NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2008

PHYSICAL SCIENCES: PAPER I

MARKING GUIDELINES

Time: 3 hours 150 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

QUESTION 1

1.1

correct units ✓ both

✓ each

T (wrong)

m and **s** in table (should only be in headings) −1

1.1.1

maximum height (m)	time to reach t floor (s)	average height (m)	average time (s)
1,54	0,61	1,57	0,63
1,60 } ✓	0,65 } ✓		
1,58	0,64		

✓ ✓ **Average 1,57** ✓ 0,63

c.o. to graph on next page (4)

10,08

1.1.2 10 $m.s^{-2}$ or 9,8 $m.s.^{-2}$ ✓ (1 or nothing) ignore units entirely) (1)

1.1.3 $v_f = v_i + a\Delta t$ ✓

✓ ✓ ✓

$= 0 + 10(0,63)$

$= 6,3\ m.s^{-1}$ ✓ ($6,174\ m.s^{-1}$) (3)

$\frac{1}{2}mv^2 = mgh$✓ ($v^2 = u^2 + 2as$ ✓)

$v = \sqrt{2gh}$ ✓

$= \sqrt{2(10)\,(2,00)}$ ✓ taking sq. root

$= 6,3\ m.s.^{-1}$ ✓ UNITS

1.1.4 $v_f^2 = v_i^2 + 2a\Delta y$ ✓

✓ ✓ ✓

$0 = v_i^2 + 2(-10)(1,57)$

$v_i = 5,63\ m.s^{-1}$ ✓ ($5,55\ m.s^{-1}$)

($\frac{1}{2}mv^2 = mgh$ ✓) (3)

1.1.5 $E_k(\text{before}) = ½mv^2 = ½(0,25)(6,3)^2 = 4,96$ J

1.1.6

$E_k(\text{after}) = ½(0,25)(5,63)^2 = 3,96$ J

$E_k(\text{before}) > E_k(\text{after})$ ✓

Neil's statement is correct

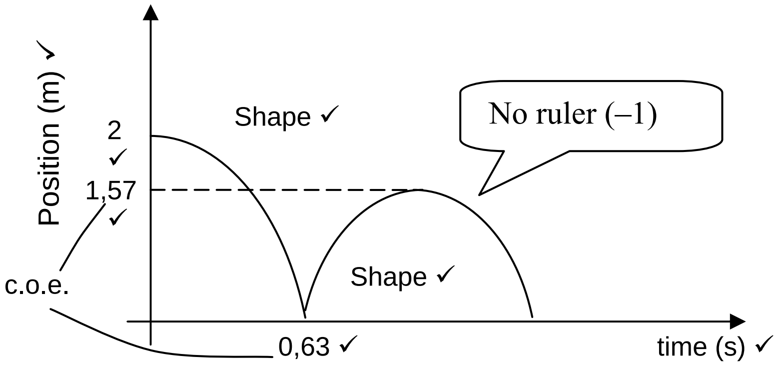
✓ magnitude of

Change in ✓velocity (speed) ✓✓

∴ E_R before differs E_K after ✓ changed (3)

1.1.7 Some E_k is transferred ✓ to sound ✓, heat, etc (2)

1.1.8



(4)

[20]

1.2

constant in direction and magnitude

1.2.1 The **total linear** ✓momentum in a **closed system is conserved/ remains constant.**

no net external forces (2)

Only (Law of) conservation of momentum ✓

or Symbols m_1v_{ii} + … ✓

1.2.2 $m_1v_{i1} + m_2v_{i2} = m_1v_{f1} + m_2v_{f2}$ (choose left as +)

✓ ✓ ✓ ✓

implied (0,25)(0) + (2,5)(2) = (0,25)(v_f) + (2,5)(1,6)

$V_f = 4 \text{ m.s}^{-1}$ units (3)

✓ isolated ✓

1.2.3 The total **mechanical** energy in a **closed system is conserved/ stays constant**. (2)

no net external forces

(total energy is conversed) 0 marks

1.2.4 $(E_p + E_k)_{bottom} = (E_p + E_k)_{top}$

$mgh + ½mvi^2 = mgh + ½mv$ ✓ implied

✓ ✓

$0 + ½(0,25)(4)^2 = (0,25)(10)h + 0$

h = 0,8 m ✓ units (3)

✓ ✓ ✓ ✓

1.2.5 work = mgh = (0,25)(10)(0,8) = 2 J

or = F.Δy (9,8) units (2)

1.2.6 **No, (he will have to do more work**). Initially the ball was at rest, but this time it has a velocity to the right, which means that Neil will have to (**exert a force**) do **more work to reverse the direction** of the ball as well as work for it to gain potential energy. (3)

Or velocity relative to bat has increased ✓✓

[15]

1.3 constant ✓ acceleration TWO VALID FACTS

✓ ✓ Velocity at B is zero.

