GRADE 11 EXAMINATION
NOVEMBER 2007

PHYSICAL SCIENCES: PAPER I

MARKING GUIDELINES

Time: 3 hours 150 marks

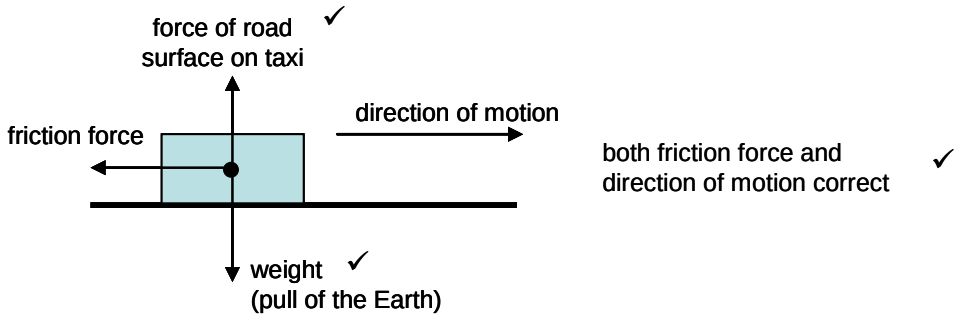
The marking guide is a working document prepared for use by teachers as they assess the Grade 11 externally set examinations.

There may be different interpretations of the marking guidelines but the teacher should keep as closely as possible to the suggested way of assessing. When in doubt, a teacher should check with another member of the cluster or with the relevant Assessment Specialist.

QUESTION 1

1.1 $F_{fric} = \mu_k F_N$ ✓
$= 0,8 \times 16\,000$ ✓
$= 12\,800$ N (2)

1.2



(3)

1.3 When a net (resultant) force acts on a body, the body will accelerate in the direction of the force. ✓ The acceleration is directly proportional to the net force and inversely proportional to the mass of the object. ✓ (2)

1.4 $F_{net} = ma$ ✓
$-12\,800 = 1\,600a$ ≅ ✓
$a = -8\ m.s^{-2}$ ✓
$= 8\ m.s^{-2}$ against the motion (3)

1.5 $\frac{86,6km}{1h} = \frac{86,6x1000}{1x60x60}$ ✓ ✓ $= 24\ m \cong s^{-1}$ (division by 3.6 ✓ ; 1 mark) (2)

1.6 $v_f^2 = v_i^2 + 2a\Delta x$ ✓
$0 = 24^2$ ✓ $+ 2(-8)$ ✓ Δx
$\Delta x = 36$ m (4)

1.7 The frictional force will be smaller ✓ ($F_{fric} = \mu_k F_N$)
The acceleration will be smaller ($F_{net} = F_{fric} = ma$) ✓
The distance will be greater ✓ (3)

1.8 1.8 $v_f^2 = v_i^2 + 2a\Delta x$
$0 = 48^2$ ✓ $+ 2(-8)\ \Delta x$
$\Delta x = 144$ m ✓
Getting the relationship correct

	Q1.6		Q1.8			
speed	24		48		x2	✓✓
stopping distance	36	and	144	⇒	x4	

Remember this questions requires the use of equations of motion (not energy)
A conclusion like:
When the initial speed (velocity) doubles, the distance becomes 4x more or "your stopping distance increases by 4 times as your speed doubles" ✓ (1 mark)

A conclusion like:
Stopping distance α (speed)^2 or stopping distance = k(speed)^2 ✓✓
(2 marks)

Explain "SPEED KILLS": Typical acceptable explanations:
More collisions✓ occur because increased speed increasing stopping distance so greatly or
More collisions occur at higher speeds✓ because increased speed increasing stopping distance so greatly (7)

