Name: ..... Teacher's Name: .....

P11Y

BAULKHAM HILLS HIGH SCHOOL

P11Y

YEARLY EXAMINATION

2010

YEAR 11

PHYSICS

GENERAL INSTRUCTIONS

- Reading Time - 5 min
- Working Time - 2 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Board approved calculators may be used
- A Data Sheet and Formulae Sheets are provided at the back of this paper
- Show all working

TOTAL MARKS: 72

Section I – Multiple Choice
15 marks

- Attempt Questions 1-15
- Allow about 25 minutes for this section

Section II – Extended Response
57 marks

- Attempt Questions 16-33
- Allow about 95 minutes for this section
- You must show all working

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PHYSICS

Section I – Multiple Choice

Select the most correct response to the question by drawing a cross through A, B, C or D on the grid below.

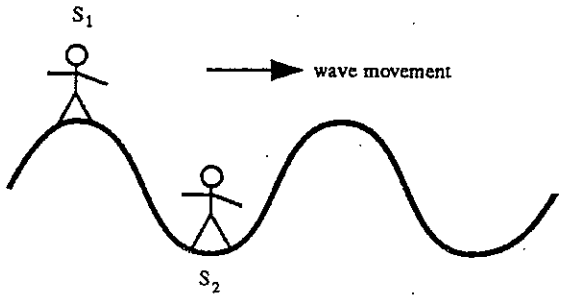
1	A	B	C	D
2	A	B	C	D
3	A	B	C	D
4	A	B	C	D
5	A	B	C	D
6	A	B	C	D
7	A	B	C	D
8	A	B	C	D
9	A	B	C	D
10	A	B	C	D
11	A	B	C	D
12	A	B	C	D
13	A	B	C	D
14	A	B	C	D
15	A	B	C	D

Section I – Multiple Choice
15 marks
Attempt Questions 1-15
Select the most correct response which best answers the question, by circling A, B, C or D on the Multiple Choice Answer Sheet

1. Waves are a disturbance that carries

   a) matter
   b) energy
   c) particles
   d) energy and matter

2. The transverse progressive wave shown below has a frequency of 0.1 hertz.



   What is the time in seconds for the crest at surfer S_1 to move to the surfer at S_2?

   a) 10
   b) 5
   c) 15
   d) 3

3. When a wave enters a more dense medium it bends:

   a) away from the normal
   b) parallel to the normal
   c) towards the normal
   d) parallel to the boundary between the two media

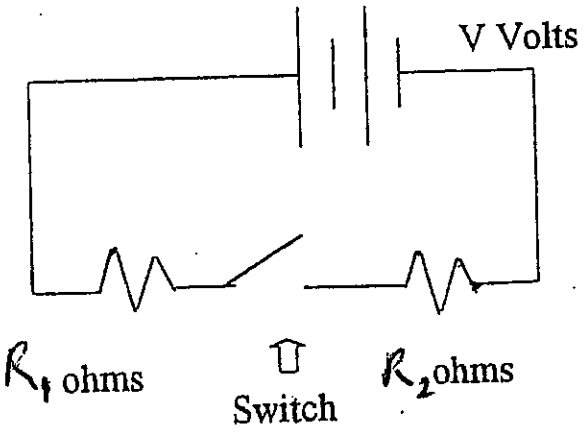
4. For light travelling from air to glass the refractive index is 1.5.
   The critical angle of incidence for this piece of glass would be

   a) 30°
   b) 90°
   c) 42°
   d) 52°

5. Which of the following circuit components will **not** increase the resistance of the circuit?

   a) Increasing the length of the conductor
   b) Increasing the temperature of the conductor
   c) Changing the conductor to one of greater resistance
   d) Increasing the cross sectional area of the conductor

6. The question refers to the following diagram:



When the switch is closed, the potential difference across resistor R_2 will be

a) $\dfrac{VR_2\ volts}{R_1 + R_2}$

b) 0 volts

c) $\dfrac{VR_1\ volts}{R_1 + R_2}$

d) $\dfrac{VR_2\ volts}{R_1}$

7. Lighting in suburban homes is wired up in

a) parallel configurations
b) series circuits
c) separate circuits for each light
d) two lights only per circuit

