Exampro A-level Physics (7407/7408)

Name:

Class:

A LEVEL PHYSICS MOCK EXAM - JANUARY 2016

BLOCK E - MR LAWRENCE

Author:

Date:

Time: 90

Marks: 76

Comments:

Q1. In a nuclear reaction $^{14}_{7}N$ is bombarded by neutrons. This results in the capture of one neutron and the emission of one proton by one nucleus of $^{14}_{7}N$. The resulting nucleus is

A $^{13}_{7}N$

B $^{14}_{6}C$

C $^{12}_{6}C$

D $^{14}_{8}O$

(Total 1 mark)

Q2. A firework rocket is fired vertically into the air and explodes at its highest point. What are the changes to the total kinetic energy of the rocket and the total momentum of the rocket as a result of the explosion?

	total kinetic energy of rocket	**total momentum of rocket**	
A	unchanged	unchanged	⬭
B	unchanged	increased	⬭
C	increased	unchanged	⬭
D	increased	increased	⬭

(Total 1 mark)

Q3. What are the numbers of hadrons, baryons and mesons in an atom of $^{7}_{3}Li$?

	hadrons	**baryons**	**mesons**	
A	7	3	3	⬭
B	7	4	4	⬭
C	7	7	0	⬭
D	10	7	0	⬭

(Total 1 mark)

Q4. The nucleus of $^{9}_{4}Be$ captures a proton and emits an α particle. What is the product nucleus?

A $^{10}_{6}C$ ⬭

B $^{7}_{3}Li$ ⬭

C $^{6}_{3}Li$ ⬭

D $^{6}_{2}He$ ⬭

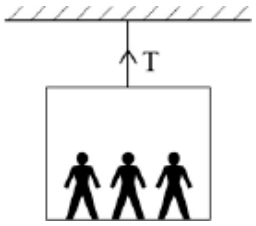
(Total 1 mark)

Q5. Which row, **A** to **D**, in the table correctly shows the quantities conserved in an inelastic collision?

	mass	**momentum**	**kinetic energy**	**total energy**
A	conserved	not conserved	conserved	conserved
B	not conserved	conserved	conserved	not conserved
C	conserved	conserved	conserved	conserved
D	conserved	conserved	not conserved	conserved

(Total 1 mark)

Q6. A lift and its passengers with a total mass of 500 kg accelerates upwards at 2 m s^{-2} as shown. Assume that g = 10 m s^{-2}.



What is the tension in the cable?

A 1000 N ⬭

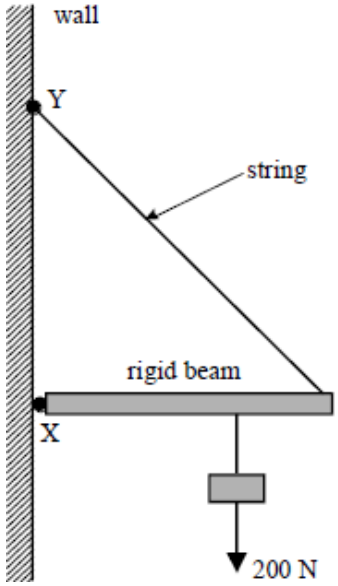
B 4000 N ⬭

C 5000 N ⬭

D 6000 N ⬭

(Total 1 mark)

Q7. In the system shown a light rigid beam, pivoted at **X**, is held in position by a string which is fixed at **Y**. The beam carries a load of 200 N. The load is moved towards **X**. Which one of the following statements is correct?



A The tension in the string increases

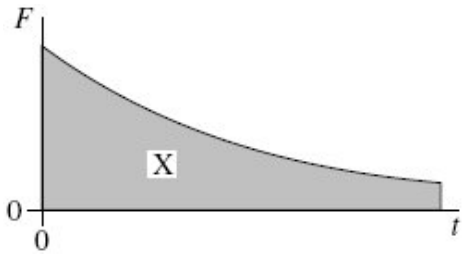
B The compression force in the beam increases

C The moment of the load about **X** increases

D The magnitude of the vertical component of the reaction at **X** increases

(Total 1 mark)

Q8. The graph shows the variation with time, *t*, of the force, *F*, acting on a body.



What physical quantity does the area X represent?