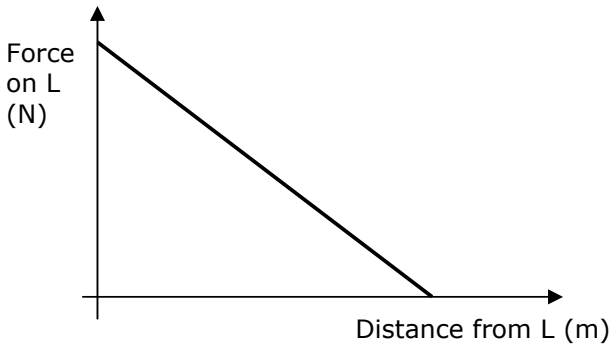
26 marks

QUESTION 2

2.1 Sum of the moments about L = 0 ✓
36 000✓x 40 – R ✓x 60 = 0
R = 24 000 N

Sum of the vertical forces = 0 ✓
L + 24 000 – 36 000 = 0 ✓
L = 12 000 N (5)

2.2



Straight line ✓ Negative slope ✓ (2)

This is for teachers. Learners are not required to present any reasons for the sketch graph they draw. They are expected to reason qualitatively. However suppose we let the distance of C from L be x then
"sum of the moments about L = 0" becomes
36 000x – R x 60 = 0 or 36 000x –60R = 0 (1)
and "the sum of the vertical forces = 0" can be written as L + R = 36 000 (2)
From (1) R = 600 ***x*** and substituting for R in (2) gives L = -600 ***x*** +36 000
This is the equation of the line in the sketch graph
When ***x*** = 0 the truck is over L and L = 36 000 N; when L= 0; C is over R, 60 m from L.

7 marks

QUESTION 3

3.1 The total linear momentum in a closed system will be conserved (2)

3.2 $m_1u_1 + m_2u_2 = MV$ ✓
3600x20 + 800x(-35) = 4400V ✓ ✓
V = 10 $m.s^{-1}$ North ✓ (4)

3.3

3.3.1 $F_{net}\,\Delta t = mv - mu$ ✓
$F_{net}(0,005) = 65(10) - 65(20)$ ✓
F_{net} = -130 000 N
= 130 000 South ✓ (4)

3.3.2 $F_{net}(0,08) = 50(10) - 50(-35)$ ✓ ✓
F_{net} = +28 125 N North (4)

3.3.3 (a) Truck driver fatal
Driver of the car severe to critical
(Note: Not necessarily fatal in spite of a much greater change in momentum than truck driver!) (2)

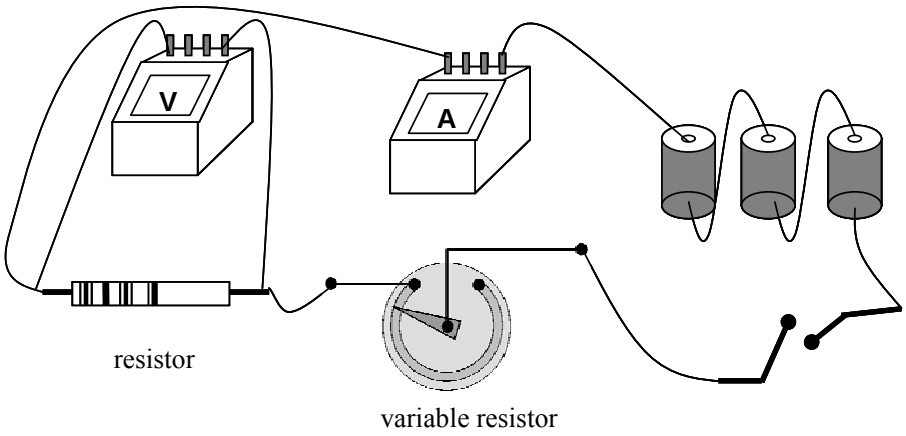
(b) Air bags ✓
Air bags will increase the time ✓ it takes the passenger to come to rest, thus decreasing the net force on the passenger. ✓
Any other correct safety feature that reduces the force exerted on the passenger or driver.
E.g. Collapsible steering column, soft dashboard, etc. (3)

19 marks

QUESTION 4

4.1 What is the relationship between the current through a resistor and the potential difference across the resistor? (2)

