2007

Year 11
Half-Yearly Science Examination
Hurlstone Agricultural High School

Physics

General Instructions

- Reading time – 5 minutes

- Working time – 1 hour

- Board-approved calculators may be used

- Write using blue or black pen

- Draw diagrams using pencil

- A Formulae Sheet is provided at the back of this paper

Write your name below.

Marks

Total marks (45)

This section has two parts, Part A and Part B

Part A

 Total marks (10)

 • Attempt Questions 1 – 10

 • Allow about 15 minutes for this part

Part B

 Total marks (35)

 • Attempt Questions 11 – 16

 • Allow about 45 minutes for this part

TIC: Mr Robson
All sheets must be handed in separately at the end of the examination.

Student I.D. _____

Tick ☐ Coombes ☐ Pitt   ☐ Robson

Part A

Use the multiple-choice answer sheet.

Total marks (10)
Attempt Questions 1 – 10
**Allow about 15 minutes for this part**

1. A person walked along the following path. He travelled 4 m west then turned south and travelled a further 4 m then turned and travelled east for 7 m. What was the magnitude of the person's displacement from the starting point?

    (A)   25 m
    (B)   3 m
    (C)   15 m
    (D)   5 m

2. In an investigation carried out on a car's motion, the direction east was chosen as being the positive direction. At one time during the investigation, the car had a velocity of -25 m s^{-1}. Which of the following is the correct statement about the car's motion?

    (A)   The car was heading west and a negative acceleration would result in its slowing down.
    (B)   The car was heading west and a positive acceleration would result in its slowing down.
    (C)   The car was heading east and a negative acceleration would result in its slowing down.
    (D)   The car was heading east and a positive acceleration would result in its slowing down.

3. Consider the following situation. A 50 N force is acting on an 8 kg mass as shown in the diagram below, moving it to the right. Measurements taken found that the frictional force acting on the mass was 16 N.

    The magnitude of the acceleration of the mass is closest to:

    (A) 6.25 m s^{-2} (B) 5.25 m s^{-2} (C) 4.25 m s^{-2} (D) 3.25 m s^{-2}

The following graph shows velocity-time information about the motion of a ball dropped from rest onto a hard surface. Answer the following **two** questions using information from this graph.
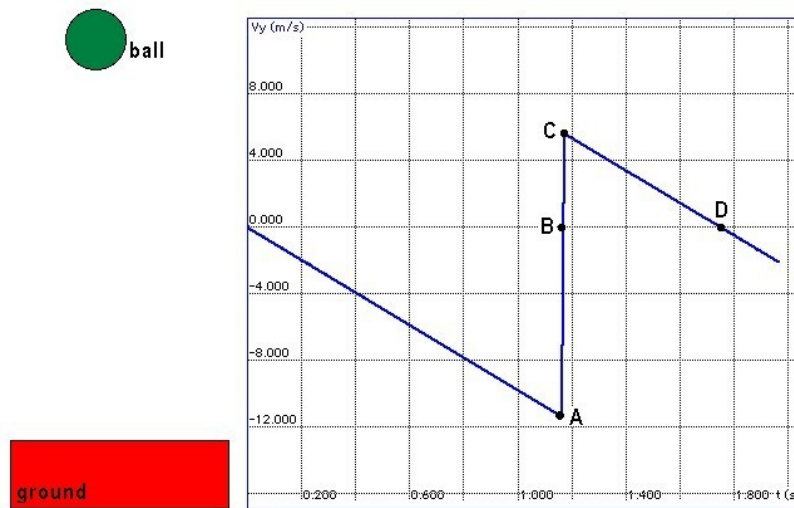
4.   The point on the graph corresponding to the ball being stationary on the ground is

(A)   A
(B)   B
(C)   C
(D)   D

5.   What is represented by the gradient (slope) of the line between points C and D?

(A) The average speed of the ball.
(B) The displacement of the ball.
(C) The distance travelled by the ball.
(D) The acceleration of the ball.