A the displacement of the body

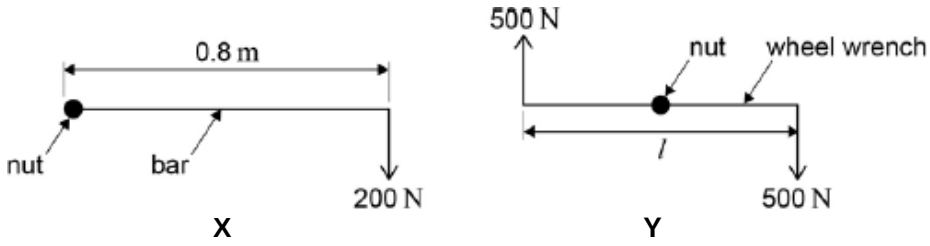
B the acceleration of the body

C the change in momentum of the body

D the change in kinetic energy of the body

(Total 1 mark)

Q9. A car wheel nut can be loosened by applying a force of 200 N on the end of a bar of length 0.8 m as in **X**. A car mechanic is capable of applying forces of 500 N simultaneously in opposite directions on the ends of a wheel wrench as in **Y**.



X **Y**

What is the minimum length l of the wrench which would be needed for him to loosen the nut?

A 0.16 m ⬭

B 0.32 m ⬭

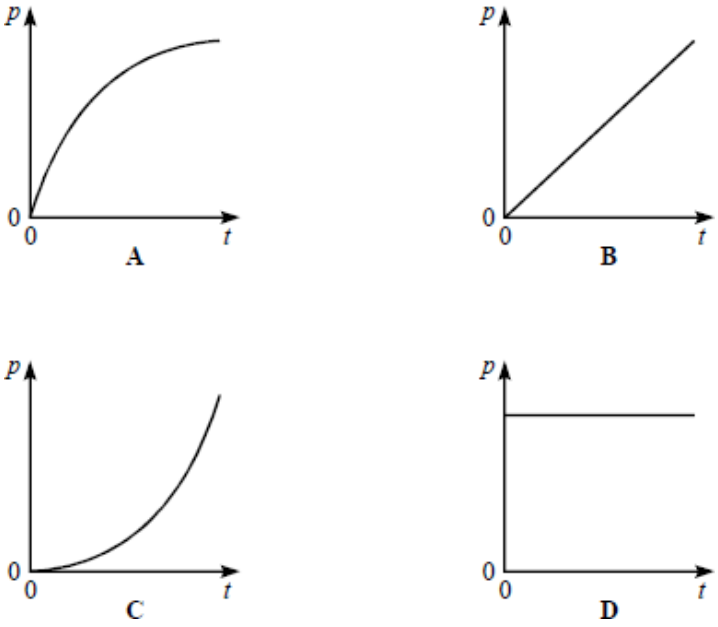
C 0.48 m ⬭

D 0.64 m ⬭

(Total 1 mark)

Q10. A body is accelerated from rest by a constant force.

Which one of the following graphs best represents the variation of the body's momentum p with time t?



(Total 1 mark)

Q11. Complete the following table.

Quantity	Vector or Scalar	S.I. Unit
Displacement	Vector	m
Velocity		
Weight		
Energy		

(Total 3 marks)

Q12. A car accelerates uniformly from rest to a speed of 100 km h^{-1} in 5.8 s.

(a) Calculate the magnitude of the acceleration of the car in m s^{-2}.

Acceleration = ...m s^{-2}

(3)

(b) Calculate the distance travelled by the car while accelerating.

Distance travelled = ...

(2)

(Total 5 marks)

Q13. (a) State the principle of moments.

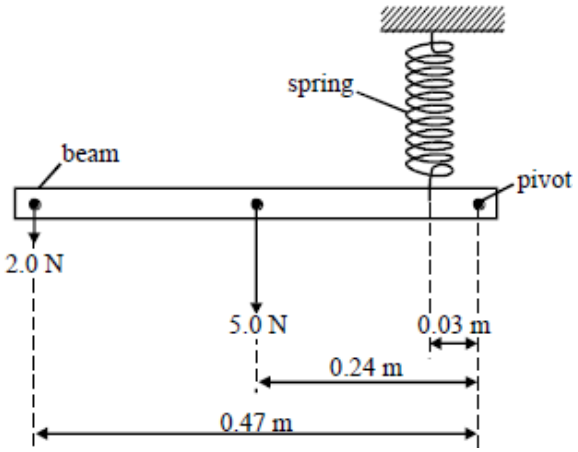
.....

.....

.....

(3)

(b) The diagram below shows a horizontal beam pivoted close to one end. The beam is supported by a spring and is loaded with weights of 2.0 N and 5.0 N as shown. All dimensions are marked on the diagram **and are measured from the pivot**.



