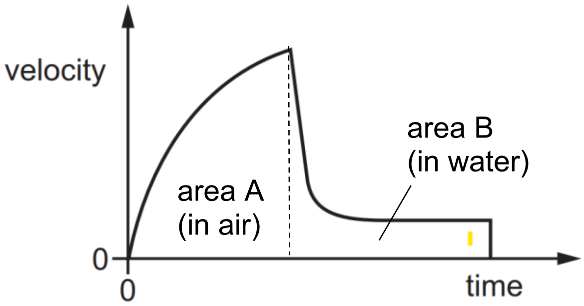
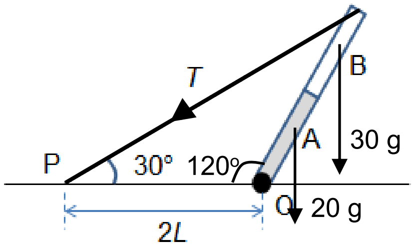
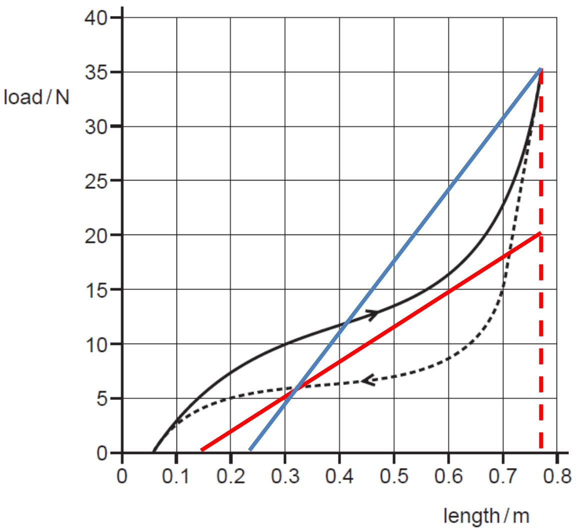
Anderson Serangoon Junior College 2025 JC2 H2 Physics P1 Prelim Mark Scheme

Paper 1 (30 marks) **E – Easy, A – Average, D – Difficult**

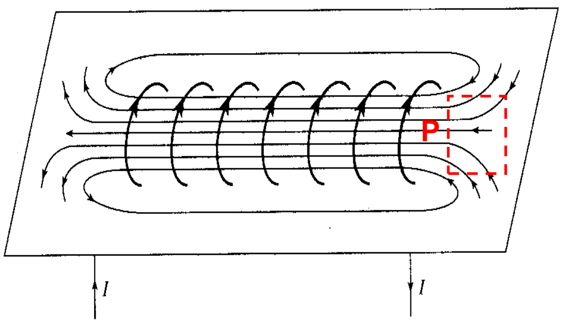
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
C	B	B	C	C	A	D	B	B	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
B	B	C	A	B	A	A	D	D	A
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
D	A	B	A	D	A	D	C	C	C

1	**C** Typical mass of a small car = 1500 kg Average KE of car = ½ (1500) (30^2) = 0.68 × 10^6 = 1 × 10^6 J (1 s.f.)	**E**
2	**B** For a fixed resistor, *R* = constant or ratio of *V*/*I* is a constant. The presence of a non-zero y-intercept indicates a systematic error. There is no random error as all points lie on the best fit line	**E**
3	**B** Using $s = ut + 0.5at^2$, as u = 0 and a = constant, Hence, $s \propto t^2$ $\frac{x}{L} = \frac{(0.5T)^2}{T^2}$ $x = 0.25L$	**A**
4	**C**  Terminal velocity was reached in water as shown by the horizontal line. Area A (distance travelled in air) > Area B (distance travelled in water). Rate of change of velocity in air (gradient of curve) is decreasing.	**A**

