

Baulkham Hills High School

Yearly Examination

2016

Year 11

Physics

General Instructions:

- Reading time - 5 minutes
- Working time - 2 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Board approved calculators may be used
- The following are provided
 - Data sheet
 - Formula sheet
 - Periodic table

Ensure you write your **name, teacher** and **class** on the top of these TWO pages:

- p9 Section I - Multiple Choice Answer Sheet
- p10 Section II - Extended Response

Total Marks: 85

This paper consists of TWO sections.

Section I – Multiple Choice

20marks

- Attempt Questions 1-20
- Allow about 30 minutes for this section

Section II – Extended Response

65 marks

- Attempt Questions 21-30
- Allow about 90 minutes for this section
- All working must be shown

Booklets and papers, used or unused, are NOT to be taken from the examination room.

Section I – Multiple Choice

20 Marks

Select the alternative, A, B, C or D which best answers the question and indicate your choice on the Multiple Choice Answer Sheet.

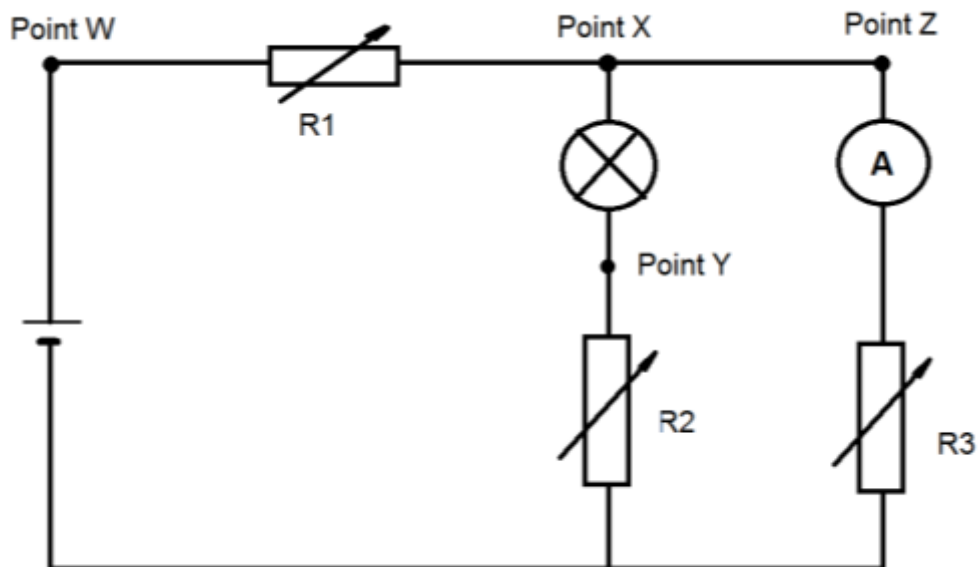
1. A sound wave with a frequency of 442 Hz is moving at a speed of 343 m/s. What is its wavelength?
 - (A) 1.51×10^5 m
 - (B) 0.780 m
 - (C) 1.29 m
 - (D) 785 m

2. A sound wave is altered so that its wavelength is increased but its amplitude is decreased. Which of the following statements are correct?
 - (A) The pitch of the sound wave is increased while its volume is decreased
 - (B) The pitch of the sound wave is decreased while its volume is decreased
 - (C) The pitch of the sound wave is increased while its volume is increased
 - (D) The pitch of the sound wave is decreased while its volume is increased

3. Which of the following statements about refraction is INCORRECT?
 - (A) The angle of incidence is measured between the normal and the incident ray
 - (B) The speed of the incident ray and refracted ray are different
 - (C) The incident and refracted ray will have the same frequency
 - (D) The incident and refracted ray will have the same wavelength

4. The brightness of a light source is measured at a certain distance. The luminosity of the light source is then halved and the distance at which it is measured is altered such that brightness remains the same. Which of the following statements is CORRECT?
 - (A) Altered distance = $\frac{1}{4}$ x original distance
 - (B) Altered distance = $\sqrt{2}$ x original distance
 - (C) Altered distance = 4 x original distance
 - (D) Altered distance = $\frac{1}{\sqrt{2}}$ x original distance

5. Consider the circuit below for questions 5-7.



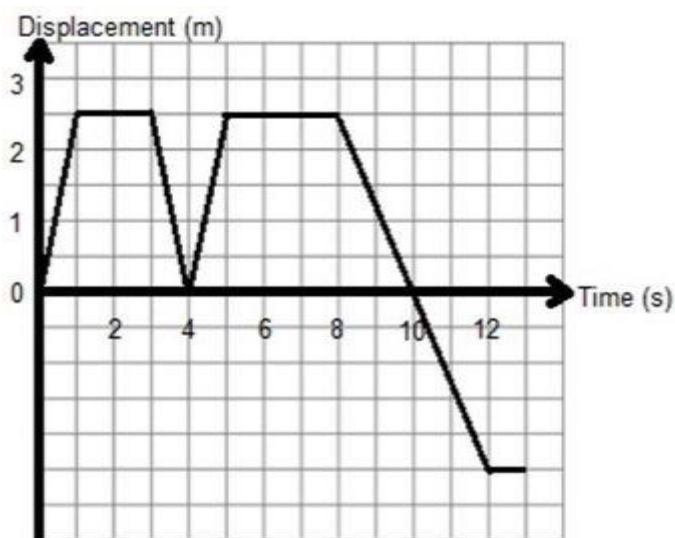
Which of the following actions will result in the highest reading on the ammeter?

- (A) Reduce the resistance of R1, R2 and R3 to minimum
 - (B) Reduce the resistance of R1 and R2 to minimum and increase the resistance of R3 to maximum
 - (C) Increase the resistance of R1 and R3 to maximum and reduce the resistance of R2 to minimum
 - (D) Reduce the resistance of R1 and R3 to minimum and increase the resistance of R2 to maximum
6. If the voltage drop across the light bulb cannot be measured directly, what information can be used instead to calculate it?
- (A) The voltage across R2, the voltage across R3 and the ammeter reading
 - (B) The voltage across R1 and the voltage across R2
 - (C) The voltage of the battery and the voltage across R1
 - (D) None of the options above provided sufficient data to determine the voltage across the light bulb
7. It is decided to install a fuse in the circuit to prevent electrocution from physical contact with either the light bulb or the wiring.

Which is the best location for this fuse?