8. A ship sails 10km due north then 15km due west.
The magnitude and direction of its displacement from its starting point is closest to:

a) 35km NW
b) 18km N 50° W
c) 35km N 50° E
d) 18km N 50° E

9. An object initially at rest is dropped from a height of 100m.
When it is 25m from the ground, the ratio of its kinetic energy to its potential energy is

a) 1 : 3
b) 3 : 1
c) 4 : 1
d) 1 : 4

10. When a cricket player catches a ball he draws his hands back on impact when the ball reaches his hands. This reduces the

    a) impulse
    b) time
    c) momentum change
    d) force

11. Elastic collisions involve conservation of

    a) momentum only
    b) momentum but not kinetic energy
    c) momentum and kinetic energy
    d) kinetic energy only

12. When a table cloth is removed quickly from under the dining implements, the implements will remain unmoved. This is best explained in terms of

    a) Newton's second law of motion
    b) Inertia
    c) Velocity
    d) Newton's third law of motion

13. The unit called the light year is a measure of

    a) light velocity
    b) speed
    c) acceleration
    c) stellar distance

14. The first of the early astronomers to suggest a heliocentric method for the universe was

    a) Aristarchus
    b) Plato
    c) Galileo
    d) Copernicus

15. Which of the following was predicted by Friedmann and later verified by Hubble?

    a) The Big Bang occurred 13 billion years ago
    b) The universe is expanding
    c) The universe was initially extremely hot
    d) A large telescope in the Earth's orbit would be able to see further into the universe than ever before

End of Section I

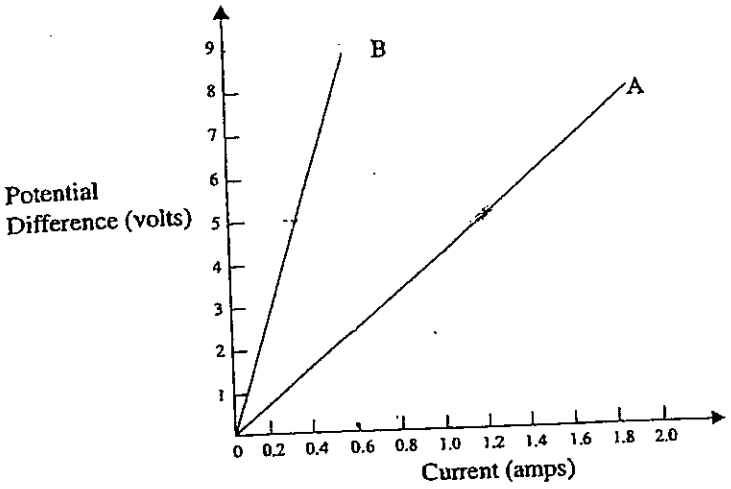
Name: ..... Teacher's Name: .....

Section II – Extended Response
57 marks
Answer the questions in the spaces provided
Mark values are indicated for individual questions
Show all relevant working in questions involving calculations

Marks

Question 16 (2 marks)

Two different metallic conductors, A and B, have their variations in current with changes in their potential difference, shown in the graph below. 2



With direct reference to this graph, fully explain which of the two metals, A or B has the greatest resistance to the flow of current.

$V/I = R$ = gradient ---------- 1 mk

R_B (grad B) > R_A (grad A) ∴ R_B is greater --- 1 mk

Question 17 (2 marks)

A student studying for her physics exam uses the following appliances:

Desk lamp operating at 35 W
Overhead light operating at 75 W
Stereo system operating at 20 W
Electric radiator operating at 1500 W

If the cost of the electricity is at an off-peak rate of 8.5 cents per kW h, how much will it cost to operate all of these appliances for one and a half hours?

