PHYSICAL SCIENCE: PAPER I

MARKING GUIDELINES

Time: 3 hours 150 marks

QUESTION 1

1.1
1.1.1 longitudinal wave ✓ (1)
1.1.2 dielectric ✓ (1)

1.2
1.2.1 True ✓ (1)
1.2.2 False ✓ (2)

1.3

1.3.1	~~A~~	B	C	D	✓✓	(2)
1.3.2	~~A~~	B	C	D	✓✓	(2)
1.3.3	A	B	~~C~~	D	✓✓	(2)

11 marks

QUESTION 2

2.1

2.1.1	Safety features	Scientific concept	Marks
	Slanted front window	Change in momentum	✓ (1)
	Seat belts and air bags	Resultant force	✓ (1)
	Soft metal body	Resultant force	✓ (1)
	Grip of tyres	Newton's 1st law	✓ (1)

(4)

2.1.2 Soft metal body: when involved in an accident, the time taken to stop the car is increased (to change the car's momentum), thus the rate of change of momentum is decreased, i.e. resultant force experienced by the passengers is decreased. ✓✓ (2)

2.2.1 11.25/100 = 0.1125l per km ✓ (1)

2.2.2 W = P x t
W = 74000 x 8.24
W = 609760 J✓✓ (2)

2.2.3

(a) The SUV because of its greater fuel consumption. ✓ (1)

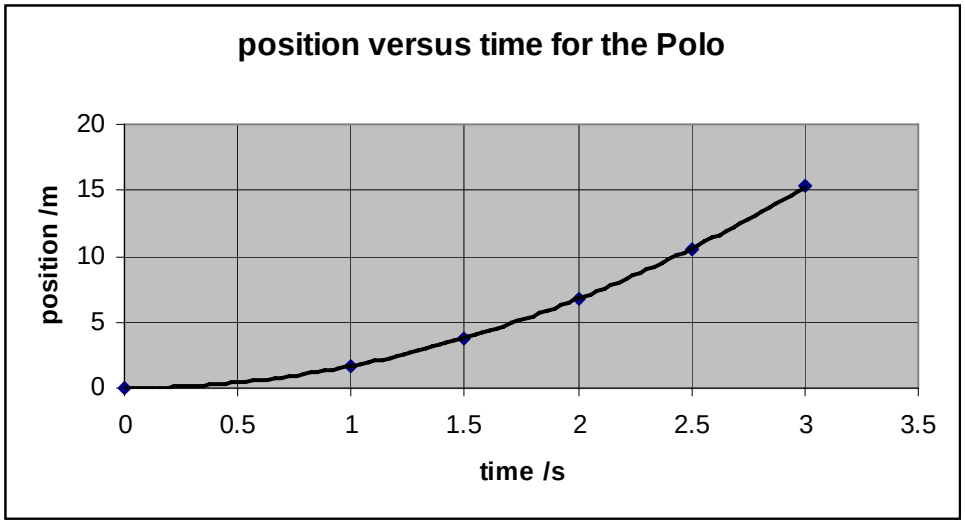
(b) Any three of:
* faster use of non-renewable resource because greater quantity of petrol/diesel needs to be manufactured
* process contributes to global warming
* more fuel used therefore more nitrous oxides produced, more acid rain
* more CO_2 produced, more greenhouse gases produced. ✓✓✓ (3)

(c) The SUV has greater mass✓ and therefore greater kinetic energy✓ at the same speed as the POLO and therefore will need more fuel to reach the same speed.
OR
The SUV is bigger and less streamlined and will experience greater air resistance✓. More work will have to be done to maintain the SUV at constant velocity✓ that the POLO, requiring more fuel. (2)

(d) To make a fair comparison✓ speed, distance and route (hills) are variables that need to be controlled✓. (2)

2.3

2.3.1 * heading and labelling axes ✓
* correct scales on both axes ✓
* parabola shape ✓ (3)