- (A) Point W
- (B) Point X
- (C) Point Y
- (D) Point Z

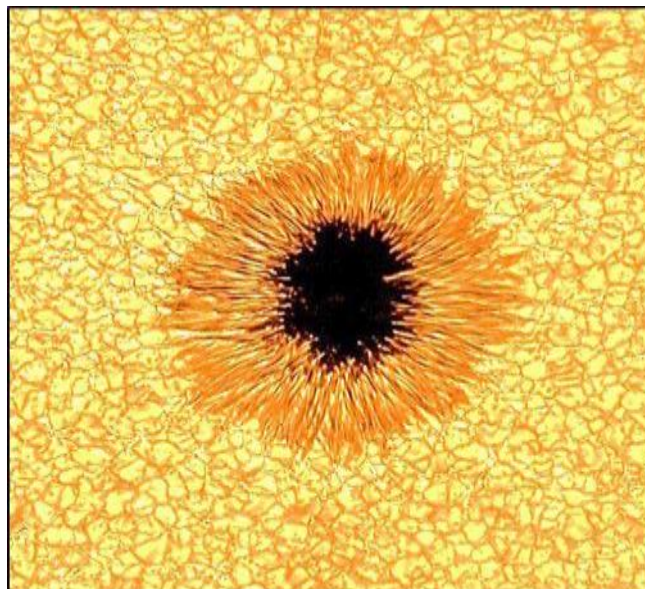
8. Consider the graph below for questions 8-9.



Between which of the following two times is the velocity zero?

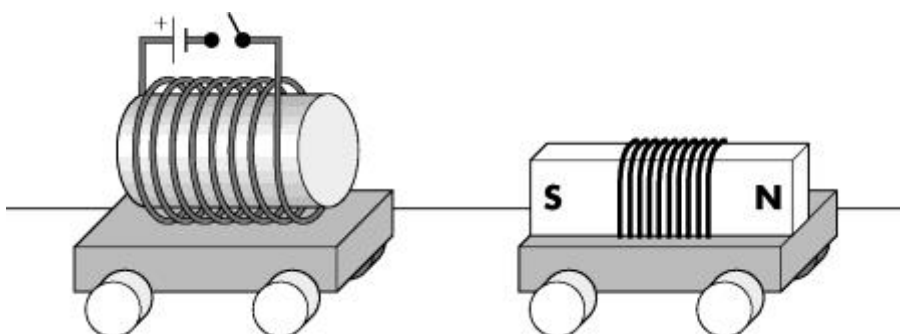
- (A) $t=1$ s and $t=3$ s
 - (B) $t=2$ s and $t=7$ s
 - (C) $t=8$ s and $t=12$ s
 - (D) $t=7$ s and $t=13$ s
9. What is the velocity of the object between 8 and 10 s?
- (A) 0.80 m/s
 - (B) -0.80 m/s
 - (C) 1.25 m/s
 - (D) -1.25 m/s
10. Which of the following can be explained by Hubble's discovery of universe expansion?
- (A) The spiral movement of our own galaxy
 - (B) The motion between planets, comets and asteroids around a central star
 - (C) Redness or blueness of stars due to the type of fusion and expanding forces
 - (D) The speed and acceleration of distant celestial objects outside the Milky Way as measured from Earth
11. Arrange the following objects from lowest to highest surface temperature.
- I. Yellow supergiant
 - II. Red giant
 - III. Orange main sequence star
 - IV. White dwarf
- (A) I, II, III, IV
 - (B) IV, III, II, I
 - (C) I, III, IV, II
 - (D) II, III, I, IV

12. The image shows a close-up photograph of the Sun taken by a spacecraft.



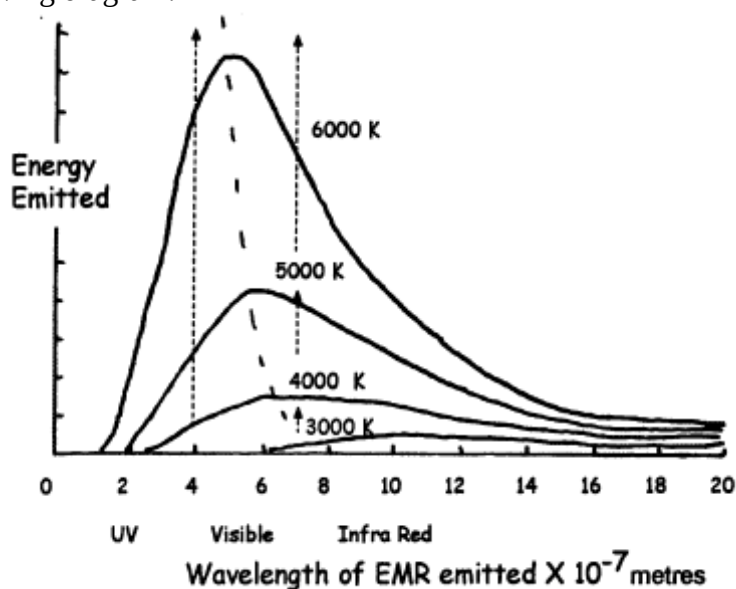
Which of the following correctly describes the nature of the object shown?

- (A) The darker region has strong magnetic activity, lower temperature compared to its surroundings and moves. Its presence increases the intensity of solar wind.
 - (B) The darker region has strong magnetic activity, higher temperature compared to its surroundings and moves. It may disappear periodically.
 - (C) The darker region has strong magnetic activity, higher temperature compared to its surroundings and has a fixed size. It rotates in a regular period.
 - (D) The darker region has strong magnetic activity, lower temperature compared to its surroundings and moves. Its presence decreases the intensity of solar wind.
13. The diagram below shows an air solenoid mounted on a frictionless trolley near a bar magnet mounted on a trolley. The total mass of both trollies and its components are the same.



- (A) Both trolleys will move apart from one another with the same magnitude of acceleration.
- (B) The air solenoid trolley will move to the left and the magnet trolley will remain at rest.
- (C) The air solenoid trolley will move to the right and the magnet trolley will remain at rest.
- (D) Both trolleys will move towards one another with the same acceleration.

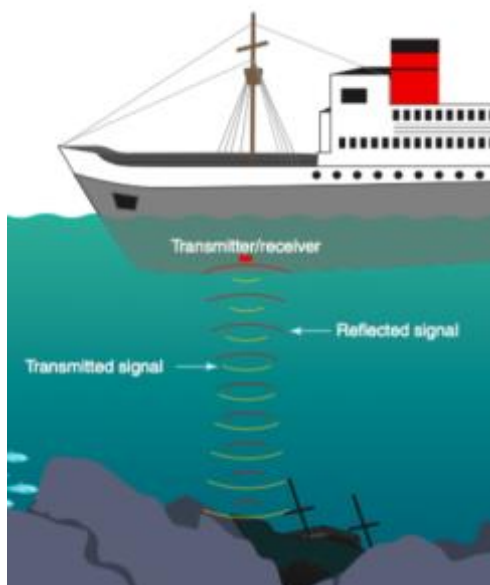
14. Which one of the following values is closest to the electric power generated by a heater running at a voltage of 230 V with a current of 730 mA?
- (A) 167 900 W
(B) 168 W
(C) 3.17 W
(D) 0.315 W
15. The particles that can be deflected in a magnetic field are:
- (A) α , β
(B) γ , α
(C) β , γ
(D) α , γ , β
16. Refer to the following diagram.



