Paper 1 – Multiple Choice Questions

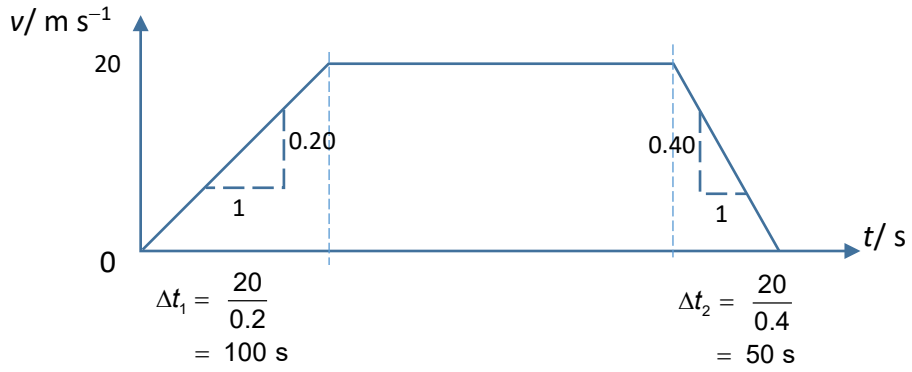
1	**Answer: D**
	Volume of car tyre ≈ $(0.3)^3 = 0.027 \approx 0.03\ m^3$

2	**Answer: B**
	N = kg m s^{-2} V = J C^{-1} = (kg m^2 $s^{-2)}$ (A s)$^{-1}$ N m V^{-1} = A s Option A: m s^{-2} Option B: A s Option C: A Option D: Unit of $\frac{V}{I}$ = kg m^2 s^{-3} A^{-1}

3	**Answer: D**
	Precise: The values are close to one another. Not accurate: The mean is not close to the true value.

4	**Answer: D**
	In between bounces, the ball experiences constant free-falling acceleration. The time of contact is taken to be similarly negligible. The duration of free-fall in between bounces decreases as the ball loses energy. The acceleration while in contact with ground decreases due to decreased normal contact force with the ground.

5	**Answer: C**



$\Delta t_1 = \frac{20}{0.2} = 100$ s

$\Delta t_2 = \frac{20}{0.4} = 50$ s

$s_1 = \frac{20^2}{2 \times 0.20} = 1000$

$s_2 = \frac{20^2}{2 \times 0.40} = 500$

$s_{const} = 3000 - 1000 - 500 = 1500$

$t_{const} = \frac{1500}{20} = 75$

$t_{total} = 100 + 75 + 50 = 225$ s

6	**Answer: D**

v = u + at
Time to reach highest point,
0 = 5.2 + (–1.62)t
t = 3.2 s

Time to return to starting point = 2 x 3.2 = 6.4 s

7	**Answer: A**
	For constant force hence constant acceleration, $v = u + at$ $p = mv$ $= mat$ (for $u = 0$) $\therefore$ *p is proportional to t* OR F = dp/dt = gradient of graph Gradient has to be constant

8	**Answer: D**
	$12 - 4\cos 37^\circ - 3\cos 53^\circ = (12 / 9.81)\, a$ $a = 5.7\ \text{m s}^{-2}$

9	**Answer: C**
	By Covservation of Linear Momentum, $(5000)(2.00) + (5000)(-1.00) = (5000 + 5000)\, v$ $v = 0.50\ \text{m s}^{-1}$ KE lost = Total KE initial – Total KE final $= ½ (5000) (2.00)^2 + ½ (5000)(-1.00)^2 - ½ (5000 + 5000) (0.50)^2$ $= 11\ 250$ J

10	**Answer: D**
	$\frac{W}{3} = kx \quad \Rightarrow \quad k = \frac{W}{3x}$ $W = kx' \quad \Rightarrow \quad W = \frac{W}{3x} x'$ $x' = 3x$

11	**Answer: C**
	Step 1: Draw vector triangle Step 2: Apply sine rule

12	**Answer: C**
	Apply Principle of Moments including moment caused by weight of ruler.

13	**Answer: A**
	By Principle of Conservation of Energy, Loss in GPE = Work done against resistive forces $mg\Delta h = F\Delta s$ $600 \times 9.81 \times \Delta h = 300 \times 1500$ $\Delta h = 76.4$ m $h = 80 - 76.4 \ = \ 3.5$ m