6.   Which of the following list contains only vector quantities

(A) Time , velocity , momentum, force
(B) Acceleration, force, velocity , kinetic energy
(C) Momentum, force, velocity, impulse
(D) Time, distance, kinetic energy, speed

7.   An astronaut weighs himself on a scale on Earth and the reading is 100 kg. If he takes the same scale up to the moon (g = 1.6 m s^{-2}) and weighs himself again the reading will be closest to

(A) 980 kg
(B) 16 kg
(C) 100 kg
(D) 160 kg

8.	The Kingswood below was travelling at its maximum speed of 50 km h^{-1} east along a freeway with a Toyota, two kilometres behind it also travelling east at 70 km h^{-1}.

How long would the Toyota take to catch up with the Kingswood and at what velocity relative to the road would the Toyota be travelling as if reached the Kingswood?

(A)	36 seconds and 20 km h^{-1} east

(B)	360 seconds and 20 km h^{-1} east

(C)	36 seconds and 70 km h^{-1} east

(D)	360 seconds and 70 km h^{-1} east

9.	9. A car travels around a corner clockwise as shown in the diagram below. Which of the following answers correctly shows the direction of the velocity and force vectors at the instant shown.
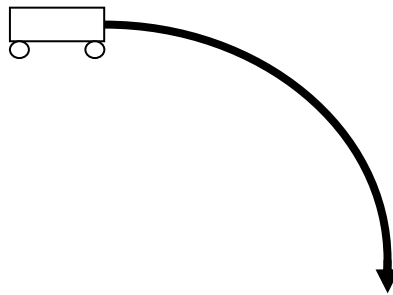
	Velocity	Force
(A)		
(B)	→	→
(C)		
(D)	→	↓

10. A car of mass 1000 kg is travelling at 45 km h^{-1}. The kinetic energy of the car is closest to

(A) 1.25 x 10^4 J

(B) 7.81 x 10^4 J

(C) 1.56 x 10^5 J

(D) 1.01 x 10^6 J

*** End Part A ***

Part B

Total marks (35)
Attempt Questions 11 – 16
Answer Questions 11 – 16 in the spaces provided.

11.   This question refers to the following description of the motion of an object.

   "An object travelled north for 3 seconds with a speed of 5 m s⁻¹ before slowing uniformly to rest in a period of 2 seconds. It began moving north again with a constant speed, covering a distance of 10 metres in 4 seconds. It then stopped instantaneously for a further 2 seconds before turning around and travelling south, accelerating uniformly to a speed of 6 ms⁻¹ in 4 seconds".

   (a) On the grid below, draw a velocity-time graph that represents the motion.   4 M
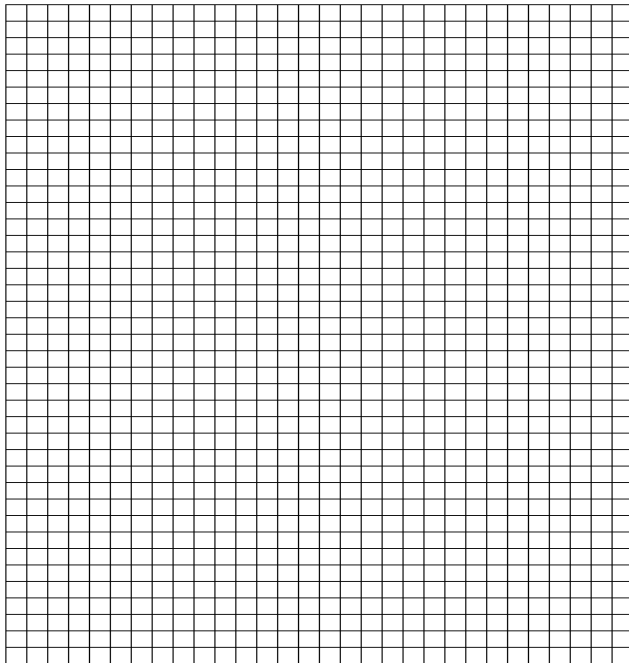
   (b) Using the graph, calculate the displacement of the object after 15 seconds.   2 M

   ....

