3.3 Physics: Forces and Energy: 1-hour Pack

ISEB CE 13+ Science (Physics) · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A parcel that weighs 120 N on Earth, where the gravitational field strength is 10 N/kg. Calculate its mass in kg.

- ☐ A) 24 kg
- ☐ B) 1200 kg
- ☐ C) 120 kg
- ☐ D) 1.2 kg
- ☐ E) 12 kg

---

2 A machine does 320 J of work moving an object 4 m in the direction of the force. Calculate the force in N.

- ☐ A) 316 N
- ☐ B) 80 N
- ☐ C) 324 N
- ☐ D) 1280 N
- ☐ E) 800 N

---

3 A moving cyclist has energy stored as

- ☐ A) sound energy
- ☐ B) thermal energy
- ☐ C) gravitational potential energy
- ☐ D) kinetic energy
- ☐ E) elastic potential energy

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4 In which device is the main useful energy transfer electrical to thermal?

- ☐ A) microphone
- ☐ B) loudspeaker
- ☐ C) toaster
- ☐ D) filament lamp
- ☐ E) electric motor

---

5 A go-kart of mass 120 kg travels at a speed of 8 m/s. Use the equation: kinetic energy (KE) = 0.5 x mass x speed^2.

(a) Calculate the kinetic energy of the go-kart. **(3)**

.....

(b) The go-kart then speeds up to 16 m/s, double its original speed. Calculate its new kinetic energy. **(2)**

.....

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6 Which quantity is measured in the kilogram?

- ☐ A) mass
- ☐ B) force
- ☐ C) pressure
- ☐ D) energy
- ☐ E) electric current

---

7 A spring extends by 10 cm under a force of 40 N. Assuming it obeys Hooke's law, calculate its extension under a force of 12 N, in cm.

- ☐ A) 30 cm
- ☐ B) 48 cm
- ☐ C) 0.3 cm
- ☐ D) 6 cm
- ☐ E) 3 cm

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8 A force of 150 N is applied at a perpendicular distance of 40 cm from a pivot. Calculate the moment in N m.

- [ ] A) 375 N m
- [ ] B) 3.75 N m
- [ ] C) 6000 N m
- [ ] D) 60 N m
- [ ] E) 150.4 N m

---

9 A heater has a power of 2 kW and is used for 5 minutes. Calculate the energy transferred in kJ.

- [ ] A) 10 kJ
- [ ] B) 600 kJ
- [ ] C) 600000 kJ
- [ ] D) 10000 kJ
- [ ] E) 6000 kJ

---

10 Ben has a mass of 90 kg. The gravitational field strength on Earth is 10 N/kg. Calculate the weight on Earth in N.

- [ ] A) 900 N
- [ ] B) 9 N
- [ ] C) 810 N
- [ ] D) 9000 N
- [ ] E) 90 N

---

11 A tractor pulls with a constant force of 800 N through a distance of 40 m. Calculate the work done in J.

- [ ] A) 840 J
- [ ] B) 20 J
- [ ] C) 760 J
- [ ] D) 32000 J
- [ ] E) 0.05 J

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12 A skier at the top of a slope has energy stored as

- ☐ A) kinetic energy
- ☐ B) sound energy
- ☐ C) gravitational potential energy
- ☐ D) elastic potential energy
- ☐ E) thermal energy

---

13 What is the useful energy transfer in a electric motor?

- ☐ A) electrical to light (and heat)
- ☐ B) electrical to kinetic
- ☐ C) kinetic to electrical
- ☐ D) sound to electrical
- ☐ E) chemical to electrical

---

14 A roller coaster car of mass 400 kg starts from rest at the top of a hill 20 m above the ground. Take g = 10 N/kg.

(a) Assuming no energy is lost to friction or air resistance, calculate the maximum possible speed of the car at the bottom of the hill. (Hint: all the gravitational potential energy lost is transferred to kinetic energy.) **(4)**

.....