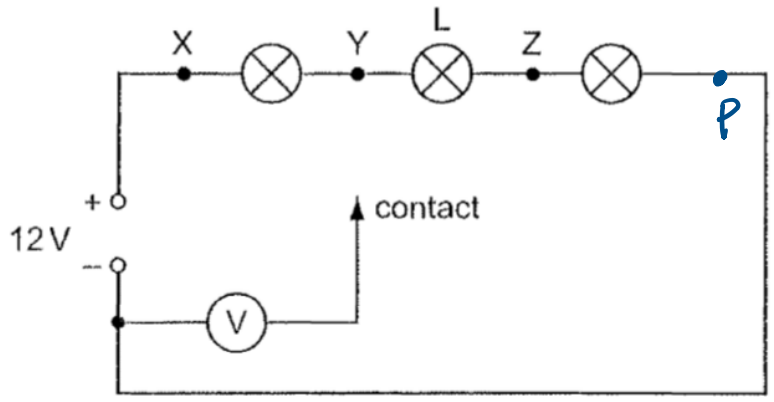
14	**Answer: C**
	Since car is travelling at constant speed, net force and acceleration is zero. $F_{Dr} = F_R \propto v^2$ Since $P = F_{Dr}\, v$ $P \propto v^3$ $\frac{P_2}{P_1} = \left(\frac{v_2}{v_1}\right)^3$ $P_2 = \left(\frac{40}{20}\right)^3 \times 23$ $= 184$

15	**Answer: A**
	Elastic Potential Energy is the area bound by the graph and the extension axis. Be careful of the axis !

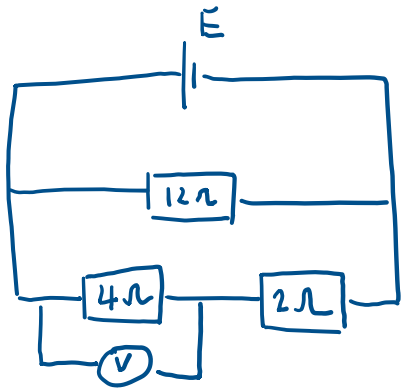
16	**Answer: B**
	Kinetic energy is scalar but linear momentum is vector.

17	**Answer: D**
	$F = \frac{GMm}{r^2}$ Be careful of the words “above the surface….”

18	**Answer: C**
	$E = QV$ To find total charge transferred during the period, Q = Area under I-t graph $= (60 \times 60) \times 0.5 + \frac{1}{2} \times (60 \times 60) \times 0.5$ $= 2700$ $E = 2700 \times 5.0 = 13500$ J

19	**Answer: C**
	It is easier to consider the “fixed” end of the voltmeter to be at point P (see below), and the other end at either X, Y or Z. When voltmeter is across XP and YP, the voltmeter is able to read the emf value given that there is a complete “path” via the voltmeter. When voltmeter is across ZP, the voltmeter is unable to read the emf value given that there is an incomplete “path” due to the broken filament in L. 

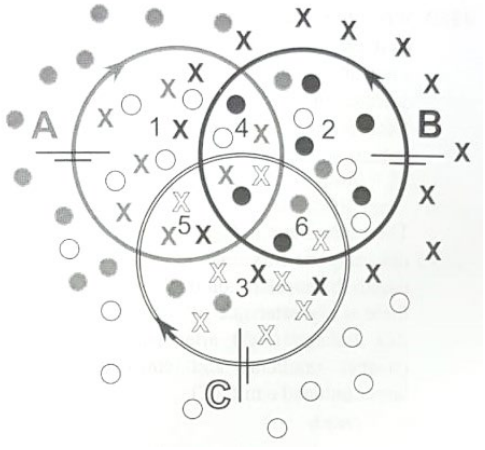
20	**Answer: D**
	Considering the diagram on the right and potential divider principle, $V = \frac{4}{4+2} \times E$ $= \frac{2}{3}E$



21	**Answer: C**
	$R = \frac{\rho L}{A}$

22	**Answer: A**
	Force on negative charge is in opposite direction to the field line. Tangential to line.

23	**Answer: D**
	Recall that uniform electric field exists between a set of parallel plates.

24	**Answer: B**
	Apply Right Hand Grip Rule on each coil separately. Mark the field direction inside and outside each coil accordingly. Areas where field direction points the same way will reinforce each other. 

25	**Answer: A**
	When there is no current flowing, balance reads a value of normal contact force equivalent to weight of the magnet. When there is current, the balance reads an additional force equals to the electromagnetic force, F_B. Hence, $F_B = (0.1446 - 0.142)g = 0.0026g$ (note that g here refers to free-falling acc) Since $F_B = BIL$ $F_B \propto I$ for given B, L $\frac{F_{B2}}{F_{B1}} = \frac{I_2}{I_1}$ $\frac{F_{B2}}{0.0026g} = \frac{5}{2}$ $F_{B2} = 0.0065g$ Since the current has changed direction, the new additional force reduces the original normal contact force, hence $(0.142 - 0.0065)g = 0.1355g$ The new balance reading is 135.5 g.

26	**Answer: A**
	By resolving v, the component perpendicular to B is $v\sin\theta$. Since $v\sin\theta$ is perpendicular to centripetal acceleration, the velocity in this plane is always constant.

27	**Answer: C**
	The nucleus is small compared to the atom.

28	**Answer: B**
	No change in proton number.

29	**Answer: B**
	For beta emission, one neutron is converted into a proton. No change in nucleon number.

30	**Answer: B**
	Background count = 10 Initial count rate, C_0 = 90 – 10 = 80 Count rate at 300 s, C_t = 30 – 10 = 20 Count rate is one-quartered. 2 x half life = 300 s Half life = 150 s