V_0 = total volume of air required at P_0, including the residual air in the ball		
$P_1V_1 = P_0V_0$	1M	
(156 kPa) (6000 cm^3) = (100 kPa) (V_0)		
$V_0 = 9360$ cm^3	1A	
∴ volume of air = V_0 − volume of the basketball	1M	
= 9360 cm^3 − 6000 cm^3		
= 3360 cm^3		
Alternatively:		
$\because n = \dfrac{PV}{RT}$		
$\dfrac{156V}{RT} - \dfrac{100V}{RT} = n'$	1M	
$\therefore V' = \dfrac{56V}{RT} \bullet \dfrac{RT}{100} = 3360 cm^3$	1M + 1A	
	3	
(ii) Number of strokes required = 3360 cm^3 ÷ 120 cm^3		
= 28	1A	
	1	
(b) Using kinetic theory, the pressure p is given by		
$pV = \dfrac{Nm\overline{c^2}}{3} = \dfrac{2N}{3} \bullet \dfrac{m\overline{c^2}}{2}$		
As the volume and the temperature (∝ kinetic energy of the air molecules) remain unchanged,	1A	
the increase in pressure is due to the increase of number of air molecules hitting the wall of the container per unit time.	1A	
Or Frequency of collision with the wall of container increases.	1A	
	2	

Solution	Marks	Remarks
3. (a) 0 – 10 s: constant / uniform acceleration	1A	
10 – 80 s: constant velocity / uniform motion	1A	
	2	
(b) (i) Car B. It is represented by the steepest slope between 10 s and 20 s for B.	1A	
$a = \dfrac{20-0}{20-10} = 2\ \text{m s}^{-2}$	1A	
	2	
(ii) 		
Uniform acceleration between 10 s and 20 s & uniform deceleration between 60 s and 80 s.	1A	
Or Either acceleration or deceleration correct.	1A	
All correct.	1A	
	2	
(c) (i) Total area of A by 20 s $= \dfrac{(10+20)}{2} \times 15 = 225$ m	1M	
Total area of B by 20 s $= \dfrac{(10 \times 20)}{2} = 100$ m		
Separation of A & B, $s_{AB} = 225\ \text{m} - 100\ \text{m} = 125$ m	1A	
	2	
(ii) Let B meet A at time $(20 + T)$ s,		
$(v_B - v_A) \times T = s_{AB}$	1M	
$(20\ \text{m s}^{-1} - 15\ \text{m s}^{-1}) \times T = 125$ m		
$T = 25$ s		
$\therefore B$ catches up with A at $t = (20 + 25)$ s $= 45$ s.	1A	
Or $s_A + v_A \times T = s_B + v_B \times T$		
$225\ \text{m} + 15\ \text{m s}^{-1} \times T = 100\ \text{m} + 20\ \text{m s}^{-1} \times T$	1M	
Or Accept using graphical method and	1M	
read the answer from the graph	1A	
	2	
(d) Let F_A and F_B be the driving forces developed by the engines of A and B respectively.		
Ratio of power developed by cars A and B,		
$P_A : P_B = F_A \times v_A : F_B \times v_B$	1M	
$= v_A^2 \times v_A : v_B^2 \times v_B$		
$= 3^3 : 4^3 = 27 : 64$	1A	
	2	

Solution	Marks	Remarks
4. (a) Arrows correct	1A	
Labels (tension / T, weight / Mg)	1A	
Or Either force correct and with label	1A	
All correct.	1A	
		
As M accelerates upward,		
$T - Mg = Ma$	1M	
i.e. $T = Mg + Ma$		
Greater tension needed ($T >$ original tension $= Mg$) and thus the spring extends further. i.e. M is closer to the bottom, smaller h in Figure 4.2	1A	
	4	
(b) Change in tension / reading = 2 N cm^{-1} × 0.5 cm = 1 N		
$\therefore\ T - Mg = 1$ N i.e. $T = 6$ N	1A	
$T - Mg = Ma$		
$1\text{ N} = \dfrac{5\text{N}}{\text{g}}\,a$ (accept $M = 0.5$ kg)	1M	
$a = \dfrac{1}{5}g$ or $0.2\,g$ (upward) (or $\dfrac{g}{5} = 2$ m s^{-2} or 1.96 m s^{-2})	1A	
	3	
(c) $a_Y = -0.5g = -g\cos\theta$	1M	
$\therefore\ \theta = 60° > 45°$, 'Landscape display' results.	1A	
Or When the phone is rotated 45° clockwise,		
$a_Y = -g\cos 45°$ or $-g\sin 45°$	1M	
$= -\dfrac{g}{\sqrt{2}} = -0.71\,g$ or -6.94 m s^{-2} (or -7.07 m s^{-2})		
'Landscape display' results as $a_Y = -0.5\,g > -0.71\,g$.	1A	
Or 'Landscape display' results as magnitude of $a_Y <$ that at 45°	1A	
	2	