   ....

   (c) Calculate the average acceleration of the object over the first 5 seconds   1 M

   ....

   ....

12. A student conducts an investigation to investigate the relationship between the radius of circular motion of a car and the maximum speed at which the car can travel in the circular path without losing traction (grip due to friction). The student drove the car around each circular path several times increasing speed gradually until the car lost traction. The following results were collected.

Radius (m)	10	15	20	25	30	35
Maximum Speed (km/hr)	6	14	25	38	57	75

(a) Identify the dependent variable in this investigation.

.... 1 M

(b) If the car has a mass of 900 kg, calculate the magnitude and direction of the traction when the circular path had a radius of 20 metres.   2 M

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(c) A graph of the data was plotted using the computer program, Graphical Analysis.

Car Motion

(11.05, 43.7)
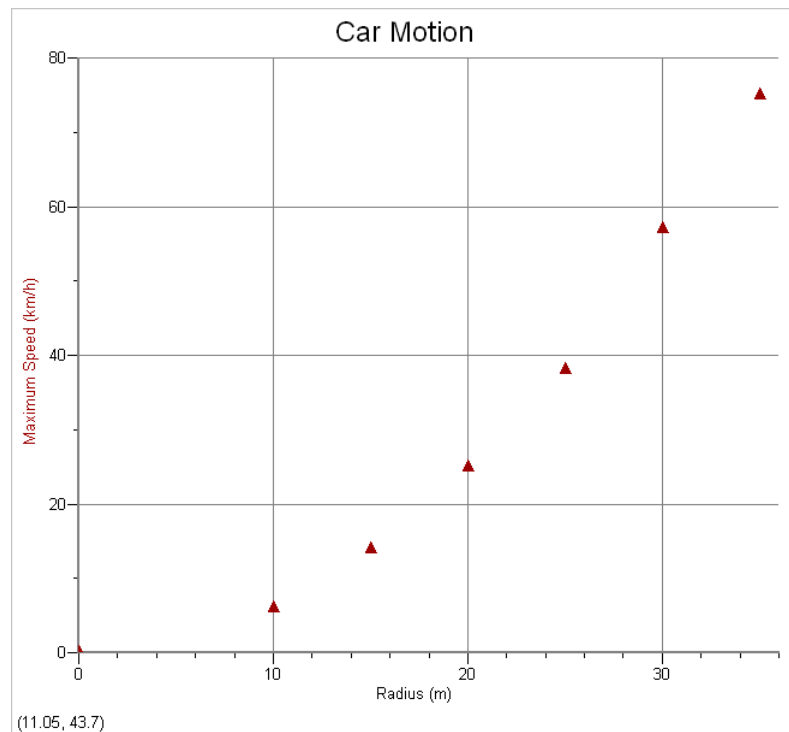
Draw a line of best fit for this data and describe in words the relationship between the graphed variables.

.... 2 M

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13. Two trains are heading towards each other on adjacent tracks.
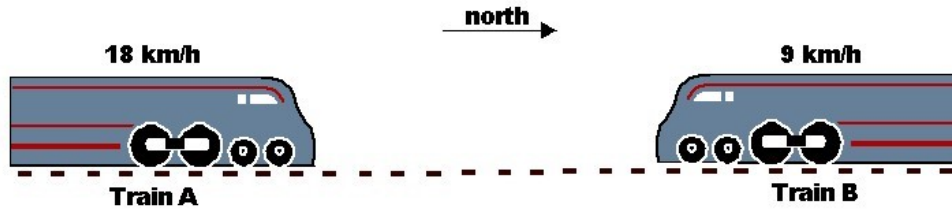
Calculate the velocity of train B relative to train A   2M

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14. This question refers to the diagram showing a 2500 kg truck moving at a constant speed of 70 km/h due west.