Total energy used = $(35+75+20+1500) \times 1.5 = 2445$ Whr --- 1 mk

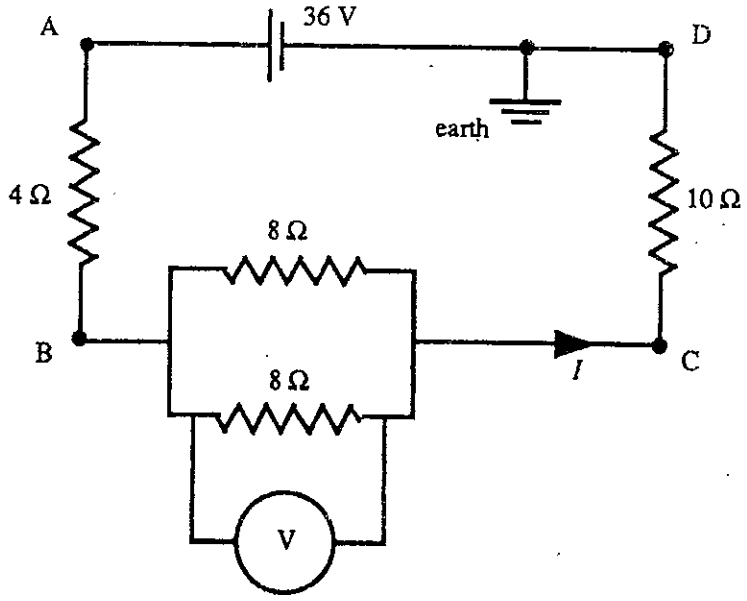
$= 2.445$ kWh

Cost = $2.445 \times 8.5¢ = 20.8¢$ ---- 1 mk

Marks

Question 18 (6 marks)

For the circuit diagram below, determine



a) the current flowing through the 4 Ω resistor 2

Parallel: $\frac{1}{R_T} = \frac{1}{8} + \frac{1}{8} = \frac{2}{8}$ $\therefore R_T = 4\,\Omega$

For circuit $R = 10 + 4 + 4 = 18\,\Omega$ ---- 1 mk

$V = IR \quad 36 = I \times 18 \quad I = 2A$ ---- 1 mk

b) the reading on the voltmeter 1

$V = IR = 1 \times 8 = 8V$ ---- 1 mk

c) the energy dissipated in the 10 Ω resistor in four (4) minutes 2

$W = VIt = \underbrace{2 \times 10}_{1\text{ mk}} \times \underbrace{2 \times 4 \times 60}_{1\text{ mk}} = 9600J.$

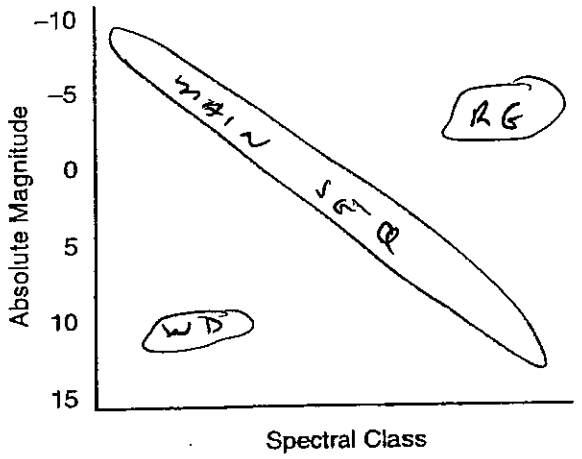
d) the potential at B 1

$V_B = 36 - (4 \times 2) = 36 - 8 = 28V$ --- 1 mk.

Marks

Question 19 (6 marks)

For this question refer to the incomplete Hertzsprung-Russell diagram shown below.



a) Suggest two (2) alternative labels for the horizontal axis 2

Colour Index, Colour, Surface Temp

b) Suggest a less technical name for the vertical axis 1

brightness or luminosity

c) On the Hertzsprung-Russell diagram above, clearly show the positions of

i) the main sequence 1
ii) a red giant 1
iii) a white dwarf 1

one mark each correct position.