For a black body at 8000 K, the intensity of radiation in the visible part of the electromagnetic spectrum would be

- (A) twice that for 4000 K
(B) less than that for 6000 K
(C) greater than that at 6000 K
(D) equal, as only the type of radiation changes

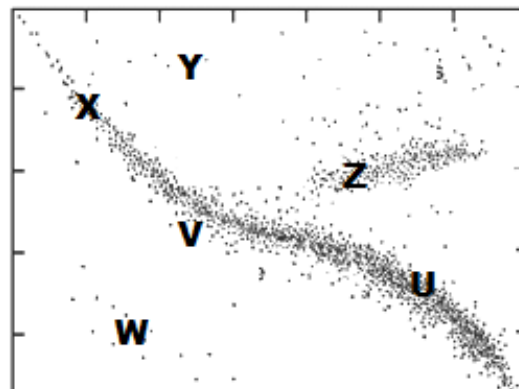
17. A ship fitted with SONAR is used to measure the distance between the ship to the ocean floor. A signal was sent out from the ship, reflected by the ocean floor and received by the ship 2.8 seconds after the signal was sent.



Given that the speed of sound in water is 1482 m/s, calculate the distance from the ship to the ocean floor.

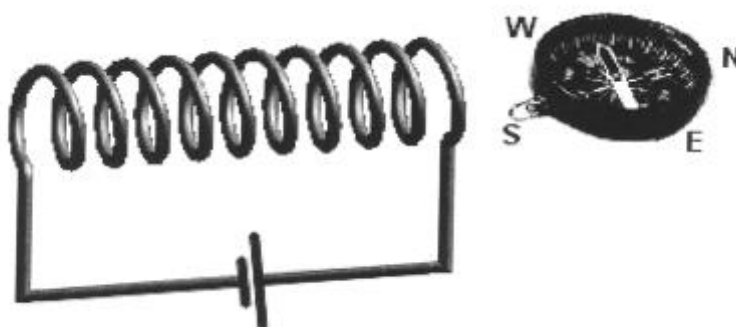
- (A) 4100 m
 - (B) 2070 m
 - (C) 530 m
 - (D) 1.9×10^{-3} m
18. In which of the following scenarios is the concept of the equivalence between mass and energy most relevant?
- (A) burning of coal to produce heat
 - (B) nuclear power
 - (C) electrical energy
 - (D) gravitational potential energy

19. The following is a H-R diagram.



Which of the following two stars would NOT be fusing hydrogen as their main fuel source?

- (A) V and W
 - (B) U and X
 - (C) Y and Z
 - (D) V and Z
20. A 12 V battery is to be connected to a copper solenoid in order to produce a strong magnetic field which will be registered by the stationary compass sitting at the end of the solenoid as shown in the diagram.



Once connected, to which letter will the north pole (painted black) of the compass needle now point?

- (A) N
- (B) S
- (C) E
- (D) W

End of Section I

Name: Teacher:..... Class:.....

Baulkham Hills High School
Yearly Examination 2016

Year 11
Physics

Section I – Multiple Choice Answer Sheet

Select the response A, B, C or D which best answers the question by placing an 'X' 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
16	A	B	C	D
17	A	B	C	D
18	A	B	C	D
19	A	B	C	D
20	A	B	C	D

Ensure you write name/teacher/class on this page.

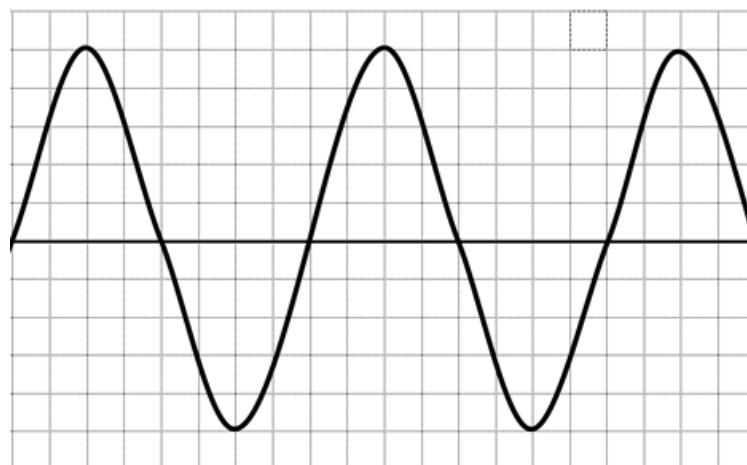
Section II - 65 marks

Attempt Questions 21-30

Answer the questions in the space provided

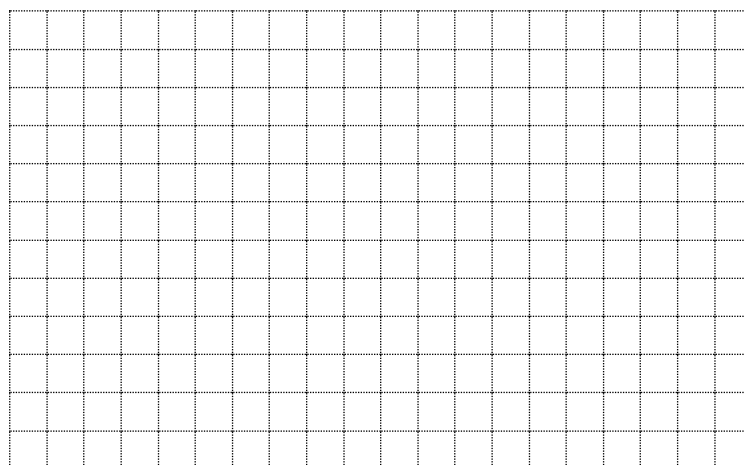
Question 21 (5 marks)

The screen of a cathode ray oscilloscope is shown below. The trace is produced from the input from a microphone.