(b) In reality, the car reaches a speed of only 18 m/s at the bottom of the hill. Calculate the amount of energy transferred to the surroundings (as heat and sound) because of friction and air resistance. **(2)**

.....

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15 What is the unit of energy?

- [ ] A) kilogram (kg)
- [ ] B) ampere (A)
- [ ] C) ohm
- [ ] D) newton (N)
- [ ] E) joule (J)

---

16 A car of mass 1200 kg is travelling at 15 m/s. Calculate its kinetic energy. Use the equation: kinetic energy (KE) = 0.5 x mass x speed^2.

(1)

---

17 A see-saw is balanced. Marcus (weight 550 N) sits 0.5 m from the pivot. Aisha sits 1.1 m from the pivot on the other side. Calculate Aisha's weight in N.

- [ ] A) 275 N
- [ ] B) 250 N
- [ ] C) 302.5 N
- [ ] D) 550 N
- [ ] E) 1210 N

---

18 A 150 W appliance is switched on for 40 s. Calculate the energy transferred in J.

- [ ] A) 600 J
- [ ] B) 60000 J
- [ ] C) 6000 J
- [ ] D) 190 J
- [ ] E) 3.75 J

---

19 A crate rests on the ground and presses down with a force of 1 N on an area of 0.01 m². Calculate the pressure on the ground in N/m2.

- [ ] A) 0.01 N/m2
- [ ] B) 10 N/m2
- [ ] C) 1000 N/m2
- [ ] D) 0.99 N/m2
- [ ] E) 100 N/m2

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20 An astronaut leaves a toolbox that weighs 40 N on the Moon, where the gravitational field strength is 1.6 N/kg. Calculate its mass in kg.

- [ ] A) 40 kg
- [ ] B) 4 kg
- [ ] C) 64 kg
- [ ] D) 25 kg
- [ ] E) 0.04 kg

---

21 Nina lifts a box of mass 8 kg through a height of 8 m at a steady speed. The gravitational field strength is 10 N/kg. Calculate the work done against gravity in J.

- [ ] A) 64 J
- [ ] B) 10 J
- [ ] C) 640 J
- [ ] D) 80 J
- [ ] E) 6400 J

---

22 Which of these describes air resistance?

- [ ] A) the pull of the Earth on an object
- [ ] B) the force that opposes motion between two touching surfaces
- [ ] C) the force between two magnets
- [ ] D) the upward force of water on a floating object
- [ ] E) the force of air on a moving object

---

23 What is the useful energy transfer in a filament lamp?

- [ ] A) kinetic to electrical
- [ ] B) electrical to thermal
- [ ] C) electrical to sound
- [ ] D) electrical to light (and heat)
- [ ] E) chemical to electrical

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24 What is the unit of power?

- ☐ A) watt (W)
- ☐ B) hertz (Hz)
- ☐ C) kilogram (kg)
- ☐ D) degree Celsius
- ☐ E) newton (N)

---

25 A bicycle with total mass 100 kg (including the rider) moves at 5 m/s, then accelerates to 10 m/s. Calculate the kinetic energy at the new speed.

(1)

---

26 A spring stretches by 2 cm when a force of 5 N is applied (it has not passed its limit of proportionality). Calculate the force needed per centimetre of extension, in N/cm.

- ☐ A) 3 N/cm
- ☐ B) 2.5 N/cm
- ☐ C) 7 N/cm
- ☐ D) 10 N/cm
- ☐ E) 0.4 N/cm

---

27 A force of 150 N acts at a perpendicular distance of 4 m from a pivot. Calculate the moment in N m.

- ☐ A) 37.5 N m
- ☐ B) 600 N m
- ☐ C) 154 N m
- ☐ D) 6000 N m
- ☐ E) 146 N m

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28 A hairdryer has a power of 0.5 kW and is used for 2 minutes. Calculate the energy transferred in kJ.