Question 20 (2 marks)

Describe the composition of the solar wind. 2

Mainly consists of charged particles such as protons, electrons, helium ions, some heavier ions

any 2 = 2 mk

Marks

Question 21 (4 marks)

The "Big Bang" Theory is described in the context of the following statement:

> *Space-time and matter came into existence spontaneously, from absolutely nothing. This happened about 14 thousand million years ago (give or take a few thousand million years). The universe was initially a tiny entity, which immediately began to expand, and which has been expanding ever since.*
>
> *The question was not an explosion into a void but the swelling or stretching of space itself. The early, small, universe was extremely hot, an opaque soup of particles and photons, constantly interacting. As the universe expanded, it cooled.*
>
> *At the age of about 300 000 years, the universe was cool enough for protons and electrons to form stable atoms. Matter and radiation were 'decoupled' and the universe became transparent, with photons free to travel long distances. Small irregularities in the composition of the early universe formed the 'seeds' of the structures that evolved into the early galaxies.*

There are a great many pieces of observational evidence supporting the 'Big Bang' Theory but four (4) of them are considered fundamental.

Of these four, list TWO fundamental observations and for each, explain how it supported the 'Big Bang' Theory. 4

Ink for name of observation. Ink how it support B.B.

C.M.B.R As predicted, as Universe cooled as it expanded, background radiation was left.

Observed recession of galaxies Relationship between distance to galaxies and recession velocity is due to expansion of space

Ratios of primordial elements Measurement of relative amounts of light nuclei in distant clouds of primordial gas correspond with calculated predicted ratios from B B model.

Observed evolution of extragalactic objects over time Surveys show more distant (older) parts of Universe contain stronger radio sources than local regions.

Marks

Question 22 (5 marks)

a) Explain the electrical implications that follow if a short circuit should arise within an electrical circuit. 3

NOTE: New path is not necessarily shorter, but has low Resistance.
Potential Difference remains same and low R means very high current. Electrical energy is converted to heat energy and can cause fire to start.
Must indicate: new path Very low R → very high I → heat.

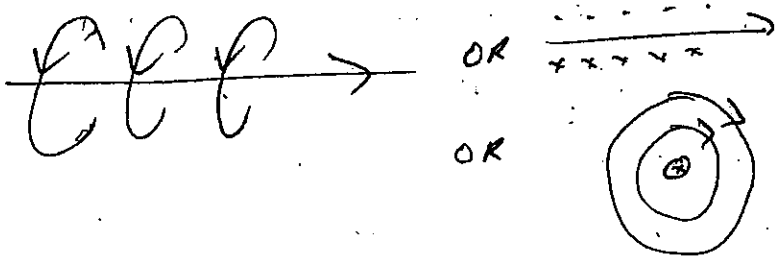
b) Name a device that could protect us against a dangerous short circuit. Explain exactly how this device operates. Simply naming a device does not gain a mark. 2

a fuse is made of low melting point metal which melts when a current above a specific value passes through it.
Fuses are rated for current.
Must indicate I above a specific current for second mark.

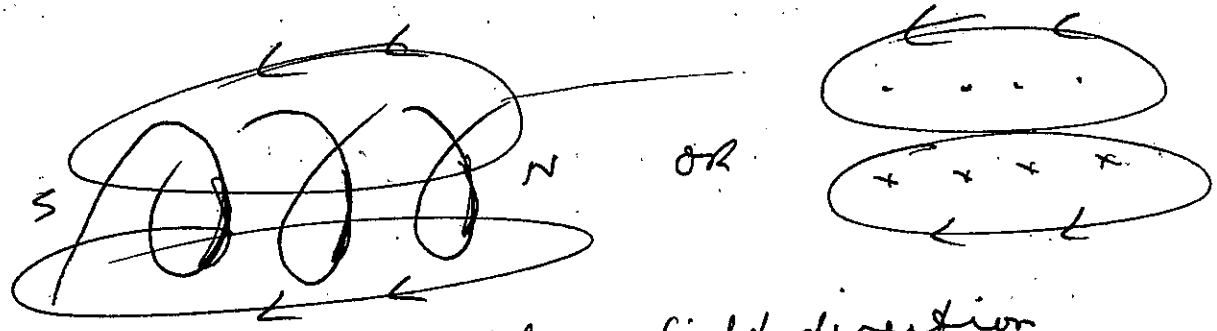
Question 23 (3 marks)

In the spaces below, sketch the magnetic field around the following:

a) A long, straight wire 1



b) A solenoid 2



2 mks only given if mag field direction is consistent with current direction and diagram clear 10 and neat.