x scale: 1 grid = 1.0 ms

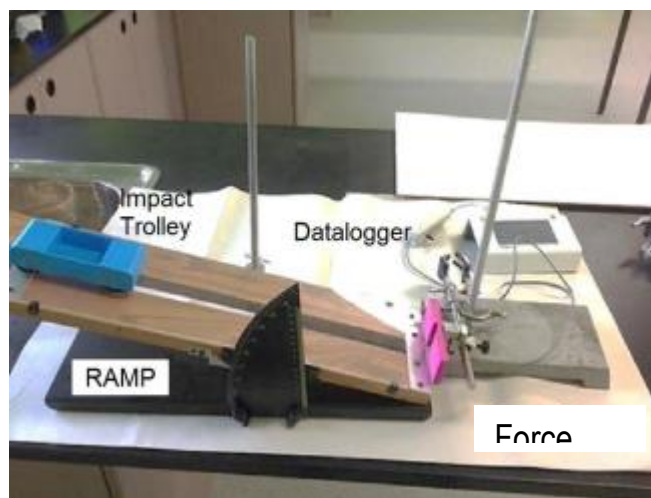
y scale: 1 grid = 5.0mV



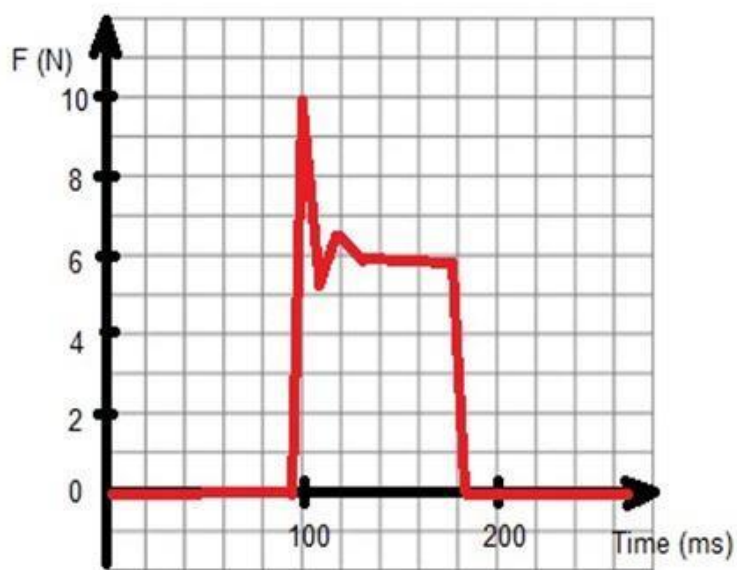
- (a) Using the grid above, sketch a labelled diagram to show a representation of the particles of air as this wave passes. The crests and troughs should correspond to the key features of your diagram. 2
- (b) Find the period of the sound wave. 1
- (c) Calculate the wavelength of the sound wave if the sound wave travels at a speed of 343 m/s. 2

Question 22 (5 marks)

Mr Blunden is investigating the impact force of a trolley moving down a ramp. The image below shows his experimental set up. At the base of the ramp, there is a force sensor that measures the impact force over time.



The impact was recorded by the data logger as shown below.



- (a) State how Mr Blunden could determine the impulse from the graph above.

1

.....
.....

Question 22 continues on the next page

- (b) Mr Blunden changes the contact pad to one made with soft rubber instead of hard plastic. 2
Explain how the graph would change.

.....

.....

.....

.....

- (c) Mr Blunden wants to use the experiment to compare the impact force between different contact pad materials. Describe what should be done during this experiment to ensure it is accurate and reliable. 2

.....

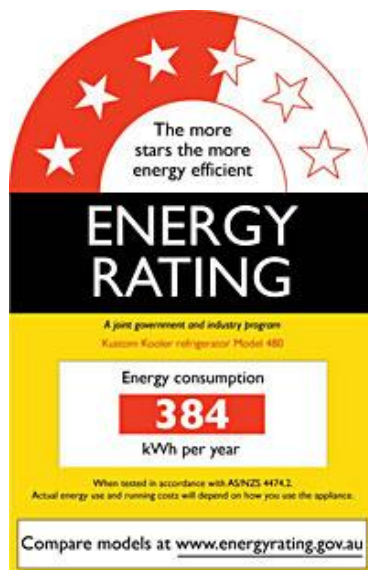
.....

.....

.....

Question 23 (5 marks)

Mr Phung is shopping for a new refrigerator and comes across one with this sticker on it.



- (a) Explain why kilowatt-hours is the preferred unit used for energy in this scenario rather than joules and calculate how many joules are in 1 kWh. 2

.....

.....

.....

.....

- (b) Mr Phung decides to buy the refrigerator. Given that the cost of electricity is \$ 0.22/kWh, calculate how much it would cost to run for refrigerator for 90 days. 3

.....

.....

.....

.....

.....

.....

Question 24 (8 marks)

- (a) Outline the prediction of the expansion of the universe by Friedmann and how Hubble later verified it. **4**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

- (b) Describe the changes to the energy radiated by a black body if its temperature is increased. **2**

.....

.....

.....

.....

- (c) Mr Chilwell is performing an experiment in his underground nuclear lab and discovers a form of radiation that can pass through a sheet of paper but cannot pass through aluminium foil. Identify what type of radiation this most likely is and justify your answer. **2**

.....

.....

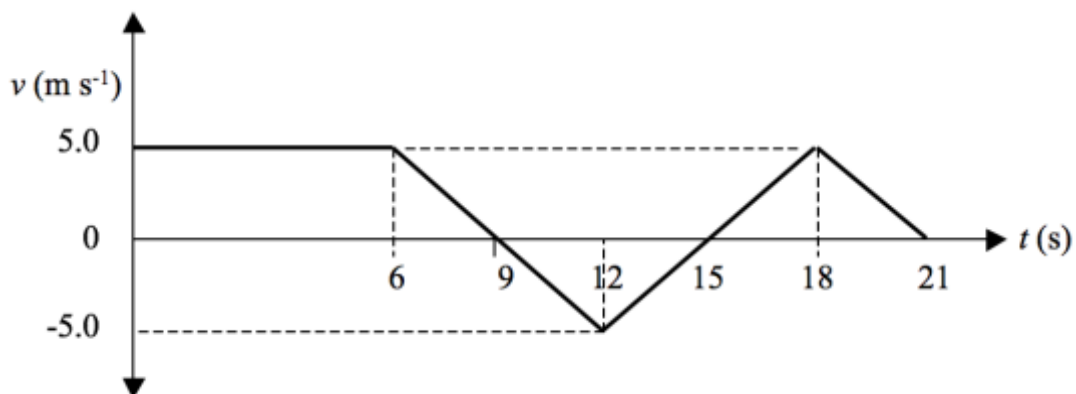
.....

.....

Question 25 (9 marks)

- (a) A velocity versus time graph for a car moving along a straight road is shown.

3



At 0 seconds, the car's displacement is 0 m. Find the car's displacement after 18 seconds.

.....

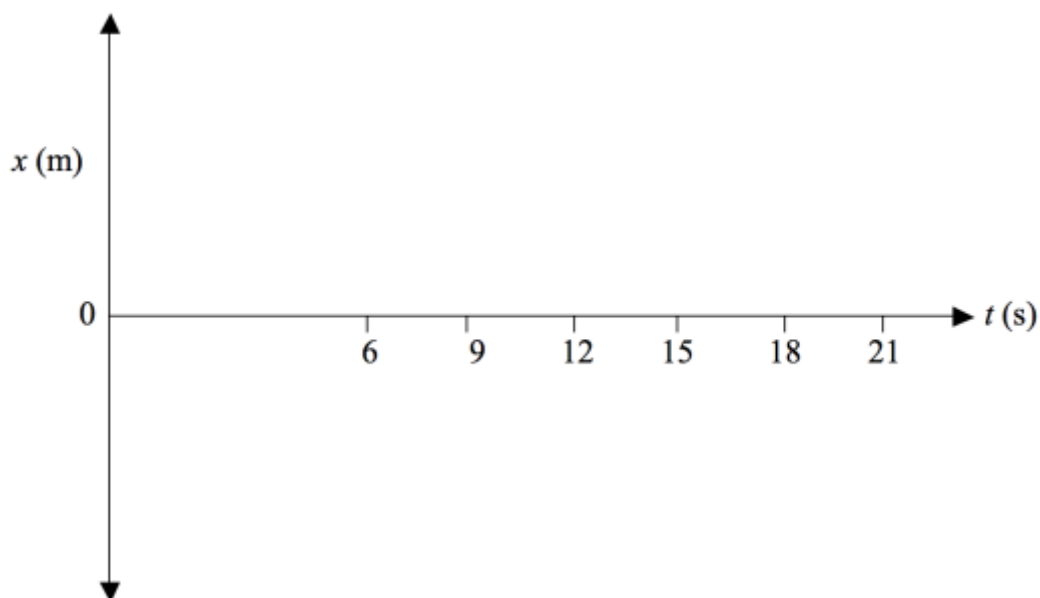
.....