70 km/h
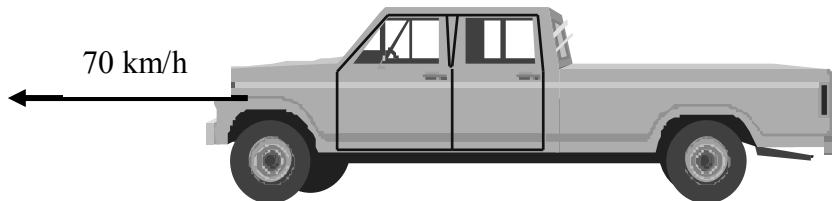
(a) Calculate the momentum of the truck.

....   2 M

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(b) The truck then increased its speed to 100 km/h in a time of 20 seconds. Calculate the change in momentum of the truck

....   2 M

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QUESTION CONTINUES ON NEXT PAGE

(c) In an unfortunate accident, the truck collided with brick wall and came to rest.
The wall did not collapse.

100 km h^{-1}

Analyse this collision with reference to the law of conservation of momentum.

.... 3 M

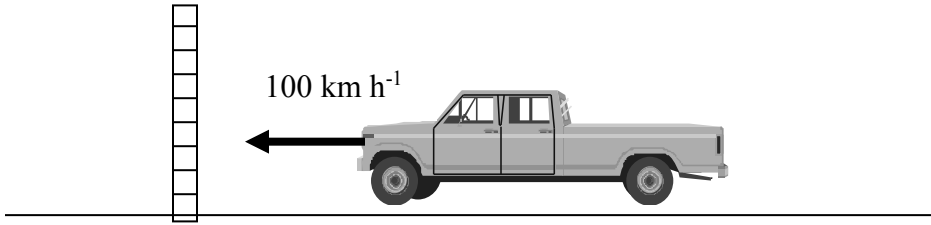..

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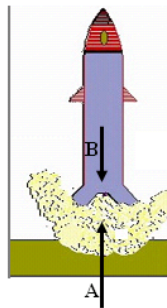..

15. The diagram below shows a 3 tonne rocket being launched vertically from the Earth's surface. The net force acting on the rocket at launch is 20 000 N vertically upwards.

The arrows labelled A an B on the diagram represent the two significant forces that act vertically on the rocket, assuming there is no air resistance.

(a) Identify the two forces

.... 2M

(b) Calculate the acceleration of the rocket

.... 1M

....

....

(c) Calculate the magnitude of force A

.... 2M

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(d) A rocket engine works by burning fuel and ejecting it at high speed from the rocket nozzle. With reference to two of Newton's Laws of motion, explain how this system can launch the rocket.

.... 4M

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16. A group of students carried out an investigation of Newton's second law using the apparatus shown in the diagram below. The students changed the force on the trolley by adding masses to the carrier hanging below the pulley. They assumed that the masses hanging on the mass carrier produced a force on the trolley given by the expression F = mg (where g is 9.8 newtons/kilogram). The accelerometer sensor was connected to a data logger and the data it collected could be analysed using the data logger software to obtain a value for the average acceleration.
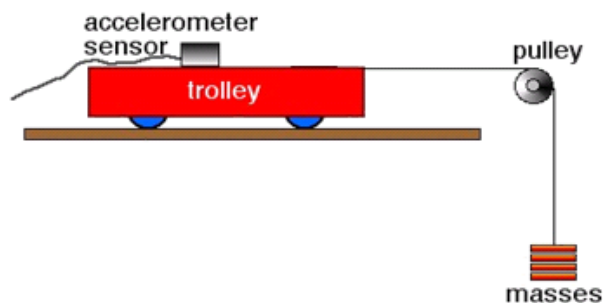
A group of students   The students' investigation

(a) Explain why the students' procedure was not valid.