4.2



Complete circuit ✓ Volmeter in parallel ✓ Cells in series ✓ (3)

4.3 Linda is correct. The variable resistor is used to vary the potential difference across the fixed resistor. ✓ The greater the variable resistor, the greater the potential difference across the fixed resistor. ✓ (2)

4.4 The current ✓ (1)

4.5 Temperature ✓ (1)

4.6 Take quick readings. Allow time for temperature to normalise between readings. ✓ (1)

4.7

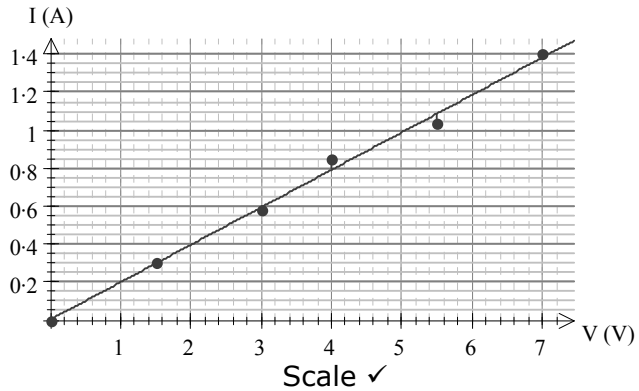
Voltmeter (V)	Ammeter (A)
0,00	0,00
1,50	0,30
3,00	0,58
4,00	0,85
5,50	1,04
7,00	1,40

Each header with unit is one mark. Values on table completely correct are 2 marks. Up to 2 incorrect lines is 1 mark, else 0.

(4)

4.8

Scale ✓



Scale ✓

Points plotted correct ✓

All labels and units ✓

(4)

Alternately a graph of V against I is also correct.

4.9 The inverse of the resistance OR IF V is plotted against I the slope gives the resistance. ✓✓ (2)

4.10 y = mx + c
I = 0,2V ✓✓
OR if V is plotted against I
V= 5I ✓✓ (2)

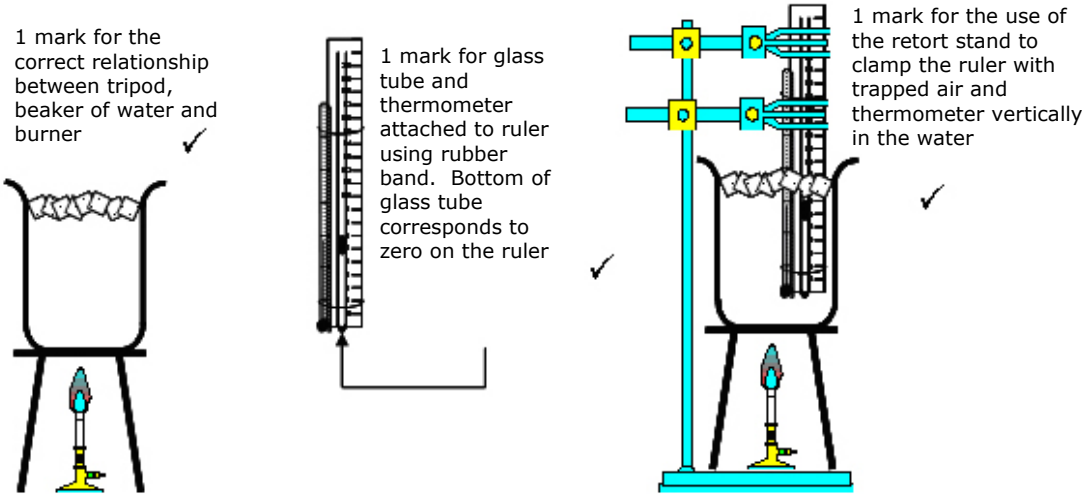
4.11 The current through a resistor is directly proportional to the potential difference across the resistor. (1)