1.3.1 The ball is **thrown upwards** and **reaches maximum height** at B. (1)

decreasing velocity ✓

✓ TWO VALID FACTS

1.3.2 The ball **falls from its maximum height** and **reaches the floor at C**. (1)

1.3.3 At E ✓ (1)

1.3.4 0,03 s ✓ (0,97 – 0,94) (1)

✓

1.3.5 Impulse is the **product of the force** that is exerted on an object and the **time (of contact)**. (force x time) (2)
Impulse equals change in momentum (only 1)

implied ✓ ✓ ✓ ✓ (sign)

1.3.6 $F = \frac{mv_f - mv_i}{\Delta t} = \frac{(0,25)(4) - (0,25)(-6,2)}{0,03} = 85\text{ N}$ ✓ (3)

✓

1.3.7 Upwards/ up ✓ (1)

[10]

1.4 **Optional**

1.4.1 vertical component of initial speed = 26sin35^{o} = 14,9 m.s^{-1}

$v_f^2 = v_i^2 + 2a\Delta y$
$0 = (14,9)^2 + 2(-10)\ \Delta y$
Max height = 11,1 m (3)

1.4.2 horizontal component of initial speed = 26cos35^{o} = 21,3 m.s^{-1}

time to gain max height: $v_f = v_i + a\Delta t$
$0 = 14,9 + (-10)\ \Delta t$
$\Delta t = 1,49$ s
Total time for motion = 2x1,49 = 2,98 s

$\Delta x = v_i\Delta t + 0$ (no horizontal acceleration)
$= (21,3)(2,98)$
$= 63,47$ m (5)

1.4.3 No: when the ball reaches the poles it is near the end of its trajectory and still needs to be more than 3 meters above the ground. (2)

[10]

45 marks

QUESTION 2

2.1

2.1.1 (a) blue, red and green ✓ (1)

✓ ✓

(b) red and green (2)

✓

(c) all the colours are absorbed
(no colours are reflected) nothing or (2)

✓

2.1.2 at the blue filter, only blue light passes through (other colours absorbed) at the cyan

✓

filter, blue light passes through (cyan = blue + green) can use diagram

blue light will be seen on the ✓ screen. (3)

2.1.3 (a) Refraction ✓ (1)
(b) Different colours have different wavelengths/ frequencies ✓
Refraction is influenced by wavelength/ frequency ✓ TWO VALID (2)

Colour with longer wavelengths are diffracted less (red) and COHERENT FACTS
shorter wavelengths diffracted more (violet). (2)

light of defferent frequency travels at different speed through glass ✓
therefore refracted at different angles ✓

✓ no green dots beam light up ✓

2.1.4 The mask must cover the green dots but the electron beams must strike the red and

✓ ✓

blue dots. When the red and blue dots **glow simultaneously**, **together/ at the same time) purple will be observed**. (4)
(electron beam hitting blue more intense than that striking red) BONUS (1)

[15]

2.2

2.2.1 distance = time × speed ✓) $x = vt$ Can use symbols.

✓ of round trip

= (**half the time** for the pulse to reach the object and return) × (the speed of sound in air) / (340 $m.s.^{-1}$) ✓ (3)

2.2.2 The camera can focus on something behind/ in front of the object v depends on the temperature of the air.
camera shake battery going flat
any two acceptable reasons.✓✓ (2)

[5]

2.3

2.3.1 To the left. ✓ (1)

(NOT closer together)

2.3.2 They are shorter ✓ smaller, has decreased. (1)

2.3.3 The pitch will be higher ✓ increased. (1)

2.3.4 The medium (water) is much denser than air ✓
Particles are much closer together/ stiffer/stronger bonds hit each other more quickly (1)