5	**C** Forces must be of the same type, opposite in direction and acts on different body.	**A**
6	**A** 90 kg min^{-1} = 1.5 kg s^{-1} $F = \frac{\Delta(mv)}{t} = v\frac{\Delta m}{t} = 20 \times 1.5 = 30\,\text{N}$	**A**
7	**D** Since the rod is in equilibrium, $\Sigma\tau = 0$ Taking moment about O, $T(2L\sin 30°) = 20g(\frac{L}{2}\cos 60°) + 30g(\frac{3L}{2}\cos 60°)$ $T = 269.78 = 270$ N 	**D**
8	**B**  WD to stretch = ½ × 0.5 × 35 = 9 J Energy recovered = ½ × 0.6 × 20 = 6 J Total WD in 1 cycle = Energy remaining in 1 cycle = 9 – 6 = 3 J Or by counting the no of squares in the area between the two curves Energy remaining = (5 × 0.1) × 6 = 3 J	**D**
9	**B** Constant force: Acceleration, a = constant Initial speed, u = 0 Therefore v = u + at = at P = Fv = Fat $P \propto t$	**A**

10	**D** The vertical component of the acceleration is the centripetal acceleration which is present since the particle is performing circular motion. The horizontal component of the acceleration causes the speed of the object to increase.	**E**
11	**B** On P, Since weight of mass is 1.0 N, *g* = weight/mass = 1.0 / 1.0 = 1.0 m s^{-2} On Q, Mass of 1.0 kg remains unchanged on Q. *g* = 1.0 x 10 = 10 m s^{-2} Weight of mass = 1.0 x 10 = 10 N	**E**
12	**B** $P = \frac{1}{3}\frac{Nm}{V} < c^2 >$ $P = \frac{1}{3}\rho < c^2 >$ $1.0 \times 10^5 = \frac{1}{3} \times 1.2 \times < c^2 >$ $\sqrt{< c^2 >} = 500 \text{ ms}^{-1}$	**E**
13	**C** For full cycle processes, the net change in internal energy is zero. $\Delta U = Q + W$ $0 = Q + [(-4.2) + (1.0 \times 10^5 \times (20.0 - 5.0) \times 10^{-6})]$ $Q = 2.7 \text{ J}$	**E**
14	**A** at equilibrium position, *x* = 0 mm amplitude = 50 mm period = 2.0 s Time shutter remained open *t*, from *x* = 0 s to *x* = 25 mm, $25 = 50 \sin \frac{2\pi t}{2.0}$ *t* = 0.17 s	**D**

15	**B** Air molecules undergo simple harmonic motion. As intensity is proportional to square of amplitude, amplitude of vibration of air molecules increases. Since $v_o = \omega x_o = (2\pi f)x_o$, maximum speed increases. Speed of wave travel of sound depends on the medium (density, temperature etc), not intensity.	**A**
16	**A** $\text{phase difference} = \frac{\text{path difference}}{\text{wavelength}} \times 2\pi + (\text{phase difference between sources})$ As light intensity at P is zero, the waves from R and S meet at P with phase difference of nπ, where n = 1, 3, 5, 7.... A: phase difference at P = 2π + π = 3π (correct) B: phase difference at P = ½ × 2π + π = 2π (incorrect) C: phase difference at P = 2π + ½π = 5/2 π (incorrect) D: phase difference at P = 2π + 0 = 2π (incorrect)	**A**
17	**A** $d \sin\theta = n\lambda$ For the same d and θ, $3\lambda_X = 2\lambda_{red}$ $3\lambda_X = 2 \times 720 \times 10^{-9}$ λ_X = 480 nm	**A**
18	**D** $F = qE$ $ma = qE$ $a = qE/m$ ⇒ Since *q, E, m* are constants, *a* is constant $v^2 = u^2 + 2ax$ $u = 0, v^2 = 2ax$ $KE = ½ m v^2 = ½ m(2ax)$ ⇒ *KE* is proportional to *x*.	**A**
19	**D** From definition, $V = \frac{W}{Q}$ From definition, $V = \frac{W/t}{Q/t} = \frac{P}{I}$, and $R = \frac{V}{I}$, hence $P = IV = I^2R = \frac{V^2}{R} = \frac{W^2}{Q^2R}$	**E**
20	**A** When S is closed, effective external resistance decreases, hence current (ammeter reading) increases, and cause voltmeter reading to decrease as p.d across internal resistance increases.	**A**