4.12 Paul measures the resistance of the new bulb as 40 Ω at room temperature. ✓✓
Paul calculates the resistance from the information on the bulb which refers to operating conditions, i.e. very high temperature. The difference is due to the fact that resistance is temperature dependent. ✓
(4)

27 marks

QUESTION 5

5.1



(3)

5.2. 4 before 1 ✓; 1 and 4 before 2 and 3 ✓; 3 before 2✓ (3)

5.3 Pressure ✓– throughout the experiment the pressure on the air is atmospheric ✓ (plus the pressure exerted by the mercury 'bead').
Alternately
Amount of gas – air cannot leave or enter the tube below the mercury 'bead' (2)

5.4 "What is the relationship between the volume of the gas and the temperature of the gas?" (1)

9 marks

QUESTION 6

6.1 A transformer is used to increase or decrease voltage (1)

6.2

6.2.1 The magnetic field inside coil C ***changed*** ✓inducing a potential difference across the ends of the✓ conductor of which the coil is made in accordance with Faraday's Law, i.e. a potential difference or voltage is generated in a conductor while the magnetic field through the conductor changes (2)

6.2.2 B soft iron core
C secondary coil
D primary coil (3)

6.2.3 When an alternating current ✓passes through the primary coil, D, say, the coil produces a magnetic✓ field in one direction which collapses and then produces a field in the opposite direction when the direction of the current changes. These magnetic fields build up and collapse with a frequency of the alternating current, 50 Hz. The changing magnetic field is retained in the iron✓ core B. Since the iron core passes through the secondary coil C the magnetic field through the secondary coil is ✓continually changing. In accordance with Faraday's Law, a potential difference or voltage is generated in a conductor while the magnetic field through the conductor changes so a potential difference is produced in the secondary coil. ✓ This potential difference alternates at a frequency of 50 Hz producing alternating current. (5)

6.2.4 Transformers are used (any two) ✓✓:

- In the national grid (country wide power distribution): at power stations✓ (to step up the voltage for transmission of electric power) at the end point municipalities (local authorities) ✓ in towns and suburbs ✓to step down the voltage for use in homes and factories.
- In 'power supplies' ✓for devices like computers, sound amplifiers, electronic musical instruments✓, toys✓ (model trains) …
- In chargers✓ for cell phones, cameras✓, shavers✓, toothbrushes✓, computers✓, rechargeable batteries✓, …
- machinery and appliances that use electric motors: e.g. mines✓, electric trains✓ (2)

6.2.5 Advantages (in fact all the advantages of having electricity):
Makes possible

- the large scale efficient distribution of energy (using electricity)
- the wide scale use of household electrical appliances: stoves, dishwashers, vacuum cleaners, TV's, …
- preservation and distribution of food by refrigeration
- climate control: air conditioners, heating,
- improved productivity through lighting – people can work and study at night, computers,
- improved communication, cell phones, phones,
- any other

(2)

6.2.6 Disadvantages

- waste disposal of the millions of tons of discarded cell phone chargers, computers,
- the large transformers used in the national grid can be dangerous
  - o if not properly maintained they are known to have exploded,
  - o the unwary have been electrocuted and
  - o transformers need to be made inaccessible to the general public
- They can be unsightly
- They take up space that could be used for agriculture, living space, …
- Though very efficient they do generate heat and contribute to global warming,
- Any other (2)

6.2.7 Give opinion and connect to a general justification: (2 marks)

e.g. Transformers are an advantage✓ since they enable the large scale, wide spread and efficient use of energy that makes possible the improvement of the quality of human life. ✓

Addresses the negative: (1 mark)

The disadvantages of the use of transformers are insignificant in comparison with the advantages and many of the disadvantages can be addressed like their unsightly appearance, e.g. they can be disguised as small cottages. (3)

20 marks

QUESTION 7

7.1

7.1.1 The displacement of the particles in the medium is parallel to the direction of propagation of the wave (1)

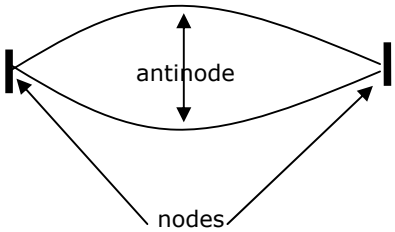
7.1.2 (a) Amplitude (1)
(b) A_2 or A_6 (1)