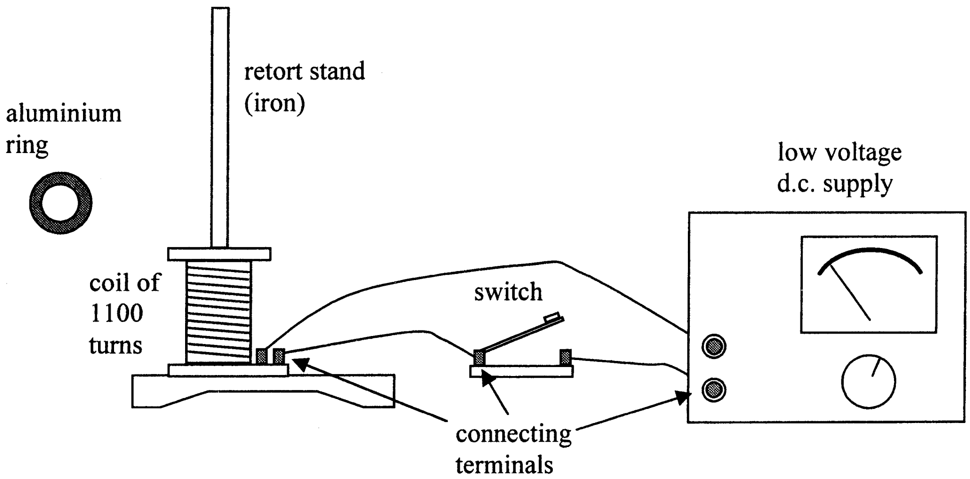
	Solution	Marks	Remarks
5.	(a) $n = \dfrac{\sin i}{\sin r}$ (or $n_1 \sin\theta_1 = n_2 \sin\theta_2$)	1M	
	$= \dfrac{\sin(90^\circ - 30^\circ)}{\sin(90^\circ - 54^\circ)} = \dfrac{\sin 60^\circ}{\sin 36^\circ}$		
	$= 1.47$	1A	Accept 1.47 to 1.50
		2	
	(b) $\sin c = \dfrac{1}{n} = \dfrac{1}{1.47}$	1M	
	$c = 42.7^\circ$ (for $n = 1.50$, $c = 41.8^\circ$)		
	Because incident angle at face AC (= 54°) > c (= 42.7°).	1M	
		2	
	(c) 		
	Reflected ray correct, $i = r$	1A	
	Emergent ray away from normal.	1A	
		2	
	(d) A spectrum is seen.	1A	
	Or splitting into different colours occurs.	1A	
		1	

Solution	Marks	Remarks
6. (a) Convex lens / Converging lens.	1A	
Refracted ray of A after passing through L bends towards the principal axis (or optical centre) / converges / bends inward / bends downward.	1A	
<u>Or</u> A real / an inverted image can be formed.	1A	
<u>Or</u> The object and the image are on opposite sides of the lens.	1A	
	2	
(b) (i)		
		
Rays A and B correctly completed.	1M	
P' correctly located.	1M	
	2	
(ii) $f = 20$ cm	1A	Accept 19 - 21 cm
	1	
(c) Ray R correctly completed.	1M	
	1	
(d) Use a screen to capture a/the (sharp) image (of a distant object).	1A	
The distance between the screen and the lens is f.	1A	
	2	

Solution	Marks	Remarks
7. (a) (i) tan $\theta = 0.38$		
$\theta = 20.8°$	1A	Accept 20.8° to 21°
	1	
(ii) $d \sin \theta = n\lambda$		
As $d = (\frac{1}{300} \times 10^{-3})$,	1M	
$(\frac{1}{300} \times 10^{-3}) \times \sin 20.8° = 2\lambda$	1M	
$\lambda = 5.92 \times 10^{-7}$ m (or 592 nm)	1A	Accept 5.90×10^{-7} m to 5.97×10^{-7} m
	3	
(iii) Smaller percentage error in x / the diffraction angle θ.	1A	
Or Larger x, percentage error decreases.	1A	
	1	
(b) Repeat the procedures with the pin on the left-hand side / the other side of the observer.	1A	
Take the average value of x obtained from both sides to calculate λ.	1A	
	2	