21	**D** $V_{out} = \frac{4}{2+4} \times E$ $\frac{V_{out}}{E} = \frac{2}{3}$	**A**
22	**A** Potential gradient $k = \frac{\Delta V}{\Delta \ell} = \frac{V_{xy}}{\ell_{xy}} = \frac{\left(\frac{0.50}{0.50+0.50}\right) \times 1.5}{0.96} = 0.781$ $E = k\, l_{XZ}$ = (0.781)(0.64)= 0.50 V	**D**
23	**B** 	**A**
24	**A** By Fleming's Left Hand Rule, force is directed out of the page. As θ tends to 0°, force becomes maximum, as wire becomes perpendicular to flux density (or as θ tends to 90°, force becomes minimum). Hence the force is a cosine function. $F = BIL$ where B and L are perpendicular to each other $= BI$ (2) (L/2 cos θ) $= BIL$ cos θ	**A**
25	**D** The wire segment can be split into 2 portions, the triangular segment and a rectangular segment. The magnitude of the rate of change of magnetic flux when triangle is entering or leaving the field, is increasing as the rate of change of area in field increases. Induced e.m.f. and hence induced current is increasing. At the rectangular segment, rate of change of flux is constant, thus induced emf and induced current is a constant.	**A**

26	**A** $\sqrt{\dfrac{2(I_o^2)+(2I_o)^2}{3}} == \sqrt{2}\,I_o$	**A**
27	**D** Frequency of violet light f = 7 × 10^{14}Hz (or wavelength of violet light λ = 400 nm) Estimated energy of a photon of violet light, $E = hf$ = (6.63 × 10^{-34}) (7 × 10^{14}) = 5 × 10^{-19} J	**A**
28	**C** Based on HUP, $\Delta x\,\Delta p \geq h$ (1.00 x 10^{-20}) (Δp) ≥ 6.63 × 10^{-34} Δp ≥ 6.63 × 10^{-14} Percentage change in uncertainty of momentum $= \dfrac{6.63\times10^{-14} - 4.00\times10^{-14}}{4.00\times10^{-14}} \times 100\%$ = 66%	**D**
29	**C** Since half-life of sample (33 years) is much greater than duration of decay (2 days), the activity of the sample is approximately constant during the duration of decay. From A = -dN/dt The number of decayed nuclei (dN) = A(dt) = 4.0 x 10^5 (2 x 24 x 3600) = 6.9 x 10^{10} OR $A = \lambda N$ $A_O = \left[\dfrac{ln2}{t_{0.5}}\right] N_O$ $4 \times 10^5 = \dfrac{N_O ln2}{33 \times 365 \times 24 \times 60 \times 60}$ $N_O = 6.00558 \times 10^{14}$ $N = N_O e^{-\lambda t}$ $N = N_O e^{-\left[\frac{ln2}{t_{0.5}}\right]t}$ $= (6.00558 \times 10^{14}) e^{-\left[\frac{ln2}{33\times365\times24\times60\times60}\right](2\times24\times60\times60)}$ $= 6.004889 \times 10^{14}$ Thus, $N_O - N = 6.91160 \times 10^{10} = 6.9 \times 10^{10}$ (2 s.f.)	**A**

30	**C** ${}^{a}_{b}X \rightarrow {}^{a-4}_{b}Y + {}^{4}_{2}He + 2\ {}^{0}_{-1}e$ Between X and Y, the number of neutrons differ, and the number of protons are the same. Hence, nucleus Y is an isotope of nucleus X.	**E**