By taking moments about the pivot, calculate the tension in the spring when the beam is horizontal.

Tension = ...

(3)

(Total 6 marks)

Q14. **Figure 1** shows a skier being pulled by rope up a hill of incline 12° at a steady speed. The total mass of the skier is 85 kg. Two of the forces acting on the skier are already shown.

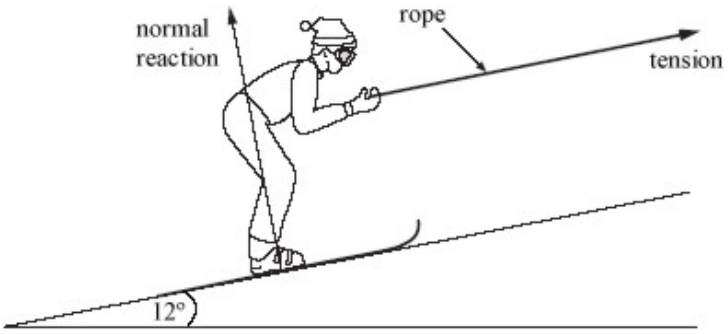


Figure 1

(a) Mark with arrows and label on **Figure 1** a further two forces that are acting on the skier.

(2)

(b) Calculate the magnitude of the normal reaction on the skier.

gravitational field strength, g = 9.8 N kg^{-1}

Normal reaction = ...

(3)

(c) Explain why the resultant force on the skier must be zero.

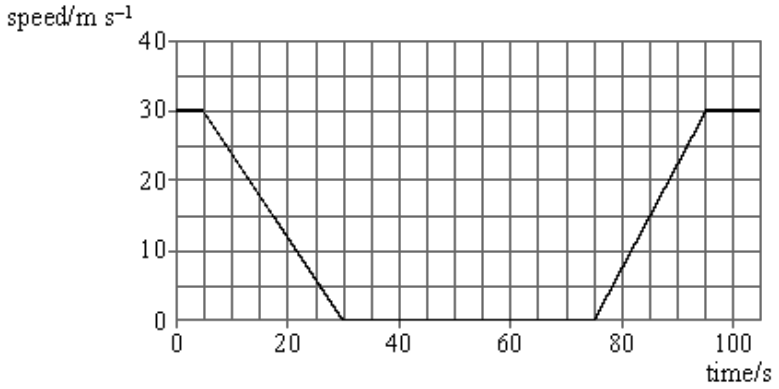
.....

.....

(1)

(Total 6 marks)

Q15. The diagram below shows a speed-time graph for a car that halts at traffic lights and then moves away.



(a) Use the graph to show that the car travels about 380 m whilst decelerating.

(2)

(b) Use the graph to calculate the acceleration of the car for the time interval from 75 s to 95 s.

Acceleration .....

(2)

(c) Calculate the total distance travelled by the car in the time interval 5 s to 95 s.

Distance travelled .....

(1)

(d) A second car travels the same route without being halted at the traffic lights. The speed of this car is a constant 30 m s^{-1}.

Calculate the difference in journey time between the first and second cars.

Journey time difference .....

(3)

(Total 8 marks)

Q16. **Figure 1** shows a graph of velocity against time for an aircraft of mass 2.8×10^4 kg landing on a stationary aircraft-carrier.