2.3.5 $f_o = \dfrac{v_{sound}}{\underset{\checkmark}{v_{sound}} - \underset{\checkmark}{v_{sub}}} f_{ship} \longrightarrow \checkmark \ \checkmark$ $V_{sound} = 1470$ (can be substituted)

($fo = 1{,}0031\ fs$) ✓✓ (2)

2.3.6 $1{,}003f_s = \dfrac{1470}{\underset{\checkmark}{1470 - v_s}} f_s$

$V_s = 4{,}4\ m.s^{-1}$ ✓ (if sign + 2 out of 4) UNITS (4)

2.3.7 Application ✓ (ultra sound: fetal heart beat) motion of stars (galaxies)
(rate of flow of blood through heart)
(speed tracking)
Explanation of working ✓✓ sunoke (2)
Effect (quality of life or society) ✓✓ (2)
[15]

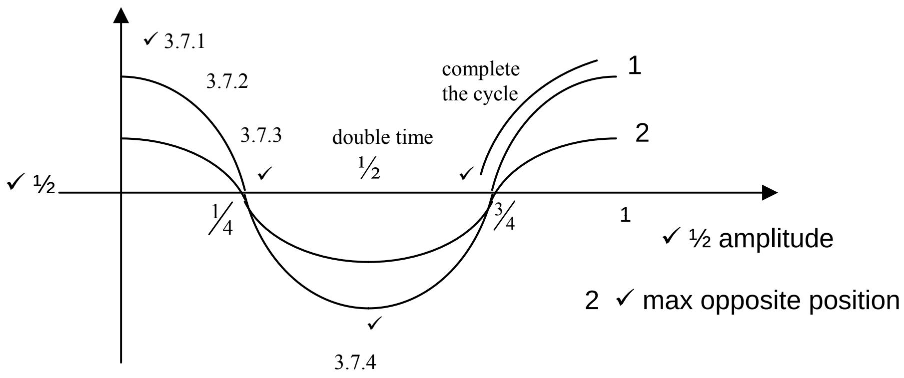
35 marks

QUESTION 3

3.1 Electromagnetic induction (1)
3.2 Mechanical/ kinetic energy to electrical energy (1)
3.3 (Slip) rings (1)
3.4 Carries the current in and out of the coil ✓ (completes the circuit) (1)
3.5 Brushes (1)
3.6 Carries the current **(from the rings) ✓ to the external circuit** (1)
provide a good correction (between circuit and rings).

3.7
3.7.1 max ✓
3.7.2 ABCD ✓
3.7.3 Zero ✓
3.7.4 Max ✓ same
3.7.5 DCBA ✓
3.7.6 No current ✓
3.7.7 Max ✓ (6)

3.8
3.8.1 and 3.8.2



(8)
[20]

3.9

3.9.1 Any two ways to use electricity more efficiently as a family. ✓✓ (2)

3.9.2 5 years (5 000 + 2 000 × = 15 000) ✓ (7½ yrs) (1)

3.9.3 Two advantages ✓✓
Work at night; work in cloudy cold conditions, turn on when needed.
Low installation cost (2)

3.9.4 Two disadvantages ✓✓
Only work during sunny times, ugly on roof, dusty, needs cleaning
High installation (2)

3.9.5 Choice (1) ✓
Motivate x 2 (2) ✓✓ (3)
[10]

30 marks

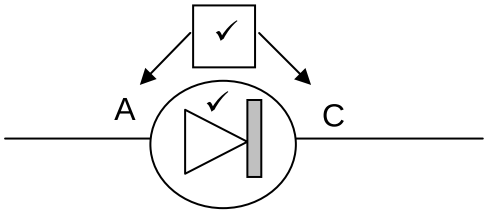
QUESTION 4

4.1

4.1.1 light emitting diode ✓ (1)

4.1.2 **It emits light** (when forward biased (current is able to flow thbrough)) ✓ (1)

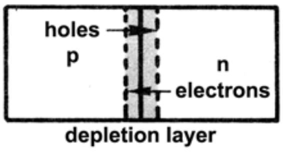
4.1.3



(2)

(Negatively dope)