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   ....   3M

(b) Two groups of students performed the above experiment using trolleys of different masses. On the axes below sketch two graphs representing the results you would predict if their procedure was identical and all other variables were kept the same.   2M
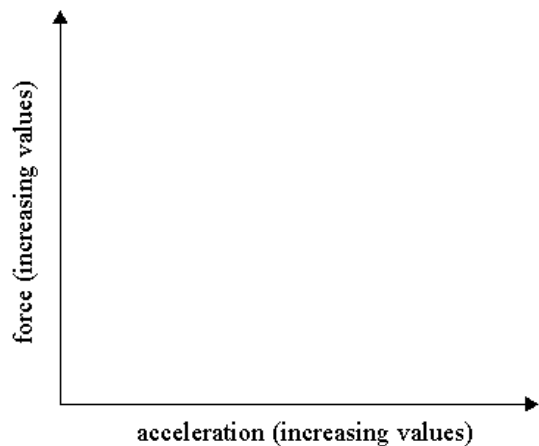
END OF QUESTIONS

Section A answer sheet

Use of the multiple-choice answer sheet.
Select the alternative A, B, C or D that best answers the question and fill in the response oval completely.

Sample   2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

     (A) ⬭   (B) ⬤   (C) ⬭   (D) ⬭

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

     (A) ⬤   (B) ✖   (C) ⬭   (D) ⬭

If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word correct and drawing an arrow as follows:

correct
↓

     (A) ✖   (B) ✖   (C) ⬭   (D) ⬭

Total marks (10)
Attempt all questions 1 – 10

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) ⬭

Half-yearly Exam Marking Criteria

Multiple Choice Answers
2007: D, B, C, B, D, C, B, D, B, B...Marking P6,5 Coombes, P8,9 Robson, P10,11 Pitt

Q11a Criteria	Marks
Axes labelled correctly and each section of the graph drawn correctly including magnitude and direction	4
Either axes not labelled correctly or one section drawn incorrectly	3
Two errors in the graph but the rest correct	2
Three errors in the graph but the rest correct	1

Q11b Criteria	Marks
Correctly calculates the displacement as 6 m North.	2
Correct working with one incorrect substitution	1

Q11c Criteria	Marks
Correctly calculates the average acceleration as 1 m s^{-2} South.	1

Q12a Criteria	Marks
Correctly identifies maximum speed as the dependant variable	1

Q12b Criteria	Marks
Correctly calculates the centripetal force as	2
Correct use of the centripetal force equation with one incorrect substitution	1

Q12c Criteria	Marks
Relationship described as radius increases the maximum speed increases at an increasing rate or A description that fits the shape of the graph. i.e. The maximum speed is proportional the radius squared.	2
Relationship described as radius increases the maximum speed also increases	1

Q13. Criteria	Mark/s
Correctly calculates the magnitude and direction of the velocity (27 km/h south)	2
Correctly calculates the magnitude OR direction of the velocity	1

Q14 a. Criteria	Mark/s
Chooses the appropriate formula and substitutes correctly to calculate the momentum including units and direction (approx 48,611 N s West)	2
Chooses the appropriate formula and substitutes correctly to calculate an answer with the correct magnitude and direction but omits appropriate units	1.5
Chooses the appropriate formula and substitutes correctly to calculate an answer with the correct magnitude OR direction including appropriate units	1

Q14 b. Criteria	Mark/s
Correctly calculates the change in momentum including direction (approx 20,833 N s west)	2
Correctly calculates the magnitude OR direction of the change in momentum	1

Q14 c Criteria	Mark/s
Response shows a clear understanding of the law of conservation of momentum and recognises that the momentum of the truck is transferred to the Earth which accelerates minutely so that the law is not violated	3

	2
Response shows a clear understanding of the law of conservation of momentum but does not clearly link this to the situation described in the question	2
Response shows some understanding of the law of conservation of momentum	1