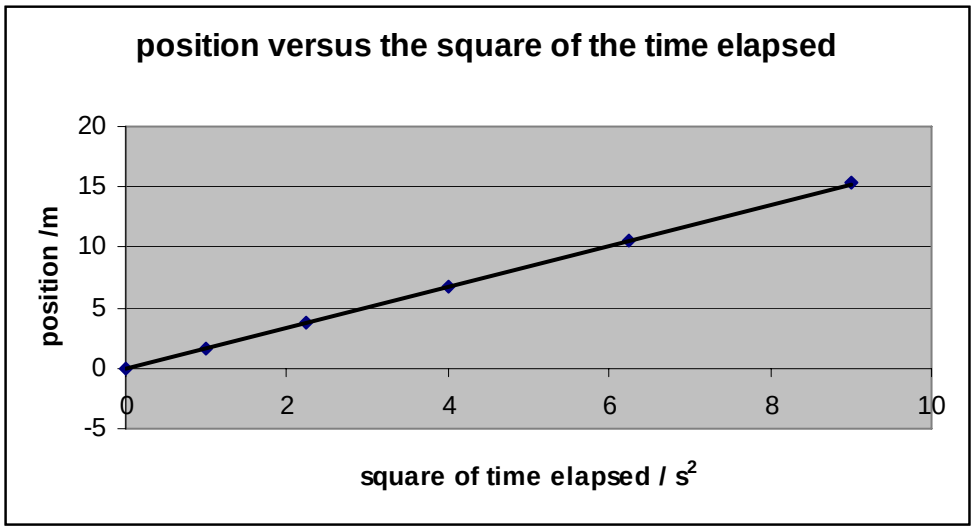


(a) $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$

(b) $\Delta x = \frac{1}{2}a\Delta t^2$ ✓ (1)

(c) 0; 1; 2.25; 4; 6.25; 9 ✓ (1)

(d) * heading and labelling axes ✓
* correct scales on both axes ✓
* straight line ✓ (3)



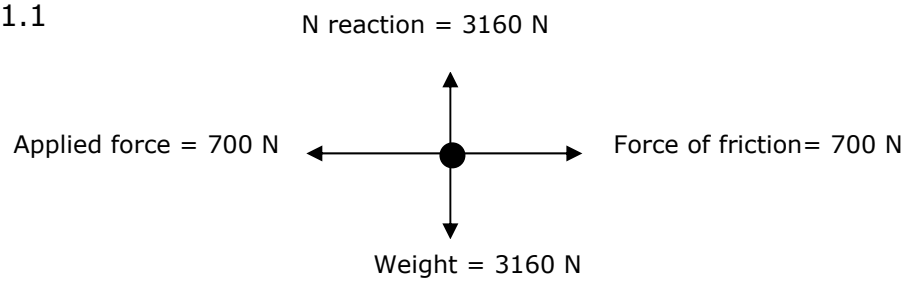
(e) half the acceleration ✓ (1)

(f) acceleration = 2 x (15.3/9) = 3.4 $m.s^{-2}$ ✓✓ (2)

28 marks

QUESTION 3

3.1
3.1.1

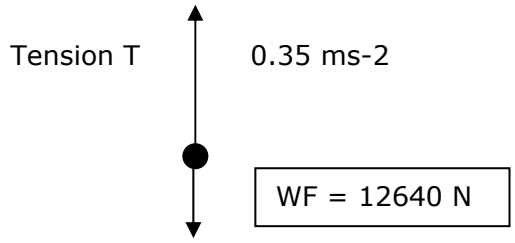


✓✓✓ (3)

[✓ for all arrows, ✓ for horizontal labels, ✓ for vertical labels]

3.1.2 μ'= 700/3160 = 0.22 ✓✓✓ (3)

3.2



Fnet = ma
T – 12640 = 1264 x 0.35 ✓✓✓
T = 13082.4 N ✓ (4)

10 marks

QUESTION 4

4.1 F.t = (mv-mu)
F x 0.09 = 1400 (0 – 36)
F = -560 000 N ✓✓✓ (3)

4.2 Wearing his seat belt – windshield not broken ✓✓✓ (3)

6 marks

QUESTION 5

5.1 $F = (6.7 \times 10^{-11} \times 6 \times 10^{24} \times 2600)/(6{,}4 \times 10^{6})^2$
F = 25500 N ✓✓✓ (3)

5.2 Force of static friction between the ground and the tyres is equal in magnitude to the force of attraction between the two cars and the cars do not move. ✓✓✓ (3)

6 marks

QUESTION 6

6.1 Some of the energy transferred during the crash causes air particles to move rapidly causing compressions in areas to which they move and rarefactions in areas from which they move. This is repeated as the moving air molecules collide and then move apart, creating a succession of compressions and rarefactions, until this wave reaches your ear and causes the middle ear to vibrate. ✓✓✓ (3)

6.2 speed = distance/time
time = 62/330
t = 0.19 s ✓✓ (2)