4.1.3 When a diode is in forward bias, electrons move from the n-type semi-conductor to the p-type. ✓ (positively doped)
The holes in the ✓ valency band, which has a **lower energy** than the conductor band, **are now filled with electrons**. (Valid chemical deswcription)
When the electrons move from the conductor band to the valency band, they emit energy as light dropping to lower-energy level. ✓ (4)



4.1.5 Uses very little energy (low current)
Can work with batteries if there is no electricity. cheap with small
Has a long life (up to 10 years). any 2 ✓✓ (2)

[10]

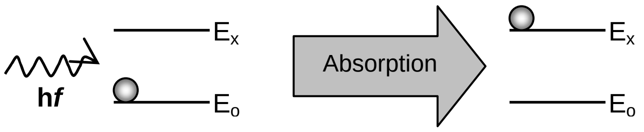
4.2 **Optional**

✓ ✓

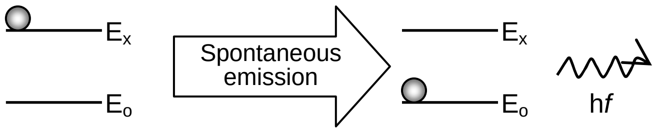
4.2.1 **light amplification** by **stimulated emission of radiation** (2)

4.2.2 All the photons emitted have the **same** wavelength (or energy E=hf) and colour ✓ (1 or 0) (1)

4.2.3 When substances are heated, the atoms are lifted to higher energy states because electrons move to higher energy levels. An atom with electrons that can move from a state of lowest energy E_o (ground state) to a higher state (the excited state).
The electron in the ground state absorbs a photo of energy (hf) and moves to a higher energy state.
The difference in energy equals the energy of the photon.



An atom cannot stay in the excited state. It will emit a photon of energy h*f* and return to its ground state. This happens spontaneously.



A photon with energy h*f* can stimulate an electron to return from its excited state to its ground state. The atom emits a photon of energy h*f*. This is stimulated emission and it produces light amplification because each photon causes the emission of an additional photon of another atom. (4)

4.2.4 example of use (1)
effect on quality of life (2) (3)

[10]

10 marks

QUESTION 5

5.1

5.1.1 electroscope (1)

2 mark either correct.

5.1.2 photo electric effect ✓✓ (1)

✓ ✓

5.1.3 For any metal there is a minimum frequency at which electrons will emitted from this metal without kinetic energy. (2)

5.1.4 a ✓✓ and b ✓ and c✓ (4)

5.1.5 The frequency of the ultra ✓ violet light is **higher than** ✓ **the threshold frequency** of aluminium. (2 or 0) electrons are emitted. (2)
(I don't understand why the leaves diverge) BONUS (3)

5.1.6 no observation/ no electrons emitted ✓ fin framed – f threshold copper (1)

5.1.7 Leaf will fall back faster/ more electrons will be emitted (per sec.) ✓
diverge faster

5.1.8 **No** change in observation/ same number of photo-electron s emitted per second ✓ (1)

5.1.9

- If the frequency of the light is lower than the threshold frequency, nothing happens to the gold leaf. ✓
- If the frequency of the light is the same as the threshold frequency, the gold leaf falls back slightly. ✓
- If the frequency of the light is higher than the threshold frequency, the gold leaf will do the same as in the previous experiment. ✓
- If the intensity of the light in the previous two experiments is increased, the leaf will fall back faster/ more. ✓ (4)

Any TWO valid observations ✓✓ each. **[7]**

5.2

5.2.1 The **frequency is inversely** ✓✓ **proportional** to the **wavelength**. (2)
(indirectly)

5.2.2 $c = f\lambda$ ✓

✓ ✓

$3x10^8 = (6,67x10^{14})\ \lambda$

$\lambda = 4,5 \times 10^{-7}$ m ✓ UNITS (2)

5.2.3 (a) At hospital for X-rays/ cancer treatment ✓
(b) A radio/ TV/ radar ✓
(c) Infra red at the physiotherapist/ night vision/ stealth/ heater/ stove ✓ (3)

5.2.4 (a) $E = hf$ ✓ (1)
(b) The energy associated with this frequency is very high ✓ and is dangerous to all living matter. ✓ **damage** (2)
(c) Gamma ✓ (1)
(d) Hiroshima / Nagasaki ✓/ Japan in the 2nd World War ✓. (2)

[13]

30 marks