Marks

Question 24 (2 marks)

Your task is to design the strongest electromagnet that you can.

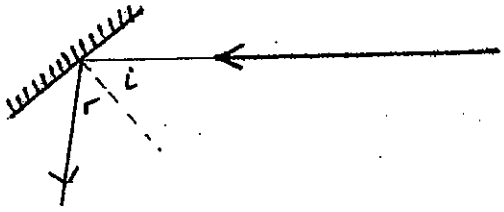
a) List the design features that you would include. 2

Many turns, tightly wound } all 3 points → 2 mks
High DC current } any 2 " → 1 mk
Soft iron core } any incorrect points give 1 mk max.

Question 25 (3 marks)

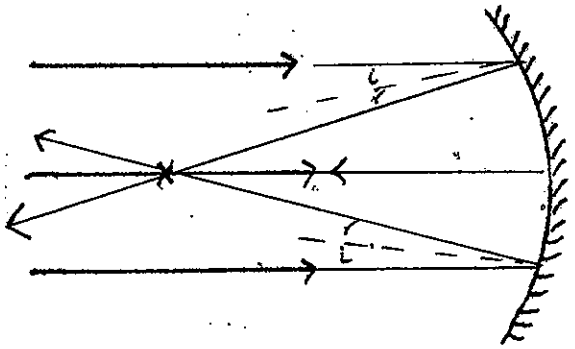
In each of the three diagrams below, draw the continuation of all light rays using a ruler. Label any significant angles. Note that the focal length of the concave mirror is 5 cm. Precise angles will not be measured in the marking of this question, so you do not have to use a protractor.

a)



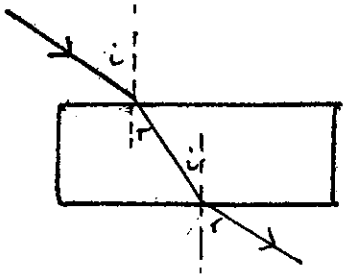
Plane Mirror

b)



Concave Mirror
Focal Length 5cm

c)



Transparent Glass Slab (actual size)

Lines must be straight with arrows
angles must be labelled on each diagram
any incorrect angle labels result in
loss of mark

Marks

Question 26 (2 marks)

A rock fisherman observes wave crests passing by at the rate of one every six seconds. He follows the progress of one crest and notes that it arrives at the beach, a distance of 400m away, approximately 130 seconds after it passes him.

Find the distance between the crests. 2

$T = 6$ sec $\quad v = f\lambda$

$f = \frac{1}{6}$ Hz $\quad \therefore \lambda = \frac{v}{f}$

$v = \frac{\text{dist}}{\text{time}}$ $\quad = \frac{3.076923077}{1/6}$

$= \frac{400}{130} = 3.076923077$ m/s $\quad = 18.5$ m ---- 2 mks

Question 27 (2 marks)

The reverberation time for a room or concert hall is defined as the time it takes for a sound to die down to one millionth of its original intensity.

Which room in a normal household is likely to have the longest reverberation time. 2
Justify your decision.

Identify the concert room ------ 1 mk

Mention that hard surfaces or tiled walls reflect sound waves --- 1 mk

Question 28 (2 marks)

Outline one useful application of each of the reflective surfaces listed below.

a) A concave reflective surface

State the use / application

AND give reason for use (application) 1

b) A convex reflective surface

State the use / application

AND give reason for use / application 1

Marks

Question 29 (2 marks)