7.1.3 (a) A_3 (1)
(b) 0,8 m (1)
(c) Time for wave to move as shown from sketches
A to D = 0125 s
Distance wave moves from A to D = 0,25 λ
Time to generate a wave (period) = 4 x 0, 25 s ✓= 0,5 s✓
(Not necessary to show working) (2)
(d) f = 1/T ✓= 1/0,5 s = 2 Hz✓ (2)
(e) v = f λ = 2 x 0,8 ✓= 1,6 $m.s^{-1}$ ✓ (2)
[11]

7.2

7.2.1 They must have the same frequency✓, wavelength✓ and amplitude✓ (3)

7.2.2



(2)

Diagram ✓
Both labels ✓

7.2.3 (a) 102 cm ✓ (1)
(b) v = f λ = 587 ✓x 1,02 = 598,74 ✓$m.s^{-1}$ (2)
[8]

19 marks

QUESTION 8

8.1 The units: μF ✓ (1)

8.2 $Q = CV$✓ $= 180x10^{-6}$ ✓ x 100 = 0,018 C ✓ (3)

8.3 Directly proportional ✓ (1)

8.4 Capacitance ✓ (1)

8.5 W = QV therefore the energy stored ✓ (1)

8.6 Energy = area = ½ x 100 ✓ x 0,018 ✓ = 0,9 J ✓ (3)

10 marks

QUESTION 9

9.1

9.1.1 D
9.1.2 A
9.1.3 C
9.1.4 B (4)

9.2

9.2.1 Semimetals have some electrons in the conduction band at normal temperatures. The band gap is small. (1)

9.2.2 Metals have a partially filled conduction band. Valence band and conduction band touch or overlap. (1)

9.2.3 Non-metals have empty conduction bands and filled valence bands. The band gap is large. (1)

9.3

9.3.1 A (1)

9.3.2 Semi-conductor is doped by element with 5 ✓valence electrons (1)

9.3.3 B1 ✓lights up. B2 ✓does not light up. A diode is a ✓rectifier. Conventional current flows through a diode in one direction only, in the direction of the 'arrow'. ✓ (4)

13 marks

Total: 150 marks

OPTIONAL QUESTIONS

QUESTION 10

10.1 R and R_2 are in parallel with R_1 and R_3 (1)

10.2 To determine resistance of unknown resistor (1)

10.3 Galvanometer: measures very small currents (1)

10.4 $R = \frac{R_1 R_2}{R_3} = \frac{650 \text{x} 400}{920} = 282{,}6\Omega$ ✓ (2)

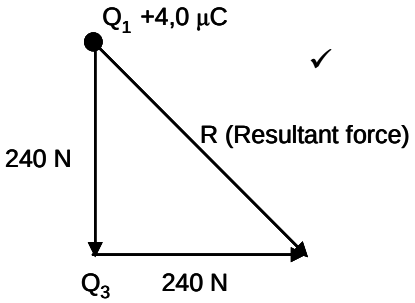
5 marks

QUESTION 11

11.1 $F = \frac{kQ_1Q_2}{r^2} = \frac{9\text{x}10^9 \text{x} 4\text{x}10^{-6} \text{x} 6\text{x}10^{-6}}{(0{,}03)^2} = 240$ ✓N attractive Substitution✓ (2)

11.2 240 N ✓attractive (1)

11.3



$Res^2 = 240^2 + 240^2$ ✓
$= 115200$
$Res = 339$ N ✓ (3)

11.4 $E = \frac{F}{q}$ ✓
$= \frac{339}{4x10^{-6}}$ ✓
$= 8.5 \text{ x } 10^7 \text{ v·m}^{-1}$ ✓
(4)

10 marks

Total: 150 marks