- [ ] A) 600 kJ
- [ ] B) 1 kJ
- [ ] C) 1000 kJ
- [ ] D) 60 kJ
- [ ] E) 60000 kJ

---

29 A force of 0.2 N produces a pressure of 20 N/m2. Calculate the area in m2.

- [ ] A) 0.01 m^2
- [ ] B) 100 m^2
- [ ] C) 19.8 m^2
- [ ] D) 4 m^2
- [ ] E) 0.1 m^2

---

30 Hana has a mass of 75 kg. The gravitational field strength on Earth is 10 N/kg. Calculate the weight on Earth in N.

- [ ] A) 7500 N
- [ ] B) 675 N
- [ ] C) 75 N
- [ ] D) 7.5 N
- [ ] E) 750 N

---

31 What is the name of the force of air on a moving object?

- [ ] A) air resistance
- [ ] B) upthrust
- [ ] C) tension
- [ ] D) friction
- [ ] E) reaction force

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32 What is the useful energy transfer in a loudspeaker?

- ☐ A) electrical to light (and heat)
- ☐ B) electrical to sound
- ☐ C) sound to electrical
- ☐ D) light to electrical
- ☐ E) electrical to kinetic

---

33 An electric motor is supplied with 500 J of energy. It usefully transfers 350 J of this as kinetic energy, and the rest is wasted as heat and sound.

(a) Calculate the efficiency of the motor, giving your answer as a percentage. Use the equation: efficiency = (useful energy output / total energy input) x 100%. **(3)**

(b) State one way, other than a design change to the motor, in which energy could be wasted as heat inside a motor. **(1)**

---

34 A boat is pushed forward by a motor with a force of 5000 N while water resistance provides 2100 N opposing motion. What is the resultant force?

(1)

---

35 A spring stretches by 10 cm when a force of 20 N is applied (it has not passed its limit of proportionality). Calculate the force needed per centimetre of extension, in N/cm.

- ☐ A) 30 N/cm
- ☐ B) 10 N/cm
- ☐ C) 2 N/cm
- ☐ D) 200 N/cm
- ☐ E) 0.5 N/cm

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36 A force of 60 N acts at a perpendicular distance of 2 m from a pivot. Calculate the moment in N m.

- [ ] A) 1200 N m
- [ ] B) 30 N m
- [ ] C) 58 N m
- [ ] D) 120 N m
- [ ] E) 62 N m

---

37 A metal block rests on the ground and presses down with a force of 200 N on an area of 2 m^2. Calculate the pressure on the ground in N/m2.

- [ ] A) 400 N/m2
- [ ] B) 0.01 N/m2
- [ ] C) 198 N/m2
- [ ] D) 1000 N/m2
- [ ] E) 100 N/m2

---

38 A parcel that weighs 400 N on Earth, where the gravitational field strength is 10 N/kg. Calculate its mass in kg.

- [ ] A) 400 kg
- [ ] B) 40 kg
- [ ] C) 4000 kg
- [ ] D) 4 kg
- [ ] E) 0.025 kg

---

39 Ella lifts a box of mass 5 kg through a height of 3 m at a steady speed. The gravitational field strength is 10 N/kg. Calculate the work done against gravity in J.

- [ ] A) 1500 J
- [ ] B) 50 J
- [ ] C) 150 J
- [ ] D) 300 J
- [ ] E) 15 J

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40 What is the name of the pull of the Earth on an object?

- [ ] A) upthrust
- [ ] B) friction
- [ ] C) tension
- [ ] D) weight
- [ ] E) magnetic force

---

41 What is the useful energy transfer in a generator?

- [ ] A) chemical to electrical
- [ ] B) light to electrical
- [ ] C) electrical to kinetic
- [ ] D) electrical to thermal
- [ ] E) kinetic to electrical

---

42 Which quantity is measured in the watt?

- [ ] A) frequency
- [ ] B) power
- [ ] C) resistance
- [ ] D) mass
- [ ] E) force

---

43 A spring is 10.8 cm long under a 2 N load and 11.6 cm long under a 4 N load (within its limit of proportionality). Calculate its natural length (with no load) in cm.