.....

.....

- (b) On the axes below, sketch a graph of the car's displacement (x) versus time.

3



Question 26 continued on the next page

- (c) A car of mass 1.25×10^3 kg is travelling at 40.0 km/h east before colliding with a stationary vehicle with a mass of 12.4×10^3 kg. The two vehicles stick together and move off as one system after the collision. Calculate the velocity of the vehicles immediately after collision.

3

.....

.....

.....

.....

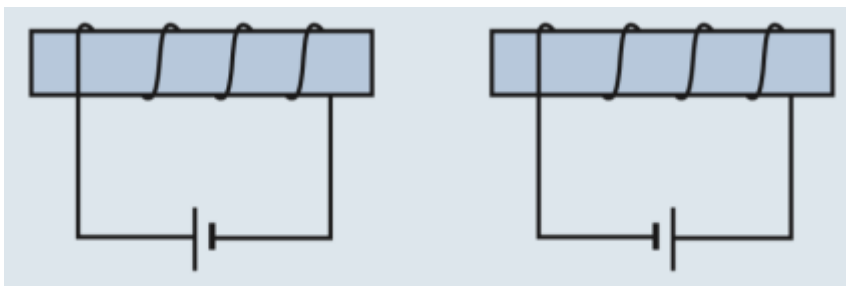
.....

.....

Question 26 (6 marks)

- (a) The following is a diagram of two electromagnets.

2



Label the polarities of the magnets (N or S) and identify whether they will attract or repel.

.....
.....

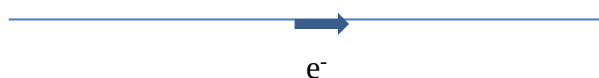
- (b) During the course of your Preliminary Physics studies, you performed a first-hand investigation to build an electromagnet. Outline the method you utilised.

3

.....
.....
.....
.....
.....
.....
.....
.....

- (c) The following is a diagram of a current carrying conductor. Using appropriate scientific conventions, draw the magnetic field around the wire.

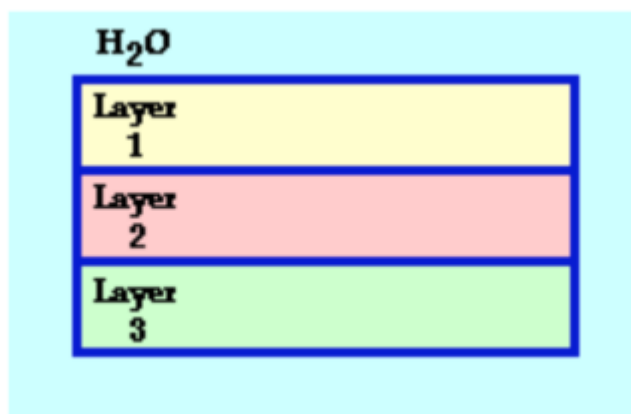
1



Question 27 (9 marks)

The following diagram shows a series of transparent materials surrounded by water ($n=1.33$). Layer 1 has an index of refraction of 1.91, layer 2 has an index of refraction of 1.52 and layer 3 has an index of refraction of 1.36.

A light ray in water approaches the boundary with layer 1 at an angle of incidence of 62° .



- (a) Calculate the angle of refraction as observed in layer 1. 2

.....

.....

.....

.....

- (b) As the light ray travels from layer 1 to layer 2, will it bend towards or away from the normal? 1

.....

.....

Question 27 continues on the next page

- (d) Determine the angle of refraction for the light ray as it moves from layer 3 into the water. 1

.....

.....

- (d) State the definition of a critical angle and find the critical angle if light were to pass from layer 2 to layer 3. 2

.....

.....

.....

.....

.....

.....

- (e) Identify the conditions necessary for total internal reflection and outline how it is used in optical fibres. 3

.....

.....

.....

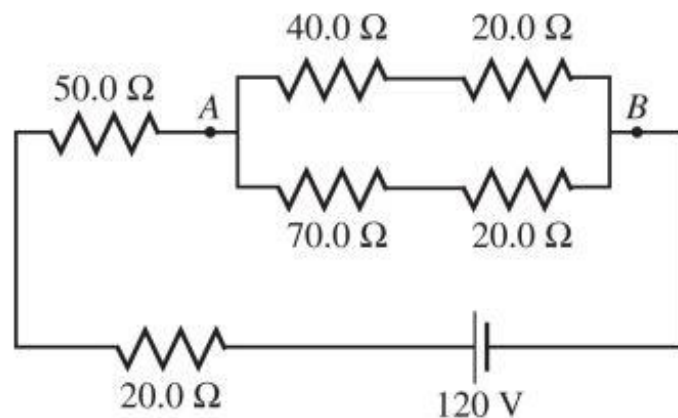
.....

.....

.....

Question 28 (7 marks)

The following is a diagram of an electric circuit.



- (a) Calculate the total resistance of the circuit. 2

.....

.....

.....

.....

- (b) Calculate the total current of the circuit. 1

.....

.....

- (c) Calculate the potential difference between points A and B. 2

.....

.....

.....

.....

- (d) Calculate the power dissipated by the 40.0 Ω resistor. 2

.....

.....

.....

.....

Question 29 (7 marks)

During the final phase of sending the *Curiosity* to land on Mars, NASA stated that it took a radio signal 12 minutes and 50 seconds to reach the descending rover.

- (a) Calculate the distance between the *Curiosity* and Ground Control on Earth in the final phase. 1

.....

.....

.....

- (b) The *Curiosity* transmits its signal in an X-band (8.00–12.00 GHz) radio wave. 2

Determine the range of wavelengths of these signals.

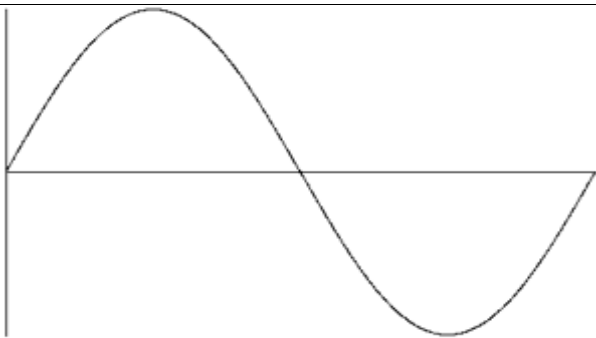
.....