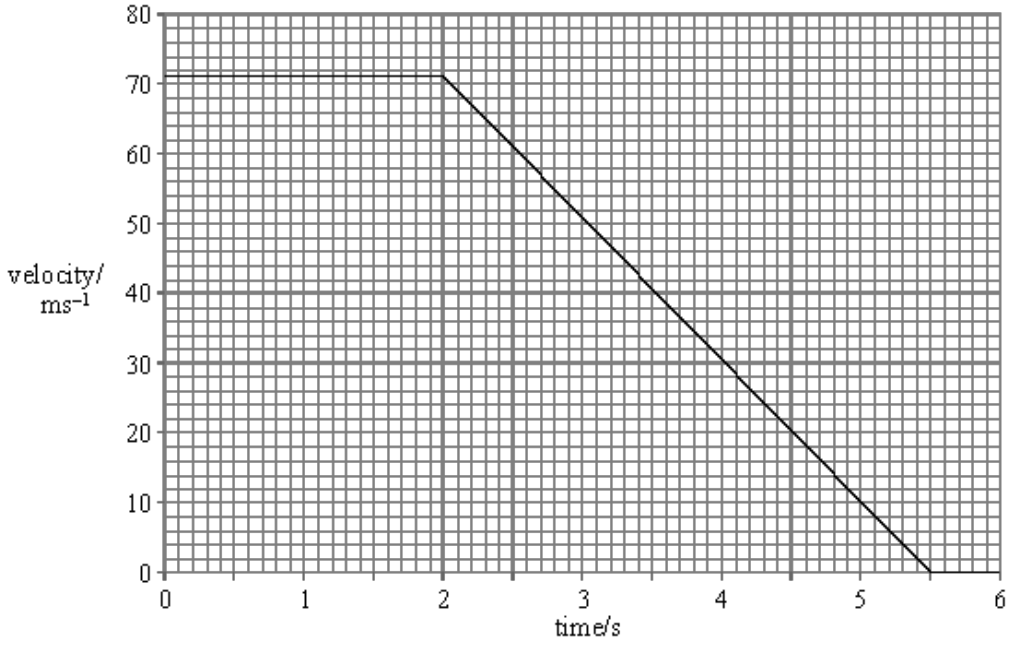


Figure 1

(a) (i) Calculate the initial kinetic energy of the aircraft.

Initial kinetic energy .....

(2)

(ii) Show that the deceleration of the aircraft is about 20 m s^{-2}.

(3)

(iii) Calculate the decelerating force acting on the aircraft.

Force .....

(2)

(b) A steam catapult is used to enable aircraft to take off from the ship. The catapult accelerates the aircraft from rest to its take-off speed of 71 m s^{-1} in a distance of 62 m.

Calculate the acceleration of the aircraft.

Acceleration .....

(2)

(c) In level flight, the pilot sets the course to be 80 m s^{-1} due north. There is a wind blowing from east to west at 20 m s^{-1}. Find, by scale drawing or otherwise, the resultant velocity of the aircraft.

Velocity of aircraft: magnitude .....

direction .....

(3)

(Total 12 marks)

Q17. (a) (i) Give an example of an exchange particle other than a W^+ or W^- particle, and state the fundamental force involved when it is produced.

exchange particle .....

fundamental force .....

(ii) State what roles exchange particles can play in an interaction.

.....

.....

.....

(4)

(b) From the following list of particles,

p $\bar{n}$ ν_e e^+ μ^- π^0

identify **all** the examples of

(i) hadrons, ...

(ii) leptons, …..

(iii) antiparticles, ...

(iv) charged particles. .....

(4)
(Total 8 marks)

Q18. Complete the equation below to show the decay of a free neutron. The proton numbers, nucleon numbers and appropriate symbols of all three particles produced should be shown.

$$^{1}_{0}n \rightarrow \text{.....} + \text{.....} + \text{.....}$$

(Total 3 marks)

Q19. Mesons that contain a strange (or antistrange) quark are known as K-mesons or kaons. Mesons are a sub-group of a larger group of particles.

(a) (i) State the name of this larger group of particles.

.....

(1)

(ii) Determine the charge on a kaon with a quark structure of $u\bar{s}$.

.....

(1)

(b) A proposed decay for this kaon is

$$u\bar{s} \longrightarrow \mu^+ + \nu_\mu$$

(i) Apply the law of conservation of strangeness to the proposed decay.

.....

.....

.....

(1)

(ii) Comment on whether or not this decay is possible.

.....

.....

.....

(1)
(Total 4 marks)

Q20. (a) (i) Name two baryons.

.....

(2)

(ii) State the quark structure of the pion π^+.

.....

(1)

(b) (i) The K^+ kaon is a strange particle. Give **one** characteristic of a strange particle that makes it different from a particle that is not strange.

.....

.....

(1)

(ii) One of the following equations represent a possible decay of the K^+ kaon.

$$K^+ \rightarrow \pi^+ + \pi^0$$

$$K^+ \rightarrow \mu^+ + \overline{\nu_\mu}$$

State, with a reason, which one of these decays is not possible.

.....

.....

(2)

(c) Another strange particle, X, decays in the following way:

$$X \rightarrow \pi^- + p$$

(i) State what interaction is involved in this decay.

.....

(1)

(ii) Show that X must be a neutral particle.

.....

.....

(1)

(iii) Deduce whether X is a meson, baryon or lepton, explaining how you arrive at your answer.

.....

.....

.....

.....

(2)

(iv) Which particle in this interaction is the most stable?

.....

(1)

(Total 11 marks)