- [ ] A) 10 cm
- [ ] B) 10.8 cm
- [ ] C) 0.8 cm
- [ ] D) 9.8 cm
- [ ] E) 8.8 cm

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44 A force of 40 N acts at a perpendicular distance of 1 m from a pivot. Calculate the moment in N m.

- [ ] A) 39 N m
- [ ] B) 400 N m
- [ ] C) 0.025 N m
- [ ] D) 40 N m
- [ ] E) 41 N m

---

45 A toaster has a power of 1 kW and is used for 10 minutes. Calculate the energy transferred in kJ.

- [ ] A) 6000 kJ
- [ ] B) 10 kJ
- [ ] C) 600 kJ
- [ ] D) 600000 kJ
- [ ] E) 10000 kJ

---

46 A force of 400 N produces a pressure of 2000 N/m2. Calculate the area in m2.

- [ ] A) 2 m^2
- [ ] B) 5 m^2
- [ ] C) 1600 m^2
- [ ] D) 0.2 m^2
- [ ] E) 800000 m^2

---

47 Marcus has a mass of 8 kg. The gravitational field strength on Earth is 10 N/kg. Calculate the weight on Earth in N.

- [ ] A) 72 N
- [ ] B) 80 N
- [ ] C) 8 N
- [ ] D) 0.8 N
- [ ] E) 1.25 N

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48 A force of 50 N does 750 J of work on an object. Calculate the distance moved in the direction of the force, in m.

- ☐ A) 1.5 m
- ☐ B) 37500 m
- ☐ C) 15 m
- ☐ D) 700 m
- ☐ E) 150 m

---

49 What is the name of the upward force of water on a floating object?

- ☐ A) upthrust
- ☐ B) air resistance
- ☐ C) tension
- ☐ D) weight
- ☐ E) friction

---

50 A cyclist's motion is recorded on a speed-time graph as she rides from home to school.
From 0 to 10 s, her speed increases steadily from 0 m/s to 8 m/s.
From 10 s to 40 s, her speed stays constant at 8 m/s.
From 40 s to 50 s, her speed decreases steadily from 8 m/s back to 0 m/s.

(a) Calculate the acceleration of the cyclist during the first 10 seconds. **(2)**

.....

(b) Calculate the total distance travelled by the cyclist during the whole 50 second journey, using the area under the speed-time graph. **(3)**

.....

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Mark scheme · 3.3 Physics: Forces and Energy: 1-hour Pack