.....

.....

.....

- (c) An example of a signal that is sent out by the *Curiosity* is shown below. This signal needs to undergo frequency modulation before it can be transmitted. Sketch what the modulated wave should look like. 2

Signal	
Modulated Wave (FM)	

Question 29 continues on the next page

Question 29 (continued)

- (d) Some planets like Mars have a weak or absent ionosphere compared to Earth. **2**

Describe ONE possible impact of this upon long-range radio communication between two points on the surface of such planets.

.....

.....

.....

.....

Question 30 (4 marks)

Using your knowledge and understanding of physics, assess the effects of sunspot activity on the Earth's power grid and satellite communications. **4**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

End of Section II
End of Paper

Name: Marking Criteria Teacher:..... Class:.....

Baulkham Hills High School Yearly Examination 2016

Year 11 Physics

Section I – Multiple Choice Answer Sheet

Select the response A, B, C or D which best answers the question by placing an 'X' on the grid below.

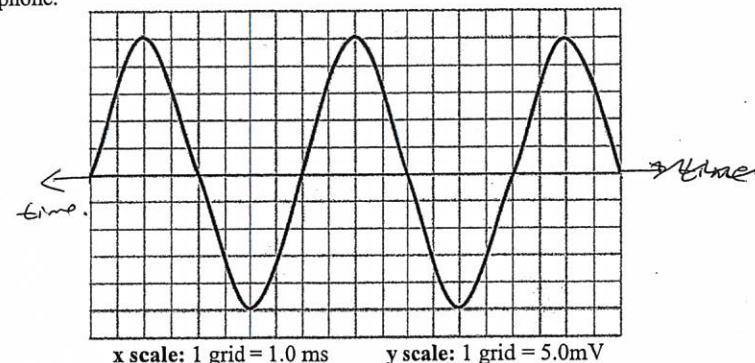
1	A	☒	C	D
2	A	☒	C	D
3	A	B	C	☒
4	A	B	C	☒
5	A	B	C	☒
6	☒	B	C	D
7	A	☒	C	D
8	☒	B	C	D
9	A	B	C	☒
10	A	B	C	☒
11	A	B	C	☒
12	☒	B	C	D
13	☒	B	C	D
14	A	☒	C	D
15	☒	B	C	D
16	A	B	☒	D
17	A	☒	C	D
18	A	☒	C	D
19	A	B	☒	D
20	A	☒	C	D

Ensure you write name/teacher/class on this page.

Section II - 65 marks
Attempt Questions 21-30
Answer the questions in the space provided

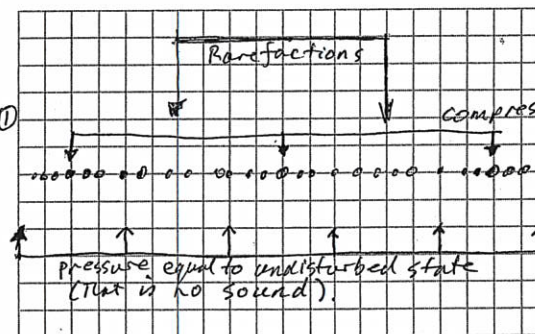
Question 21 (5 marks)

The screen of a cathode ray oscilloscope is shown below. The trace is produced from the input from a microphone.



Accurate +
Reasonable
approximation ①
air Rarefactions +
compressions labelled ①

Direction
of energy
propagation



- (a) Using the grid above, sketch a labelled diagram to show a representation of the particles of air as this wave passes. The crests and troughs should correspond to the key features of your diagram. 2

- (b) Find the period of the sound wave. 1

From upper graph: 8 grids $\times$ 1.0 ms/grid = period T
 $\therefore T = 8 \times 1 = 8 \text{ ms}$ ①

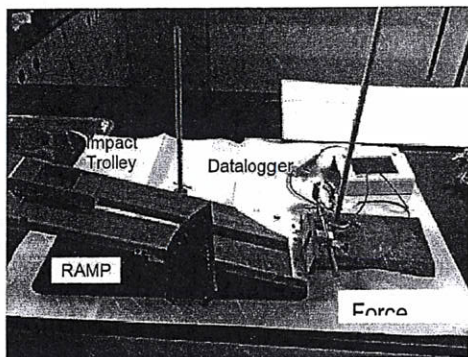
- (c) Calculate the wavelength of the sound wave if the sound wave travels at a speed of 343 m/s. 2

$V = \lambda f = \lambda / T \therefore \lambda = VT = 343 \times 8 \times 10^{-3}$
 $\therefore \lambda = 2.74 \text{ m}$

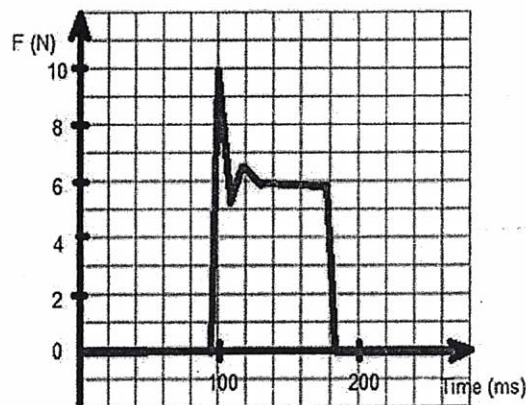
For 2 marks - must show complete working ①
correct answer with unit ①

Question 22 (5 marks)

Mr Blunden is investigating the impact force of a trolley moving down a ramp. The image below shows his experimental set up. At the base of the ramp, there is a force sensor that measures the impact force over time.



The impact was recorded by the data logger as shown below.



- (a) State how Mr Blunden could determine the impulse from the graph above.

Impulse can be determined from the area under the graph as $\text{Impulse (I)} = \text{Force (F)} \times \text{Time (t)}$.

Question 22 continues on the next page

- (b) Mr Blunden changes the contact pad to one made with soft rubber instead of hard plastic. Explain how the graph would change.

Assuming a completely inelastic collision then

- The soft rubber will increase the stopping distance and stopping time
- Impulse ($\vec{I}$) = change in momentum $\Delta \vec{p} = \text{constant}$ for inelastic collisions as same initial velocity ($\vec{v}$) and same final velocity (0). $\therefore$ area under graph is the same for both scenarios.
- As $I = Ft$, = constant, $\therefore$ longer t means smaller F . $\therefore$ graph will be flatter + longer

- (c) Mr Blunden wants to use the experiment to compare the impact force between different contact pad materials. Describe what should be done during this experiment to ensure it is accurate and reliable.

Reliable! Repeat experiment multiple times and take the average - results should not vary too much

Accurate! Ensure force meter is calibrated (maybe via a National Measurements body) and correctly zeroed.
or Use a more precise meter - finer calibrations.