Q15 a Criteria	Mark/s
Identifies that A is the thrust or driving force and B is the weight or force due to gravity	2
Identifies one force correctly Or identifies both forces correctly but does not clearly indicate which is A and which is B	1
Identifies one force correctly without distinguishing which it is	0.5

Q15 b Criteria	Mark/s
Correctly substitutes the value for net force and the rocket mass into the formula F = ma to calculate the acceleration (6.67 m s^{-2} vertically upwards)	1

Q15c Criteria	Mark/s
Uses $F_{net} = F_t + W$ to determine that F_t = 50 000 N up (or 49 400 N if g = 9.8 m s^{-1} was used)	2
Uses $F_{net} = F_t + W$, but makes an error with the directions of the forces leading to an incorrect answer OR States that the magnitude of the acceleration is 9.8 + 6.7 (not quite correct physics however)	1

Q15d Criteria	Mark/s
States two of Newton's laws AND Applies at least one of the laws to rocket motion AND Explicitly shows a cause and effect relationship (explains) One mark deducted for unclear communication, verbosity or any statement that indicates a poor understanding of physics presented in the answer.	4
States two of Newton's laws AND Applies at least one of the laws to rocket motion OR Explicitly shows a cause and effect relationship (explains)	3
States two of Newton's laws OR Applies at least one of the laws to rocket motion	2
States one of Newton's laws OR Makes a correct statement about rocket motion	1

Q16a Criteria	Mark/s
Identifies the TWO variables were changed – F and m AND reasons that because both affect the acceleration a valid relationship between acceleration and force cannot be established.	3
States that mass of the system is not constant AND describes how the investigation should have been done.	2
Describes how the investigation should have been carried out OR identifies that any other variable that should have been controlled.	1

Q16b Criteria	Mark/s
Draws two straight lines of different gradient through the origin AND indicates which line corresponds to the greater / less mass trolley.	2
Draws two straight lines of different gradient OR Draws two lines originating at the same point and labels the most appropriate one as greater / less mass trolley	1

11 PHYSICS HY OUTCOMES 2007

			TOTAL
P2. applies the processes that are used to test and validate models, theories and laws of science with particular emphasis on first-hand investigations in physics	**12(a)** ____/1 **16(a)** ____/3		____/4
P6. describes the forces acting on an object which causes changes in its motion	**2** ____/1 **3** ____/1 **7** ____/1 **9** ____/1 **12(b)** ____/2 **15(a)** ____/2 **15(d)** ____/4		____/12
P7. describes the effects of energy transfers and energy transformations	**10** ____/1 **14** ____/7		____/8
P12. discusses the validity and reliability of data gathered from first-hand investigations and secondary sources 2a) using appropriate data collection techniques, employing appropriate technologies, including data loggers and sensors 4b) apply mathematical formulae and concepts	**5** ____/1 **8** ____/1 **11(b)** ____/2 **12(b)** ____/2 **13** ____/2 **14(a)** ____/2 **15(b)** ____/1 **15(c)** ____/2 **16(a)** ____/2	**11(c)** ____/1 **14(b)** ____/2	____/18
P13. identifies appropriate terminology and reporting styles to communicate information and understanding in physics d) using symbols and formulae to express relationships and using appropriate units for physical quantities f) selecting and drawing appropriate graphs to convey information and relationships clearly and accurately	**1** ____/1 **4** ____/1 **11(a)** ____/4 **13** ____/2 **14(a)** ____/2 **12(c)** ____/2 **16(b)** ____/2	 **14(b)** ____/2	____/16
P14. draws valid conclusions from gathered data and information 1b) justify inferences and conclusions 1g) use cause and effect relationships to explain phenomena 3b) propose ideas that demonstrate coherence and logical progression and include correct use of scientific principles and ideas 3c) apply critical thinking in the consideration of predictions, hypotheses and the results of investigations	**12(a)** ____/1 **14(c)** ____/3 **15(d)** ____/4 **16(a)** ____/3 **16(b)** ____/2		____/13