6.3 Aim: to determine the speed of sound in air ✓
Hypothesis: the speed of sound in air is 330 ms^{-1} ✓
Apparatus: starter pistol, 2 stop watches, tape measure, 2 people ✓
Method: Use the tape measure to measure out 100 m. One person with a stop watch and the starter pistol stands at one end, the other person with the second stop watch stands with his back towards the first person at the 100 m mark.
The first person fires the pistol and simultaneously starts his watch. The second person, on hearing the bang starts his watch. The two come together. One stops both watches. Subtract the times to use in the calculation. ✓✓
Control variable: reaction time (one person stops the stop watches), one person starts the stop watch and fires the pistol, the other person starts the stop watch when he hears the bang and not when he sees the pistol fired (achieved by having back to 'starter', control errors by repeating the experiment five times). ✓
Conclusion: after repeating the experiment 5 times, the average speed of sound in air is 330 ms^{-1}. ✓ (7)

6.4

6.4.1 Medical diagnosis technique. (Ultrasound is a medical procedure that uses high-frequency sound waves to view internal organs and produce images of the human body. The human ear cannot hear the sound waves used in an ultrasound.) ✓ (1)

6.4.2 Different types of body tissue have different reflective properties for high frequency waves. ✓
High frequency waves are emitted from an ultrasonic probe. These waves are reflected off the different body parts and then analysed by computer. ✓✓ (3)

6.4.3 geophysical prospecting/ sonar, etc ✓ (1)

17 marks

QUESTION 7

7.1
7.1.1 * away from each charge ✓
* space in the centre ✓
* shape ✓ (3)

7.1.2 F = (9 x 109 x 5 x 10-9 x 5 x 10-9)/(0.003)2 ✓✓✓
F = 0.025 N ✓ (4)

7.2 Concern for respirator illnesses – fine particles, not all are attached onto car, breath this in, after a time period your lungs will be damaged ✓✓✓✓ (4)

11 marks

QUESTION 8

8.1 R = V/I
I = 10.8/(1 + 16 + 8 + 35)
I = 0.18 A ✓✓✓ (3)

8.2 r = 'lost volts'/I
r = 1.2/0.18
r = 6.67 Ω ✓✓✓ (3)

8.3 W = I2Rt
W = 0.182 x 16 x (25 x 60)
W = 777.6 J ✓✓✓ (3)

8.4 The battery is connected to a coil with a break and makes contact (the rotating cam). This causes a fluctuation in the current (continuously changing) through the primary coil and then induces a pd in the secondary coil. ✓✓✓ (3)

8.5 Np/Ns = Vp/Vs
50/80000 = 12/Vs
Vs = 19200 V ✓✓✓ (3)

8.6
8.6.1 E = 19200/0.002
E = 9 600000 V.m-1 ✓✓ (2)
8.6.2 W = 19200 x 1.6 x 10-19
W = 3.07 x 10-15 J ✓✓✓ (3)

8.7
8.7.1 Stores charge ✓ (1)
8.7.2 C = 1.6 x 10-19/ 6
C = 2.67 x 10-20 F ✓✓ (2)

23 marks

QUESTION 9

9.1

9.1.1

V /cm3	P/kPa
52.08	80
41.67	100
34.72	120
29.76	140
26.04	160
23.15	180

✓✓ (2)

9.1.2 k = pV = 4166.67 kPa.cm3 (or = p ÷ 1/V) ✓✓ (2)

9.1.3 Boyle's law constant (the energy of the gas particles) ✓ (1)

9.1.4 inversely proportional ✓ (1)

9.1.5 pV = nRT
1000 x 100 x 41.67 x 10-6 = n x 8.31 x (273 +25) ✓✓✓
n = 0.0017 mol ✓ (4)

9.1.6
(a) higher ✓ (1)
(b) higher ✓ (1)

9.2

9.2.1 As the pressure increased even more, the 1/V value does not increase, so the graph takes on an exponential look. ✓✓ (2)

9.2.2 As the pressure increases the particle get closer together. This cannot continue as in an ideal gas because the real gas particles have volume. Although this stays constant, the pressure still gets bigger. ✓✓✓ (3)

17 marks

QUESTION 10

10.1 amount of gas, volume of gas ✓✓ (2)

10.2 temperature ✓ (1)

10.3 by heating up the water which in turn heats up the air. ✓✓ (1)

10.4 p = 0 ✓ (1)

10.5 Ensuring that the vertical axis of the graph passes through the point Q by using the Kelvin scale. Q then has co-ordinates 0;0 and the equation of the line is p = kT where T is in Kelvin and k is the slope of the line through the origin.✓✓ (3)

8 marks

QUESTION 11

11.1 Positive: more mobile, saves time going from place to place, safety features are enhanced.

Negatives: more speed used means more danger, man is inconsiderate, non-renewable resources getting used up, contributing to greenhouse effect. ✓✓✓✓ (6)

11.2 Considering their response to Q 11.1, 5 points of few should be mentioned to achieve 5 marks. ✓✓✓✓✓✓ (6)

12 marks

Total: 150 marks