Solution	Marks	Remarks
8. (a) $P = \frac{V^2}{R}$		
$500 = \frac{220^2}{R}$		
$R = 96.8\ \Omega$	1A	Accept 97 Ω
	1	
(b) As the total resistance of the circuit for mode X is doubled,	1M	
total power dissipation $= \frac{V^2}{2R}$		
$= \frac{220^2}{2 \times 96.8} = 250$ W	1A	Accept 249 W for 97 Ω
Alternative method: As the voltage across each heating element (1 and 2) is halved, power dissipated in each of the heating element		
P_1 or $P_2 = \frac{500}{4} = 125$ W (since $P \propto V^2$)	1M	
Or P_1 or $P_2 = \frac{V'^2}{R} = \frac{110^2}{96.8} = 125$ W	1M	
Or $i = \frac{V}{R_1 + R_2} = \frac{220}{2 \times 96.8} = 1.14$ A		
P_1 or $P_2 = i^2R = 1.14^2 \times 96.8 = 125$ W	1M	
Total power dissipation $= 2 \times 125$ W $= 250$ W	1A	
	2	
(c) In mode Z, the equivalent resistance of the heating elements is the least as they are connected in parallel,	1A	
hence, under the same voltage, the total power dissipation is the largest since $P = \frac{V^2}{R}$.	1A	
	2	
(d) (i) For mode Z, the total power dissipated = 500 + 500 = 1000 W		
$I_z = \frac{P}{V} = \frac{1000}{220} = 4.55$ A	1M+1M	
Alternative method: $R_{eq} = \frac{96.8}{2}\ \Omega = 48.4\ \Omega$		
$I = \frac{220\ \text{V}}{48.4\ \Omega} = 4.55$ A	1M+1M	
Most suitable value of fuse = 5 A	1A	
	3	
(ii) Although the heater still works in either connection, it is dangerous for switch S to be fitted in wire B (neutral) as the heater / cable would still be live even when the switch was turned off.	1A 1A	1+1
	2	
(iii) Wire C (Earth).	1A	
Current would be conducted from the case through this wire to the Earth.	1A	
	2	

Solution	Marks	Remarks
9. (a) Connect the coil to the terminals of the d.c. supply via the switch (diagram).	1A	



Solution	Marks	Remarks
Put the aluminum ring on the top of the coil through the rod of the retort stand.	1A	
When closing the switch, the ring would shoot up the rod once,	1A	
as the aluminum ring experiences a changing magnetic field produced by the coil at the start,	1A	
According to Lenz's Law, eddy currents flow in the ring to oppose the change.	1A	
Or A magnetic field in the opposite direction generated by the eddy currents repels the magnetic field produced by the coil.	1A	
However, when the current and thus the resulting magnetic field are constant, the ring would fall back to the coil as eddy currents no longer flow.	1A	
	6	
(b) (i) The aluminum ring would float in the air.	1A	
	1	
(ii) The aluminum ring with a slit would remain stationary.	1A	
	1	

Solution	Marks	Remarks
10. (a) Alpha particles emitted can be stopped by the (thin) metallic casing. Or Shorter range / Lower penetrating power.	1A 1A	
	1	
(b) (i) $k = \frac{\ln 2}{t_{1/2}} = \frac{\ln 2}{87.74 \times 3.16 \times 10^7}$ $= 2.5 \times 10^{-10}\,\text{s}^{-1}$ or $7.9 \times 10^{-3}\,\text{year}^{-1}$ Activity $A = kN$ $= \frac{\ln 2}{87.74 \times 3.16 \times 10^7}(3.2 \times 10^{25})$ $= 8.000 \times 10^{15}$ (Bq)	1M 1M 1A	
	3	
(ii) Power = Energy per decay × Activity $= 5.5\text{ MeV} \times 8.000 \times 10^{15}\text{ Bq}$ $= 5.5 \times 10^6 \times 1.60 \times 10^{-19} \times 8.000 \times 10^{15}$ = 7040 W or 7.040 (kW)	 1M 1A	
	2	
(iii) Power $\propto$ Activity Activity $\propto N$ $\therefore$ Percentage of power left $= (\frac{1}{2})^{t/t_{½}} \times 100\%$ $= (\frac{1}{2})^{36/87.74} \times 100\%$ $= 75.25\% \approx 75\%$ Or Percentage / fraction of power left = 3/4	 1M 1A	
Alternatively: $N = N_0 e^{-kt}$ $\therefore$ Percentage of power left $= e^{-kt} \times 100\%$ $= e^{-(\ln 2 \div 87.74) \times 36} \times 100\%$ $= e^{-0.2844} \times 100\%$ $= 75.25\% \approx 75\%$	 1M 1A	
	2	