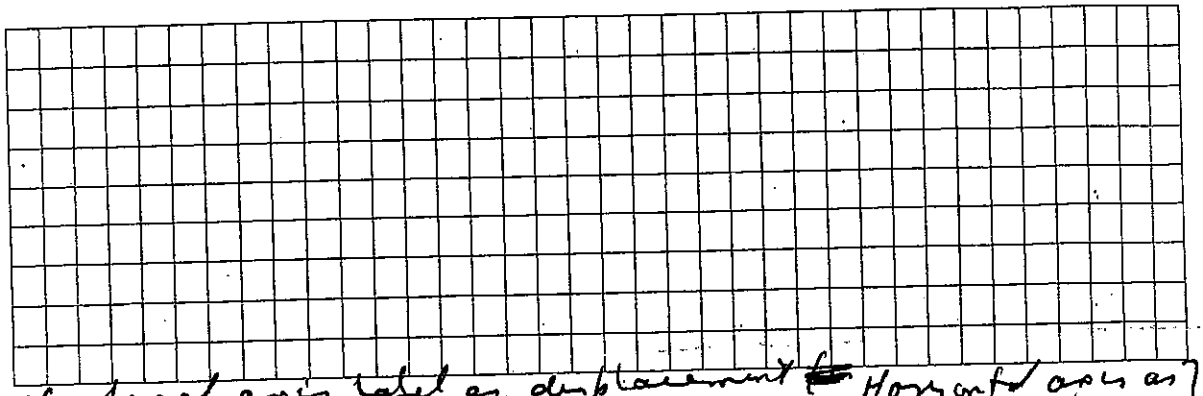
If the intensity of a light source is 14 Lux (lx) at a distance of 30 metres, calculate the intensity you would expect at a distance of 8 metres from the source. 2

$\frac{I_a}{I_b} = \frac{d_b^2}{d_a^2}$ $\therefore I_b = I_a d_a^2 / d_b^2 = \frac{14 \times 30^2}{8^2}$ --- 1 mk

$= 197$ lx --- 1 mk

Question 30 (1 mark)

On the diagram below, draw an example of a transverse wave with a 2cm amplitude and a 7cm wavelength. 1

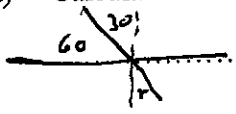


1 mk

Question 31 (5 marks)

A light wave currently travelling in air is about to enter a block of perspex of Refractive Index 1.4 at an angle to the surface of 60°.

a) Calculate the number of degrees that the wave will deviate through as it enters the glass. 3



$\frac{\sin i}{\sin r} = 1.4$ $\frac{\sin 30}{\sin r} = 1.4$ --- 1 mk

$\sin r = \frac{\sin 30}{1.4} = \frac{0.5}{1.4} = 0.357$

$r = 20.9°$ --- 1 mk

Deviation $= 30 - 20.9 = 9.1°$ --- 1 mk

b) Calculate the speed of the light wave in the perspex 2

$\frac{n_1}{n_2} = \frac{v_2}{v_1}$ $\therefore v_2 = \frac{n_1 v_1}{n_2} = \frac{1 \times 3 \times 10^8}{1.4}$ --- 1 mk

$= 2.1 \times 10^8$ m/s --- 1 mk

Marks

Question 32 (2 marks)

Gamma X Rays Ultra Violet	Light	Infra Red Microwaves Television Radio

State two reasons why all of the above types of radiation are similar. 2

* all travel at same speed, c, or 3×10^8 m/s
* electromagnetic waves, with electric wave + mag wave @ 90°
* do not require a medium
* all emitted by sun ANY TWO = 2 mks.
* self-propagating & all transverse

Question 33 (6 marks)

Using the work of Aristotle, Kepler and ONE other astronomer, show how the model of the universe has changed AND propose reasons for the acceptance OR rejection of the various models. 6

Outline clearly and correctly the models of 3 astronomers and the reasons for acceptance/rejection of their models 5-6 mks

Outline clearly and correctly the models of 2 astronomers and the reasons for acceptance/rejection, OR
Mention briefly the models of 3 astronomers but the reasons for acceptance/rejection are not linked to the astronomer's time 3-4

Outline clearly and correctly the models of 1 astronomer and reasons for acceptance/rejection of his model, OR
Mention briefly the models of 2 astronomers and give a generalised statement for acceptance/rejection of their models