Question 1

E (12 kg) **B1**

Answer: E) 12 kg

Question 2

B (80 N) **B1**

Answer: B) 80 N

Question 3

D (kinetic energy) **B1**

Answer: D) kinetic energy

Question 4

C (toaster) **B1**

Answer: C) toaster

Question 5

(a) KE = 0.5 x m x v^2 **M1**

(a) correct substitution, 0.5 x 120 x 8^2 **M1**

(a) 3840 J, cao **A1**

(a) Answer: 3840 J

(b) 0.5 x 120 x 16^2 **M1**

(b) 15360 J, cao **A1**

(b) Answer: 15360 J

Question 6

A (mass) **B1**

Answer: A) mass

Question 7

E (3 cm) **B1**

Answer: E) 3 cm

Question 8

D (60 N m) **B1**

Answer: D) 60 N m

Question 9

B (600 kJ) **B1**

Answer: B) 600 kJ

Question 10

A (900 N) **B1**

Answer: A) 900 N

Question 11

D (32000 J) **B1**

Answer: D) 32000 J

Question 12

C (gravitational potential energy) **B1**

Answer: C) gravitational potential energy

Question 13

B (electrical to kinetic) **B1**

Answer: B) electrical to kinetic

Question 14

(a) GPE lost = mgh = 400 x 10 x 20 (= 80000 J) **M1**

(a) set KE = GPE, 0.5 x 400 x v^2 = 80000 **M1**

(a) rearrange, v^2 = 80000 / 200 (= 400) **dM1**

(a) 20 m/s, cao **A1**

(a) Answer: 20 m/s

(b) actual KE = 0.5 x 400 x 18^2 (= 64800 J) **M1**

(b) 15200 J, cao (80000 - 64800) **A1**

(b) Answer: 15200 J

Question 15

E (joule (J)) **B1**

Answer: E) joule (J)

Question 16

135000 J (oe) **B1**

Answer: 135000 J

Question 17

B (250 N) **B1**

Answer: B) 250 N

Question 18

C (6000 J) **B1**

Answer: C) 6000 J

Question 19

E (100 N/m2) **B1**

Answer: E) 100 N/m2

Question 20

D (25 kg) **B1**

Answer: D) 25 kg

Question 21

C (640 J) **B1**

Answer: C) 640 J

Question 22

E (the force of air on a moving object) **B1**

Answer: E) the force of air on a moving object

Question 23

D (electrical to light (and heat)) **B1**

Answer: D) electrical to light (and heat)

Question 24

A (watt (W)) **B1**

Answer: A) watt (W)

Question 25

5000 J (oe) **B1**

Answer: 5000 J

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Question 26

B (2.5 N/cm) **B1**

Answer: B) 2.5 N/cm

Question 27

B (600 N m) **B1**

Answer: B) 600 N m

Question 28

D (60 kJ) **B1**

Answer: D) 60 kJ

Question 29

A (0.01 m^2) **B1**

Answer: A) 0.01 m^2

Question 30

E (750 N) **B1**

Answer: E) 750 N

Question 31

A (air resistance) **B1**

Answer: A) air resistance

Question 32

B (electrical to sound) **B1**

Answer: B) electrical to sound

Question 33

(a) 350 / 500 **M1**

(a) x 100 **M1**

(a) 70%, cao **A1**

(a) Answer: 70%

(b) friction between moving parts, e.g. bearings or gears, oe **B1**

(b) Answer: Friction between the motor's moving parts, such as its bearings or gears.

Question 34

2900 N (oe) **B1**

Answer: 2900 N

Question 35

C (2 N/cm) **B1**

Answer: C) 2 N/cm

Question 36

D (120 N m) **B1**

Answer: D) 120 N m

Question 37

E (100 N/m2) **B1**

Answer: E) 100 N/m2

Question 38

B (40 kg) **B1**

Answer: B) 40 kg

Question 39

C (150 J) **B1**

Answer: C) 150 J

Question 40

D (weight) **B1**

Answer: D) weight

Question 41

E (kinetic to electrical) **B1**

Answer: E) kinetic to electrical

Question 42

B (power) **B1**

Answer: B) power

Question 43

A (10 cm) **B1**

Answer: A) 10 cm

Question 44

D (40 N m) **B1**

Answer: D) 40 N m

Question 45

C (600 kJ) **B1**

Answer: C) 600 kJ

Question 46

D (0.2 m^2) **B1**

Answer: D) 0.2 m^2

Question 47

B (80 N) **B1**

Answer: B) 80 N

Question 48

C (15 m) **B1**

Answer: C) 15 m

Question 49

A (upthrust) **B1**

Answer: A) upthrust

Question 50

(a) a = change in speed / time = 8 / 10 **M1**

(a) 0.8 m/s^2, cao **A1**

(a) Answer: 0.8 m/s^2

(b) identify the three sections as two triangles and one rectangle, and find each area: 0.5 x 10 x 8 (= 40 m), 30 x 8 (= 240 m), 0.5 x 10 x 8 (= 40 m) **M1**

(b) add the three areas together **M1**

(b) 320 m, cao **A1**

(b) Answer: 320 m

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