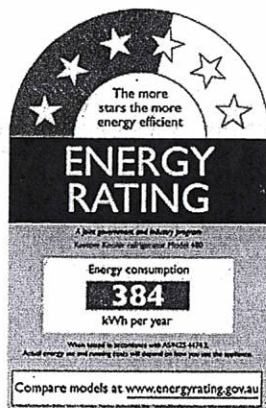
Note: A digital meter is not more or less precise than an analogue meter, although it may be easier to read. The precision/accuracy comes from the TRANSDUCER.

22(b) Continued: MARKS for 2 marks require 3 points above. Note this is a Q on EXPLANATION NOT a DESCRIPTION

Note * because plastic is hard should have an elastic collision (like billiard balls) - with short t high F
* because rubber is elastic, should have an elastic collision! with long t , low F & same area for both.
* But note $\Delta \vec{p}$ for elastic collision is $2 \times \Delta \vec{p}$ for inelastic collision. ($\Delta \vec{p}_{\text{elastic}} = m\vec{v}_1 - m\vec{v}_2 = 2m\vec{v}_1$; $\Delta \vec{p}_{\text{inelastic}} = (m\vec{v}_1 - 0)$)

Question 23 (5 marks)

Mr Phung is shopping for a new refrigerator and comes across one with this sticker on it.



$$1 \text{ kWh} = 10^3 \times (60 \times 60) \text{ s} \\ = 3.6 \text{ MJ} \text{ (1)}$$

* MUST show working
as Q says calculate.

just writing

$$1 \text{ kWh} = 3.6 \text{ MJ} = \text{zero.}$$

- (a) Explain why kilowatt-hours is the preferred unit used for energy in this scenario rather than joules and calculate how many joules are in 1 kWh. 2

either = (1) {
• 'kWh' is a more practical unit of ENERGY than Joules.
It is easy to see that a device which runs at 0.5W
will use 1 kWh of Energy in 2 hours.
• kWh is a larger unit than Joules and so is 'better' due to
large numbers of J. But note, could give units in MJ !!
→ accepted as answer is in text.

- (b) Mr Phung decides to buy the refrigerator. Given that the cost of electricity is \$ 0.22/kWh, 3
calculate how much it would cost to run for refrigerator for 90 days.

$$384 \text{ kWh/year} \times \left[\frac{90}{365} \right] \text{ years} = 94.685 \text{ kWh.}$$

$$94.685 \text{ kWh} \times \$0.22 / \text{kWh} = \$20.8$$

For 3 MARKS. must show working,
correct result,
units (\$).

Question 24 (8 marks)

- (a) Outline the prediction of the expansion of the universe by Friedmann and how Hubble later verified it. 4

1 - Friedmann's mathematical solutions OR 3
possible models of a dynamic universe.

1 - Red shift

1 - Relating spectral lines to red shift.

1 - Expansion at an accelerating rate - further
objects are moving away faster.

- (b) Describe the changes to the energy radiated by a black body if its temperature is increased. 2

1 - Total energy emitted increases.

1 - DOMINANT WAVELENGTH decreases. (wavelength
decreases is NOT accepted.)

- (c) Mr Chilwell is performing an experiment in his underground nuclear lab and discovers a form of radiation that can pass through a sheet of paper but cannot pass through aluminium foil. Identify what type of radiation this most likely is and justify your answer. 2

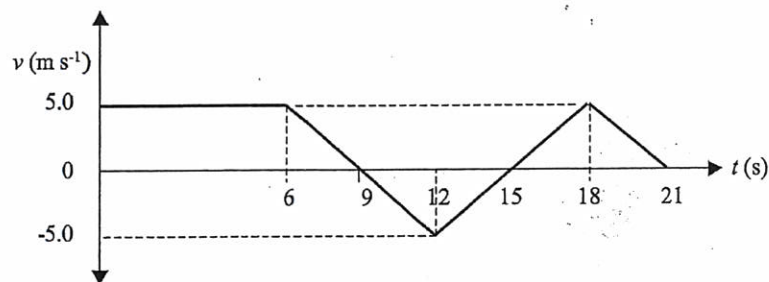
1 - Beta radiation

1 - Justification (mention why it can't be alpha/gamma
OR justify using properties of beta radiation.)

Question 25 (9 marks)

- (a) A velocity versus time graph for a car moving along a straight road is shown.

3

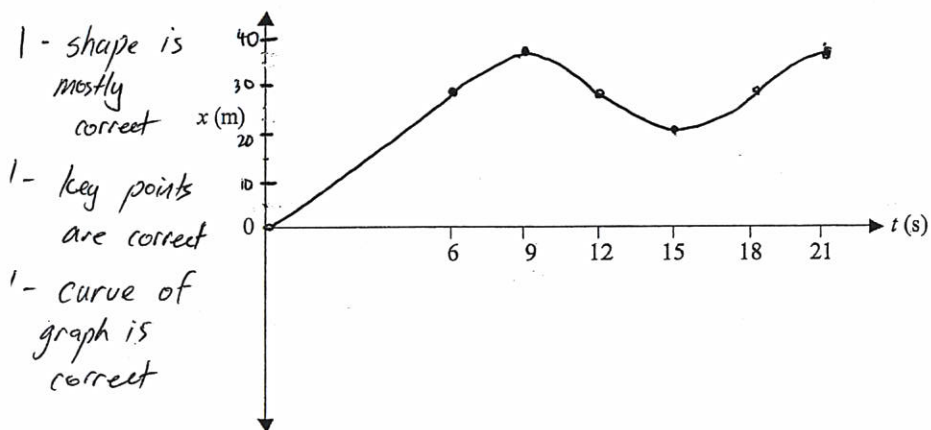


At 0 seconds, the car's displacement is 0 m. Find the car's displacement after 18 seconds.

- 1 - working out
- 1 - correct answer (30 m)
- 1 - correct direction (positive, forwards, in the direction of initial motion).

- (b) On the axes below, sketch a graph of the car's displacement (x) versus time.

3



Question 26 continued on the next page

- (c) A car of mass 1.25×10^3 kg is travelling at 40.0 km/h east before colliding with a stationary vehicle with a mass of 12.4×10^3 kg. The two vehicles stick together and move off as one system after the collision. Calculate the velocity of the vehicles immediately after collision.

3

$$m_1 = 1.25 \times 10^3 \text{ kg} \quad m_2 = 12.4 \times 10^3 \text{ kg}$$

$$u_1 = \frac{40}{3.6} \text{ m/s} \rightarrow u_2 = 0 \text{ m/s}$$

$$m_c = 1.25 \times 10^3 + 12.4 \times 10^3$$

$$= 13.650 \text{ kg}$$

$$v_c = ?$$

$$m_1 u_1 + m_2 u_2 = m_c v_c$$

$$(1.25 \times 10^3) \left(\frac{40}{3.6} \right) + (12.4 \times 10^3)(0) = (13650)(v_c)$$

- 1 - correct working out / formula
- 1 - correct numerical answer
- 1 - correct significant figures (3)

$$v_c = \frac{(1.25 \times 10^3) \left(\frac{40}{3.6} \right) + (12.4 \times 10^3)(0)}{13650}$$

$$= 1.02 \text{ m/s east}$$

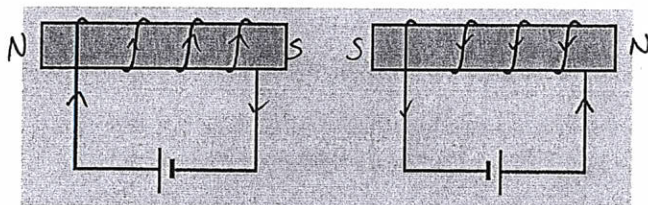
OR

$$= 3.66 \text{ km/h east}$$

Question 26 (6 marks)

- (a) The following is a diagram of two electromagnets.

2



Label the polarities of the magnets (N or S) and identify whether they will attract or repel.

1 - labelled polarities
1 - repel

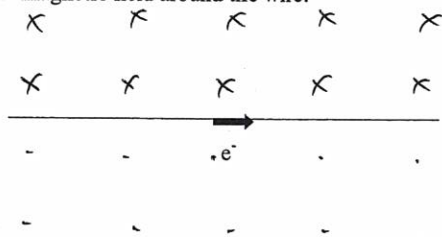
- (b) During the course of your Preliminary Physics studies, you performed a first-hand investigation to build an electromagnet. Outline the method you utilised.

3

1 - correct equipment identified in method
1 - method is clear in terms of circuit connections
1 - method is clear in terms of winding a wire around an iron core

- (c) The following is a diagram of a current carrying conductor. Using appropriate scientific conventions, draw the magnetic field around the wire.

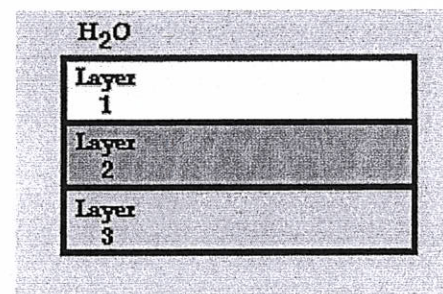
1



Question 27 (9 marks)

The following diagram shows a series of transparent materials surrounded by water ($n=1.33$). Layer 1 has an index of refraction of 1.91, layer 2 has an index of refraction of 1.52 and layer 3 has an index of refraction of 1.36.

A light ray in water approaches the boundary with layer 1 at an angle of incidence of 62° .



- (a) Calculate the angle of refraction as observed in layer 1.

2

formula $\frac{\sin i}{\sin r} = \frac{n_1}{n_2} \rightarrow \sim 38^\circ$

- (b) As the light ray travels from layer 1 to layer 2, will it bend towards or away from the normal?

1

away

Question 27 continues on the next page

- (d) Determine the angle of refraction for the light ray as it moves from layer 3 into the water. 1

62°

- (d) State the definition of a critical angle and find the critical angle if light were to pass from layer 2 to layer 3. 2

① Along boundary or 90° to the normal

① 63°

- (e) Identify the conditions necessary for total internal reflection and outline how it is used in optical fibres. 3

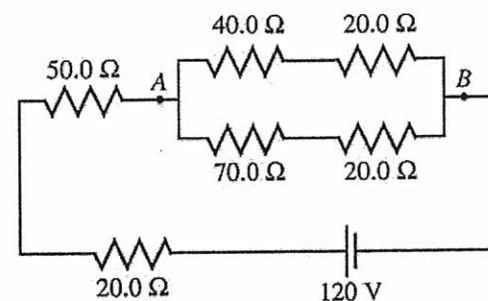
① different optical densities

① > critical angle

① carries information

Question 28 (7 marks)

The following is a diagram of an electric circuit.



- (a) Calculate the total resistance of the circuit. 2

working ①

answer 106 → ①

- (b) Calculate the total current of the circuit. 1

1.13 A

- (c) Calculate the potential difference between points A and B. 2

40.68 V

① ③ ①

- (d) Calculate the power dissipated by the 40.0 Ω resistor. 2

① - $P = VI$ 18 W - ①

or $P = I^2 R$

Question 29 (7 marks)

During the final phase of sending the *Curiosity* to land on Mars, NASA stated that it took a radio signal 12 minutes and 50 seconds to reach the descending rover.

- (a) Calculate the distance between the *Curiosity* and Ground Control on Earth in the final phase. 1

$$v = \frac{s}{t} \quad 2.16 \times 10^{11} \text{ m}$$

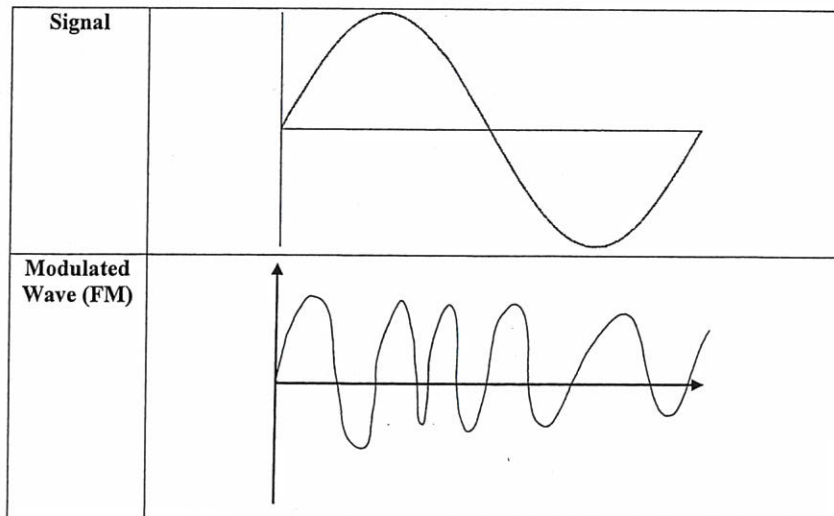
- (b) The *Curiosity* transmits its signal in an X-band (8.00–12.00 GHz) radio wave. 2

Determine the range of wavelengths of these signals.

$$v = f\lambda \quad (1)$$

$$3.75 \times 10^{-2} - 2.5 \times 10^{-2} \text{ m} \quad (1)$$

- (c) An example of a signal that is sent out by the *Curiosity* is shown below. This signal needs to undergo frequency modulation before it can be transmitted. Sketch what the modulated wave should look like. 2



Same
amp. = (1)
 $\Delta f_{\text{freq}} = (1)$

Question 29 (continued)

- (d) Some planets like Mars have a weak or absent ionosphere compared to Earth. 2

Describe ONE possible impact of this upon long-range radio communication between two points on the surface of such planets.

• name of problem eg. lack of reflection - (1)
• result of problem (1)

Question 30 (4 marks)

Using your knowledge and understanding of physics, assess the effects of sunspot activity on the Earth's power grid and satellite communications. 4

↑ solar wind (1)
- effect on power grid described (1)
- " " satellite communications (1)
assessment statement (1)

End of Section II
End of Paper

Question 29 continues on the next page